Woodward

Product Manual 26701
(Revision A, 9/2016)
Original Instructions

TecJet™ 85 Gas Regulation and Metering Valve / Actuator System

Installation and Operation Manual
Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

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Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

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   Woodward
Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

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**WARNING**

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

---

**WARNING**

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- Eye Protection
- Hearing Protection
- Hard Hat
- Gloves
- Safety Boots
- Respirator

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

---

**WARNING**

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

---

**WARNING**

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.
To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).
- Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.
- Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.

Follow these precautions when working with or near the control.
1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.
Regulatory Compliance

European Compliance for CE Marking:
These listings apply to stationary industrial markets only and are limited only to those units bearing the CE Marking.


Other European and International Compliance:
Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking.


**Pressure Equipment Directive:** Exempt per Article 1.1 of 2014/68/EU

North American Compliance:
These listings are limited only to those units bearing the CSA identification.

**CSA:** CSA Certified for Class I, Division 2, Groups A, B, C, & D, T3 at 85 °C Ambient for use in Canada and the United States.
Certificate 1167451
Type 3R Enclosure Rainproof

This product is certified as a component for use in other equipment. The final combination is subject to acceptance by the authority having jurisdiction or local inspection.

Special Conditions for Safe Use:

Wiring must be in accordance with North American Class I, Division 2 wiring methods, as applicable, and in accordance with the authority having jurisdiction.

Field Wiring must be suitable for at least 85 °C.

Connect ground terminal of TecJet 85 to earth ground.

The Ingress Protection rating of the control depends on the use of proper mating connectors. Refer to Table 2-1 in the Installation section of this manual for information on the proper mating connectors for use with this control.

Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.
EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2.

RISQUE D'EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurer auparavant que le système a bien été mis hors tension; ou que vous vous situez bien dans une zone non explosive.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2 ou Zone 2.

Do not connect any cable grounds to “instrument ground”, “control ground”, or any non-earth ground system. Make all required electrical connections based on the wiring diagram per Figure 2-1.
Chapter 1.
General Information

Introduction

The TecJet 85 Gas Regulation and Metering Valve / Actuation System [hereinafter called simply the TecJet 85] is an integrated, digitally compensated control valve and actuator system for regulating and metering the flow of gaseous fuels. The TecJet 85 is designed to accept a fuel rate demand signal, and it also incorporates feedback sensors which monitor fuel pressure, temperature, and valve pressure differential. Based on these sensor signals, the TecJet 85 modulates the valve opening to produce a physical fuel mass flow which matches the flow demand level within the accuracy specified elsewhere in this manual (see Chapter 3, General Specifications).

The TecJet 85 is intended to be mounted on or very close to the engine. The dominant application of this valve is gas-fueled reciprocating engines controlled by an electronic engine control system.

Connections to the TecJet 85

The TecJet 85 valve has the following connections to the ECM (Engine Control Module), and the engine harness:

- **Earth Ground**: Provided through ground lug on housing.
- **Power Input**: 18–32 Vdc measured at the TecJet 85.
- **Key Switch input**: Contact input to switch the TecJet 85 in and out of a low-power state.
- **CANbus In**: Configurable as mass flow demand input.
- **PWM**: Configurable as mass flow demand input.
- **4–20 mA Analog**: Configurable as mass flow demand input.
- **CAN ID Inputs**: TecJet 85 number selection for CANbus IDs.
- **CAN Termination**: Internal CAN termination resistor option.
- **CANbus Out**: Second set of CAN pins for connecting to the next CAN device.
- **Status Output**: High side switch that changes state during a fault condition.

The TecJet 85 has RS-232 connections available in the main connector for program upgrades and service tool interfacing by qualified service personnel.
Chapter 2.
Installation

Introduction

**WARNING** Due to typical noise levels in engine environments, hearing protection should be worn when working on or around the TecJet 85.

**WARNING** The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

**WARNING** Do not lift or handle the TecJet 85 by any conduit or wiring harness.

**WARNING** External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

**WARNING** The TecJet 85 valve is pressure tested at Woodward. Allowable external leakage is less than 2 SCCM or 0.00015 kg/h.

**WARNING** Leak-check all gaseous fuel connections. Leaking gaseous fuel can cause explosion hazards, property damage, or loss of life.

**WARNING** The TecJet 85 valve is NOT equipped with an overboard drain in the event of gas leakage through its various seals. The valve should therefore be used in a well-ventilated area. A methane detector should be used if the valve will be used in an enclosed installation.

**CAUTION** The TecJet 85 weighs 27 kg (59 lb). In order to prevent injury, some form of lifting assistance (a lifting strap is recommended) should be used when handling the TecJet 85.

Be careful when unpacking the TecJet 85. Check the assembly for signs of damage, such as bent or dented covers, scratches, and loose or broken parts. Be especially careful not to rest the TecJet 85 on the valve position pointer or the actuator electrical connectors. Notify the shipper and Woodward if damage is found.

If the TecJet 85 will be painted, you must appropriately mask the following items/areas:
- All identification and warning labels
- Main electrical connector
- Junction between the valve shaft and the valve housing (this is a dynamic junction next to the valve position pointer)
Mounting

TecJet 85 orientation and mounting must be designed to reduce the possibility of fuel contamination. Orientation of the valve should be with the actuator ±15° relative to horizontal with the sensor module skyward. The axis of the valve bore can be +90°/-15° relative to horizontal, with +90° representing the outlet of the valve pointing skyward. Installations with a bore axis orientation in the +15 to +90° range must incorporate means to prevent the buildup of moisture or other liquids in the fuel train. The valve has an arrow indicating flow direction cast into the outside of the valve housing. Washers should be placed between the valve body and any fasteners used. Give consideration to the strength of the mounting plate in order to support the 27 kg (59 lb) weight of the TecJet 85. Refer to the outline drawing in Figure 2-1 for dimensions and details relative to the valve inlet flange and outlet flange.

For on-engine applications, a suitable bracket must be constructed to brace the actuator to a secure structure on the engine. See the Outline Drawing for the actuator mounting hole and hole-location details. Torque the four M8 fasteners attaching the actuator to a bracket to 22.6 N-m (200 lb-in). This actuator mounting configuration should ensure that moment loads are not applied to the actuator, either through installation or thermal stress that could cause the valve to bind and lose functionality.

The inlet and outlet piping of the TecJet 85 must be in accordance with ANSI/ISA-S75.02 to ensure the flow metering accuracy specified elsewhere in this manual (see Chapter 3, General Specifications). However, an inlet piping length as short as 6 diameters and an outlet piping length as short as 2 diameters can typically be used with a negligible loss in valve metering accuracy.

WARNING

EXPLOSION HAZARD—Leak check all gaseous fuel connections. Leaking gaseous fuel can cause explosion hazards, property damage, or loss of life.
Figure 2-1a. TecJet 85 Outline Drawing
Figure 2-1b. TecJet 85 Outline Drawing
Electrical Connections

The TecJet 85 is connected to the control system (ECM) by the main connector in Figure 2-2. The engine harness mating connector for the TecJet 85 is the connector MS3106E24-28S. This mating connector should be torqued per the value indicated in Figure 2-1.

**WARNING**

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

**AVERTISSEMENT**

RISQUE D’EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurer auparavant que le système a bien été mis hors tension; ou que vous vous situez bien dans une zone non explosive.

**WARNING**

Due to the hazardous location listing associated with this product, proper wire type and wiring practices are critical to operation.

**WARNING**

The control will only meet ingress protection specifications while the mating connector is installed in the unit. As such, the unit should not be exposed to operating environments unless the mating connector is installed.

In addition, if a wire is not used for each of the 24 pins on the control, a sealing plug must be used in place of each missing wire. Failure to adhere to these guidelines may result in product failure or decreased life.

**NOTICE**

Do not connect any cable grounds to “instrument ground”, “control ground”, or any non-earth ground system. Make all required electrical connections based on the wiring diagram in Figure 2-1.

**Shielded Wiring**

All shielded cable must be twisted conductor pairs. Do not attempt to tin (solder) the braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields to the correct pins on the driver connector or wiring as specified in the wiring diagram. Do not connect shields to the actuator ground. Wire exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches). The other end of the shields must be left open and insulated from any other conductor. DO NOT run shielded signal wires along with other wires carrying large currents. Where shielded cable is required, cut the cable to the desired length and prepare the cable as instructed below:

- Strip the outer insulation from BOTH ENDS, exposing the braided or spiral wrapped shield. DO NOT CUT THE SHIELD.
- Using a sharp, pointed tool, carefully spread the strands of the shield.
- Pull the inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.
- Remove 6 mm (1/4 inch) of insulation from the inner conductors. The shield must be considered as a separate circuit when wiring the system. The shield must be carried through connectors without interruption.

Woodward
Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward for more information.

Failure to provide shielding can produce future conditions which are difficult to diagnose. Proper shielding at the time of installation is required to ensure satisfactory operation of the TecJet 85 Gas Metering System.

The recommended wire size for W and Z (Power Supply Inputs) is at least 16AWG. For all other I/O the recommended wire size is at least 20AWG.

Figure 2-2. TecJet 85 Valve Wiring Diagram
Earth Ground

Ground Lug = Earth Ground

In order to ensure CE compliance, the connection to the earth ground needs to meet the following requirements. First, the connection must be less than 183 cm (6 ft) in length. Second, the wire that is used must be at least 3.3 mm² (12 AWG) in size.

Supply Voltage

\[ W = \text{Power-In} (+) \]
\[ Z = \text{Power-In} (-) \]

The supply voltage during normal operation must be 18 to 32 V, measured at the TecJet 85 connector. Steady state input current can reach 4.0 A, and transient input current may reach up to 13.0 A. The recommended power supply cable size is at least 1.3 mm² or 16 AWG. The power supply wiring must be fused outside of the valve. The recommended fuse is a 15 A fast blow fuse.

Recommended maximum wire length from power source to TecJet 85 valve based on an 18 V Power Supply: 16 AWG (1.3 mm²)—8 m (26 ft*)

*Rated transient torque may not be achievable with an 18 V power supply. Listed lengths will provide at least 75% of rated transient torque.

Recommended maximum wire length from power source to TecJet 85 valve based on a 24 V Power Supply: 16 AWG (1.3 mm²)—13 m (43 ft)

Keyswitch

\[ F = \text{Keyswitch} \]

The keyswitch is not active in all TecJet configurations. The keyswitch is used to switch the TecJet 85 in and out of a low power state (less than 200 mA input current). A high signal (connected to supply [+] will allow the valve to operate in a normal mode, and a low signal (connected to supply [−] or open connection) will force the valve to a minimum position (if possible) and then into a low power state. When the key switch input goes low, the valve will disable the driver circuitry after the software has gone through a shutdown procedure.
PWM Input

K = PWM input (+)
L = PWM input (−)

The PWM input is configurable as the mass flow demand input. The PWM Input is designed to be used with a push-pull type driver.

- Input Magnitude: 7–32 V differential input
- Input Impedance: 40 kΩ
- Input Type: Single-ended, ground referenced
- Frequency Range: 80–1100 Hz
- Isolation: none
- Resolution: 12 bits
- Accuracy: 1.5% of full scale @ 25 °C
- Temperature Drift: 300 ppm/°C
- Input Common Mode Range: At least ±50 V
- Safe Input Common Mode Voltage: At least ±50 V

CAN ID Inputs

H = CAN ID 1
G = CAN ID 2
J = Discrete/RS232 Common

The CAN ID inputs are used to select which CAN identifiers will be used on the CANbus. With no programming tools, the customer can select from the four pre-programmed CAN IDs through a hard-wired code in the engine harness. This is especially important where more than one TecJet 85 is used on an engine. If one TecJet 85 valve is replaced with another, the new valve will read the correct ID number from the engine harness connector. See the table below for the code definition.

<table>
<thead>
<tr>
<th>TecJet 85 CAN ID</th>
<th>CAN ID1</th>
<th>CAN ID2</th>
</tr>
</thead>
<tbody>
<tr>
<td>“TecJet 1”</td>
<td>Battery + or Open</td>
<td>Battery + or Open</td>
</tr>
<tr>
<td>“TecJet 2”</td>
<td>Discrete Common</td>
<td>Battery + or Open</td>
</tr>
<tr>
<td>“TecJet 3”</td>
<td>Battery + or Open</td>
<td>Discrete Common</td>
</tr>
<tr>
<td>“TecJet 4”</td>
<td>Discrete Common</td>
<td>Discrete Common</td>
</tr>
</tbody>
</table>
CAN Termination

P = Termination resistor
Q = Termination resistor

The internal termination resistor (120 Ω) is used to terminate the CANbus. According to the CAN specification, every CANbus must be terminated at both ends of the bus. If a TecJet 85 valve is connected to the far end of the bus, this termination resistor can be used. If termination is needed, connect a link between pins P and Q. This link should be as short as possible. If no termination resistor is needed, leave pins P and Q unconnected.

If the internal termination is used, other devices on the CANbus may not operate properly when the TecJet 85 valve is disconnected from the bus. An external termination resistor should be used if there are other devices on the CANbus that must not lose communication when the TecJet 85 valve is disconnected.

---

CAN In

R = CAN high in
S = CAN low in
V = CAN GND

Pins R, S, and V are the CAN communication wires. Make sure that the correct cable is used for connection to the CAN terminals (SAE J1939/11).

Voltage Level: 5 V
Isolation: 1000 Vrms (optically decoupled)
Type: The TecJet 85 valve supports CAN 2.0B.
Baud Rate: Configurable from 250 K to 1 Meg

CAN Out

T = CAN high out
U = CAN low out
V = CAN GND

The CAN output pins are internally connected to the CAN input pins. They are provided for linking more than one TecJet 85 to the CANbus without the need for junction boxes or doubled terminations to connector pins. For example, the CANbus from the control may be connected to the input pins, and the output pins are connected to the second TecJet 85 input pins.

---

If a second device is connected to the CAN output pins, this device will lose communication if the TecJet 85 valve is disconnected.
CAN Shield

X = CAN Shield

The CAN Shield can be used to terminate the shield of the CAN wiring. Internally, this pin is connected to the TecJet 85 case through a capacitor.

4–20 mA Analog Input

A = 4–20 mA Analog Input (+)
B = 4–20 mA Analog Input (–)

The 4–20 mA Analog Input is configurable as the mass flow demand input like the PWM input.

Input Impedance: 225 Ω
Input Type: 4–20 mA differential
Max Input Current: 25 mA ±2%
Input Common Mode Range: At least ±50 V
Common Mode Rejection Ratio: -60 dB minimum
Safe Input Common Mode Voltage: At least ±200 V
Accuracy: ±1.5% of full scale @ 25 °C
Temperature Drift: 300 ppm/°C

Status Output

E = Status Output
J = Discrete/RS232 Common

The status output indicates whether the TecJet 85 valve is operating correctly. It will be "on" when the valve is operating normally and "off" when any warnings or errors are active. The Status Output is a high-side switch: it will be actively driven to Battery (+) when "on" and pulled to Battery (–) through a resistor when "off".

Output Type: High Side Discrete Output Driver
Drive Current: 500 mA max (w/ 24 V supply and 48 Ω load)
Load Range: 48 Ω to 100 kΩ

RS-232 Serial Communication Service Port

M = RS-232 TX
N = RS-232 RX
J = Discrete/RS-232 Common

The access to the service port will be provided through the main connector. The RS-232 communications will be provided for the purposes of configuring and servicing the TecJet 85 valve.

Isolation: None
Baud Rate: 38.4 Kbaud
Chapter 3.
Description of Operation

Configuration

The valve can be configured to accept a flow demand from the analog input, the PWM input, or the CAN port. The configuration also includes user adjustable warning limits, and default values for failed sensor backup modes. The configuration can be viewed or changed using the TecJet Service Tool. See Chapter 6 for information on installing the service tool.

Power-on Procedure

When power is applied to the valve, it performs a diagnostic check. If there are no problems detected, the actuator is enabled with 1.1 N·m (0.8 lb-ft) of torque, and the valve closes. If the flow demand source is configured for EGS CAN or Jenbacher CAN, the valve reads the CAN ID input pins and begins sending diagnostic information on the CAN link. If a problem is detected, the valve will not operate and the status output will indicate a fault.

The TecJet 85 is typically continuously connected to the supply voltage. If the flow demand source is configured to Jenbacher CAN, the key switch has no effect. If the flow demand source is configured for anything else, the key switch input must be connected to a high signal (supply [+]) for the valve to operate. When the key switch is off, the valve closes, if possible, and the actuator that positions the valve is disabled to minimize the amount of current drawn from the battery.

Normal Operation

If a valid flow demand is present, the valve begins normal operation. The TecJet 85 calculates the area needed to provide the requested flow. This area is calculated using the delta pressure (inlet to outlet pressure differential), the absolute inlet fuel gas pressure, the fuel gas temperature, the fuel gas ratio of specific heats (K), the fuel gas density, and the calibration information stored in the valve. The actuator positions the valve to achieve the calculated area requirement.

Diagnostics

The TecJet 85 may not return to minimum fuel for all faults. The engine, turbine, or other type of prime mover should be equipped with an overspeed, misfire, detonation detection shutdown device(s), that operate totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the TecJet 85 system fail. An independent fuel shutoff device should also be used to shut off fuel flow in case the TecJet 85 system fails.
The valve continuously performs a variety of diagnostic checks. Diagnostic events are classified as warnings, errors or status indications. The status output indicates the overall status of the valve. For more detailed information and a complete list of the diagnostics, see the User Guide in the TecJet Service Tool. A brief summary follows:

**Warnings:**
A warning indicates a condition that may require an operator’s attention or intervention. For example, the valve may be operating in conditions that are outside its specification range, or a failure has occurred for which there is a back-up mode of operation, possibly with reduced accuracy or performance. If any warnings are active, the status output is “off”.

**Errors:**
An error indicates a problem that prevents the valve from operating. The valve closes, if possible, and remains inoperable until power is cycled. If the error persists, the valve requires service. If any errors are active, the status output is “off”.

**Status indications:**
The valve provides the following status indications:
- **Zero flow detected**—The flow demand is not present or is not valid. The valve is closed and the status output is “off”.
- **Zero pressure detected**—The pressure across the valve is essentially zero, so no flow can occur. The valve is closed and the status output is “off”.
- **Flow not reached**—The valve cannot achieve the demanded flow given the present operating conditions (fuel gas temperature and pressure, delta pressure, gas K and density). The status output is “off”.
- **Overall status OK**—There are no errors or warnings, and the Flow not detected, Zero flow detected, and Flow not reached status indications are not true. The status output is “on”.

See Chapter 5 (Troubleshooting) for more information on non-normal operation.

**Run Hours Counter**
The valve maintains a running hours counter that can be viewed or reset with the service tool. Running hours do not accumulate when the “Flow not detected” status indication is true.

**Position Limiter**
After the TecJet 85 is powered up and receives a flow command, the valve remains in a closed position until the delta-p sensor senses a non-zero valve delta-p. This non-zero delta-p is established when the fuel source is turned on. Once the non-zero valve delta-p is sensed, the valve is positioned according to an interpolated value from the position limiter table. This table contains three position vs flow command points. By limiting the valve position as the fuel pressure is established, the delta-p required for the TecJet 85 to begin metering fuel is obtained at a lower fuel flow rate. This function ensures that adequate delta-p will be created, even with a substantially drooping fuel source, to allow the TecJet 85 to begin metering fuel.
Here is an example. During start-up, if the valve is operating under very low differential pressure, and the valve indicates a “flow not reached” condition, but the valve position is less than 1.2 radians, then the valve position is being limited by the table values as indicated above. This situation can generally be resolved by increasing the differential pressure across the valve by increasing the valve pre-pressure.

**IMPORTANT**

After any pressure adjustments, ensure during normal operation that pre-pressure and differential pressure are operating within the ranges specified in the General Specifications section of this manual.

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**CANopen Communications**

The TecJet 110, 85, 50 Plus, and Precision Flow devices support CAN communications in the CIA CANopen Protocol format complying with DS301 version 4.02. Further detailed information regarding CANopen can be obtained at [www.can-cia.org](http://www.can-cia.org). Information about CAN is available at [www.semiconductors.bosch.de](http://www.semiconductors.bosch.de). Specific information regarding TecJet behavior is detailed below.

All TecJet CANopen messages use the CAN 2.0 11-bit Standard Data Frame Format.

**Baud Rate**
The baud rate is tunable for 125, 250, 500, or 1000 kbps. The default is 250 kbps.

**Node ID**
The Node ID is tunable between 1 and 31. The default is 18.

**Heartbeat Production Rate**
The Heartbeat rate is tunable but defaulted to 1 second.

**CANopen State**
The TecJet starts in boot-up mode, sends the required Boot Message, and then goes to the pre-operational state. If configured for PWM demand, it will operate based on the PWM signal regardless of the CANopen State (the valve is fully operational.) Once it receives the operational command on the CANbus, the PDOs will be available on the CANbus.

If CAN demand is configured, it needs to receive a command to go to the operational state followed by receiving a valid flow rate on the CANbus before the valve can be operational.

**TecJet PDO Support**

All data in CANopen is formatted as “Little Endian” also known as “Intel Format”.

This section lists the PDOs that will be sent from the TecJet.

The TecJet will use the standard connection set to assign PDO numbers. The Node ID determines the COB ID for the PDOs.
Transmit PDO table.

<table>
<thead>
<tr>
<th>Name</th>
<th>NODE_ID</th>
<th>TxPDO</th>
<th>COB_ID</th>
<th>Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Valve Parameters</td>
<td>18</td>
<td>1</td>
<td>402 (192h)</td>
<td>ASYNC</td>
<td>99 ms</td>
</tr>
<tr>
<td>Gaseous Fuel Flow</td>
<td>18</td>
<td>2</td>
<td>658 (292h)</td>
<td>ASYNC</td>
<td>99 ms</td>
</tr>
<tr>
<td>Diagnostics &amp; Status</td>
<td>18</td>
<td>3</td>
<td>914 (392h)</td>
<td>ASYNC</td>
<td>198 ms</td>
</tr>
</tbody>
</table>

Receive PDOs Table.

<table>
<thead>
<tr>
<th>Name</th>
<th>NODE_ID</th>
<th>RxPDO</th>
<th>COB_ID</th>
<th>Timeout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous Fuel Command</td>
<td>18</td>
<td>1</td>
<td>530 (212h)</td>
<td>N/A for PWM, Adjustable for CAN.</td>
</tr>
</tbody>
</table>

Transmit PDO 1 - Fuel Valve Parameters
Transmission rate: 99 ms
Message type = “ASYNC” (does not require SYNC message)
COB Id: 402 (0x192) default for Node Id = 18. All others 384+Node Id.
Node ID = 18 (default address of TecJet when configured as TecJet #1)

Data:

Byte 1: Actual Fuel Valve Position
- Data length: 1 byte
- Resolution: 0.4%/bit, 0 offset
- (Multiply received value by 0.4 to recover % value)
- Range: 0 to 100% (0x00 to 0xFA)

Byte 2: Desired Fuel Valve Position
- Data length: 1 byte
- Resolution: 0.4%/bit, 0 offset
- (Multiply received value by 0.4 to recover % value)
- Range: 0 to 100% (0x00 to 0xFA)

Bytes 3-4: Absolute Inlet Gas Pressure
- Data length: 16 bits, integer
- Resolution: 0.1 kPa/bit, 0 offset
- (Multiply received value by 0.1 to recover kPa value)
- Range: 0 to 6425.5 kPa

Bytes 5, 6: Absolute Outlet to Inlet Gas Pressure Differential
- Data length: 16 bits, integer
- Resolution: 0.1 kPa/bit, 0 offset
- (Multiply received value by 0.1 to recover kPa value)
- Range: 0 to 6425.5 kPa

Byte 7: Fuel Temperature
- Data length: 1 byte
- Resolution: 1 ºC/bit gain, -40 ºC offset
- (Subtract 40 from received value to recover ºC value)
- Range: -40 to +210 ºC

Byte 8: Reserved, sent as 0.

Transmit PDO 2 - Gaseous Fuel Flow
Transmission rate: 99 ms
Message type = “ASYNC” (does not require SYNC message)
COB Id: 658 (0x292) default for Node Id = 18. All others 640+Node Id.

Data:

Bytes 1-4: Fuel Flow – Desired
(Either the demand via PWM or CANopen)
- Data length: 4 bytes
- Resolution: 0.0002778 L/S/bit, 0 offset
- (Divide by 3600 to recover L/S value)
- Range: 0 to 1169744.78194 L/S
**Bytes 5-8: Gaseous Fuel Flow – Calculated, based on measured parameters**

| Data length: | 4 bytes |
| Resolution: | 0.0002778 L/S/bit, 0 offset |
| (Divide by 3600 to recover L/S value) | |
| Range: | 0 to 1169744.78194 L/S |

**Transmit PDO 3 - Diagnostics and Status**

Transmission rate: 198 ms

Message type = "ASYNC" (does not require SYNC message)

COB Id: 914 (0x392) default for Node Id = 18. All others 896+Node Id.

Range: Boolean, 8 bytes of status. All reserved bits are set to 0.

Data Length: 8 bytes

<table>
<thead>
<tr>
<th>Byte 1 (Overall Status)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0: OVERALL_STATUS_OK</td>
</tr>
<tr>
<td>Bit 1: HOLD_POSITION_WARN</td>
</tr>
<tr>
<td>Bit 2: ZERO_PRESSURE_DETECTED</td>
</tr>
<tr>
<td>Bit 3: ZERO_FLOW_DETECTED</td>
</tr>
<tr>
<td>Bit 4: FLOW_NOT_REACHED</td>
</tr>
<tr>
<td>Bit 5: VALVE_POSITION_ERROR</td>
</tr>
<tr>
<td>Bit 6: HIGH_ELEC_TEMP</td>
</tr>
<tr>
<td>Bit 7: RESERVED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0: ELEC_TEMP_FAIL_HIGH</td>
</tr>
<tr>
<td>Bit 1: FGT_FAIL_HIGH</td>
</tr>
<tr>
<td>Bit 2: DELTA_P_FAIL_HIGH</td>
</tr>
<tr>
<td>Bit 3: FGP_FAIL_HIGH</td>
</tr>
<tr>
<td>Bit 4: COIL_CURRENT_FAIL_HIGH</td>
</tr>
<tr>
<td>Bit 5: RESERVED</td>
</tr>
<tr>
<td>Bit 6: RESERVED</td>
</tr>
<tr>
<td>Bit 7: POSITION_FAIL_HIGH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0: ELEC_TEMP_FAIL_LOW</td>
</tr>
<tr>
<td>Bit 1: FGT_FAIL_LOW</td>
</tr>
<tr>
<td>Bit 2: DELTA_P_FAIL_LOW</td>
</tr>
<tr>
<td>Bit 3: FGP_FAIL_LOW</td>
</tr>
<tr>
<td>Bit 4: COIL_CURRENT_FAIL_LOW</td>
</tr>
<tr>
<td>Bit 5: RESERVED</td>
</tr>
<tr>
<td>Bit 6: RESERVED</td>
</tr>
<tr>
<td>Bit 7: POSITION_FAIL_LOW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0: RESERVED</td>
</tr>
<tr>
<td>Bit 1: RESERVED</td>
</tr>
<tr>
<td>Bit 2: RESERVED</td>
</tr>
<tr>
<td>Bit 3: RESERVED</td>
</tr>
<tr>
<td>Bit 4: ANALOG_INPUT_LOW_ERR</td>
</tr>
<tr>
<td>Bit 5: ANALOG_INPUT_HIGH_ERR</td>
</tr>
<tr>
<td>Bit 6: PWM_DUTY_CYCLE_LOW_ERR</td>
</tr>
<tr>
<td>Bit 7: PWM_DUTY_CYCLE_HIGH_ERR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Byte 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0: BATTERY_VOLT_LOW_ERR</td>
</tr>
<tr>
<td>Bit 1: FGT_LOW_LIMIT_ERR</td>
</tr>
<tr>
<td>Bit 2: DELTA_P_LOW_LIMIT_ERR</td>
</tr>
<tr>
<td>Bit 3: FGP_LOW_LIMIT_ERR</td>
</tr>
<tr>
<td>Bit 4: BATTERY_VOLT_HIGH_ERR</td>
</tr>
<tr>
<td>Bit 5: FGT_HIGH_LIMIT_ERR</td>
</tr>
<tr>
<td>Bit 6: DELTA_P_HIGH_LIMIT_ERR</td>
</tr>
<tr>
<td>Bit 7: FGP_HIGH_LIMIT_ERR</td>
</tr>
</tbody>
</table>
Byte 6
Bit 0: RESERVED
Bit 1: WATCHDOG_RESET
Bit 2: RESERVED
Bit 3: RESERVED
Bit 4: CAN_FLOW_DEMAND_FAILED
Bit 5: RESERVED
Bit 6: TECJET_SHUTDOWN
Bit 7: TECJET_INTERNAL_FAULT

Byte 7
Bit 0: RESERVED
Bit 1: KEYSWITCH_STATE
Bit 2: RESERVED
Bit 3: RESERVED
Bit 4: RESERVED
Bit 5: RESERVED
Bit 6: RESERVED
Bit 7: RESERVED

Byte 8
Bit 0: RESERVED
Bit 1: RESERVED
Bit 2: RESERVED
Bit 3: RESERVED
Bit 4: RESERVED
Bit 5: RESERVED
Bit 6: RESERVED
Bit 7: RESERVED

Receive PDO 1 - Gaseous Fuel Command
Maximum Reception rate: 3 ms (Engine Control to TecJet 50 Plus)
Message type = "ASYNC" (does not require SYNC message)
Timeout: If Flow demand via CAN, the timeout for this message is adjustable from 10 to 10,000 ms.
COB Id: 530 (0x212) default for Node Id = 18. All others 512+Node Id.
Node ID = 18 (default address of TecJet when configured as TecJet #1)
Data length: 8 bytes

Bytes 1,2: Fuel specific gravity
Data length: 16 bits, integer
Resolution: 0.0001/bit, 0 offset (multiply by 10,000 before sending)
Range: 0.3101 to 2.0 (3101 to 20000 as scaled for transmission)
Upon receipt of this message if the specific gravity is within the allowed range, the TecJet+ is updated.
The CAN data received is divided by 10,000 and multiplied by the density of air, 1290.0 g/m^3 to get Normalized Density.

Bytes 3, 4: Ratio of Specific Heats (K)
Data length: 16 bits, integer
Resolution: 0.0001/bit, 0 offset (multiply by 10,000 before sending)
Range: 1.0001 to 2.0 (10001 to 20000 as scaled for transmission)
Upon receipt of this message if the value is within the allowed range, the TecJet+ will be updated with the raw data divided by 10,000.
If CAN data has not been received during the current power cycle, a default parameter, K will be used as configured by the service tool.

Bytes: 5-8 Fuel Flow Rate
Data length: 4 bytes, unsigned
Resolution: 0.0002778 L/sec/bit, 0 offset
(Divide by 3600 to recover L/sec value)
Range: 0 to 1169744.78194 L/sec
If the received flow demand is 0.00 or greater than 1169.74478194 L/sec, the valve will be closed.
If the TecJet is configured to expect the Flow Command via PWM, the Flow Command in this message will be ignored. It can have any value since it will be completely ignored in that case.

**CANopen Data Summary**

**PDO Summary**
Node/PDO represents the Node ID + PDO combination from the standard connection set.

<table>
<thead>
<tr>
<th>Name</th>
<th>CANopen</th>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel specific gravity</td>
<td>18/1(R)</td>
<td>Bytes 1-2</td>
<td>UINT16</td>
</tr>
<tr>
<td>Ratio of Specific Heats</td>
<td>18/1(R)</td>
<td>Bytes 3-4</td>
<td>UINT16</td>
</tr>
<tr>
<td>Fuel Flow Rate</td>
<td>18/1(R)</td>
<td>Bytes 5-8</td>
<td>UINT32</td>
</tr>
<tr>
<td>Actual Fuel Valve Position</td>
<td>18/1(T)</td>
<td>Byte 1</td>
<td>UINT8</td>
</tr>
<tr>
<td>Desired Fuel Valve Position</td>
<td>18/1(T)</td>
<td>Byte 2</td>
<td>UINT8</td>
</tr>
<tr>
<td>Absolute Inlet Gas Pressure</td>
<td>18/1(T)</td>
<td>Bytes 3-4</td>
<td>UINT16</td>
</tr>
<tr>
<td>Absolute Outlet to Inlet Gas Pressure Differential</td>
<td>18/1(T)</td>
<td>Bytes 5-6</td>
<td>UINT16</td>
</tr>
<tr>
<td>Fuel Temperature</td>
<td>18/1(T)</td>
<td>Byte 7</td>
<td>UINT8</td>
</tr>
<tr>
<td>Gaseous Fuel Flow-Desired</td>
<td>18/2(T)</td>
<td>Bytes 1-4</td>
<td>UINT32</td>
</tr>
<tr>
<td>Gaseous Fuel Flow-Calculated</td>
<td>18/2(T)</td>
<td>Bytes 5-8</td>
<td>UINT32</td>
</tr>
<tr>
<td>Diagnostic Byte 1</td>
<td>18/3(T)</td>
<td>Byte 1</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 2</td>
<td>18/3(T)</td>
<td>Byte 2</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 3</td>
<td>18/3(T)</td>
<td>Byte 3</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 4</td>
<td>18/3(T)</td>
<td>Byte 4</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 5</td>
<td>18/3(T)</td>
<td>Byte 5</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 6</td>
<td>18/3(T)</td>
<td>Byte 6</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 7</td>
<td>18/3(T)</td>
<td>Byte 7</td>
<td>BYTE</td>
</tr>
<tr>
<td>Diagnostic Byte 8</td>
<td>18/3(T)</td>
<td>Byte 8</td>
<td>BYTE</td>
</tr>
</tbody>
</table>

**SAE J1939 Communications**

Specific information regarding TecJet behavior is detailed below.

All TecJet J1939 messages use the CAN 2.0B 29-bit Extended Data Frame Format.

**Gaseous Fuel Command**
Transmission rep rate: 5 ms (Engine Control ➔ TecJet 50 Plus)
Data length: 8 bytes
Data page: 0
PDU format: 239
Note that this is the only Proprietary PDU Format 1 message allowed in J1939.
PDU specific: 18, 125, 126, 127 depending on harness code
Default priority: 0 (high)
PGN: 0xEF12, 0xEF7D, 0xEF7E, 0xEF7F
Data:
**Bytes 1-2:** Fuel specific gravity
Data length: 2 bytes, unsigned
Resolution: 0.0001/bit, 0 offset
Range: 0 to 2
Bytes 3-4: Ratio of Specific Heats
Data length: 2 bytes, unsigned
Resolution: 0.0001/bit, 0 offset
Range: 0 to 2

Bytes 5-8: Fuel Flow Rate
Data length: 4 bytes, unsigned
Resolution: 0.001 m^3/hr/bit, 0 offset (normalized to 0 deg C, 1013 mbar
Range: 0 to 4211081.215 m^3/hr (1169744.78194 Liters/second)

Fuel Valve Position
Transmission repetition rate: 100 ms (TecJet 85 Engine Control)
Data length: 8 bytes
Data Page: 0
PDU format: 255
PDU specific: 252
Default priority: 6
PGN: 65532 (0xFFF)
Data:
Byte 1: Actual Fuel Valve Position
Data length: 1 byte
Resolution: 0.4%/bit, 0 offset
Range: 0 to 100% (0x00 to 0xFA)

Byte 2: Desired Fuel Valve Position
Data length: 1 byte
Resolution: 0.4%/bit, 0 offset
Range: 0 to 100% (0x00 to 0xFA)

Bytes 3-8: Reserved, sent as 0xFF

Gas Properties
Transmission repetition rate: 100 ms (TecJet 85 Engine Control)
Data length: 8 bytes
Data Page: 0
PDU format: 255
PDU specific: 253
Default priority: 6
PGN: 65533 (0xFFFD)
Data:
Bytes 1-2: Absolute Inlet Gas Pressure
Data length: 2 byte
Resolution: 0.1 kPa/bit, 0 offset
Range: 0 to 6425.5 kPa

Bytes 3-4: Absolute Outlet to Inlet Gas Pressure Differential
Data length: 2 byte
Resolution: 0.1 kPa/bit, 0 offset
Range: 0 to 6425.5 kPa

Byte 5: Fuel Temperature
Data length: 1 byte
Resolution: 1 °C/bit gain, −40 °C offset
Range: −40 to +210 °C

Bytes 6-8: Reserved, sent as 0xFF

Gaseous Fuel Flow
Transmission repetition rate: 100 ms (TecJet 85 Engine Control)
Data length: 8 bytes
Data Page: 0
PDU format: 255
PDU specific: 254
Default priority: 6
Parameter Group Number: 65534 (0xFFFF)
Data:
Bytes 1-4: Fuel Flow
Data length: 4 byte
Resolution: 0.001 m^3/hr/bit, 0 offset (normalized to 0 deg C, 1013 mbar
Range: 0 to 4211081.215 m^3/hr

Bytes 5-8: Undefined, sent as 0xFF
Diagnostics and Status

Transmission Rate: 200 ms (TecJet 85 Engine Control)
Data Length: 8 bytes
Data Page: 1
PDU Format: 255
PDU Specific: 255
Default Priority: 6
Parameter Group Number: 65535 (0xFFFF)

Data Bytes: 8 bytes of status.

Byte 1 (Overall Status)
Bit 0: OVERALL_STATUS_OK
Bit 1: RESERVED
Bit 2: ZERO_PRESSURE_DETECTED
Bit 3: ZERO_FLOW_DETECTED
Bit 4: FLOW_NOT_REACHED
Bit 5: VALVE_POSITION_ERROR
Bit 6: HIGH_ELEC_TEMP
Bit 7: RESERVED

Byte 2
Bit 0: ELEC_TEMP_FAIL_HIGH
Bit 1: FGT_FAIL_HIGH
Bit 2: DELTA_P_FAIL_HIGH
Bit 3: FGP_FAIL_HIGH
Bit 4: COIL_CURRENT_FAIL_HIGH
Bit 5: RESERVED
Bit 6: RESERVED
Bit 7: POSITION_FAIL_HIGH

Byte 3
Bit 0: ELEC_TEMP_FAIL_LOW
Bit 1: FGT_FAIL_LOW
Bit 2: DELTA_P_FAIL_LOW
Bit 3: FGP_FAIL_LOW
Bit 4: COIL_CURRENT_FAIL_LOW
Bit 5: RESERVED
Bit 6: RESERVED
Bit 7: POSITION_FAIL_LOW

Byte 4
Bit 0: RESERVED
Bit 1: RESERVED
Bit 2: RESERVED
Bit 3: RESERVED
Bit 4: ANALOG_INPUT_LOW_ERR
Bit 5: ANALOG_INPUT_HIGH_ERR
Bit 6: PWM_DUTY_CYCLE_LOW_ERR
Bit 7: PWM_DUTY_CYCLE_HIGH_ERR

Byte 5
Bit 0: BATTERY_VOLT_LOW_ERR
Bit 1: FGT_LOW_LIMIT_ERR
Bit 2: DELTA_P_LOW_LIMIT_ERR
Bit 3: FGP_LOW_LIMIT_ERR
Bit 4: BATTERY_VOLT_HIGH_ERR
Bit 5: FGT_HIGH_LIMIT_ERR
Bit 6: DELTA_P_HIGH_LIMIT_ERR
Bit 7: FGP_HIGH_LIMIT_ERR

Byte 6
Bit 0: RESERVED
Bit 1: WATCHDOG_RESET
Bit 2: RESERVED
Bit 3: RESERVED
Bit 4: CAN_FLOW_DEMAND_FAILED
Bit 5: RESERVED
Bit 6: TECJET_SHUTDOWN
Bit 7: TECJET_INTERNAL_FAULT
Address Claimed
The Address Claimed message will be sent out shortly after power has been applied to the TecJet 85 if the TecJet is configured for the EGS-02 Flow Demand mode.

The Address Claimed message will be sent out in response to a Request for Address Claimed if the preferred address was successfully claimed or if the TecJet has not won or lost address claiming.

The Request for Address Claimed can be sent to a specific Address or to the Global Destination Address, 255. The TecJet 85 will respond to a specific query, or one to the Global Destination Address, 255. The Source Address for this transmit message will be 18 for TecJet 1, 125 for TecJet 2, 126 for TecJet 3, 127 for TecJet 4. Addresses are not re-programmable.

The Address Claimed Message will also be sent out if the TecJet 85 receives an Address Claimed message from the same Address as the receiving node and a lower priority (higher value) NAME. The entire 8-byte value of the NAME is used for arbitration with the Arbitrary Address Capable Field as the Most Significant Bit.

Cannot Claim Address
The Cannot Claim Address message will be sent out if the TecJet 85 receives an Address Claimed message with the same Source Address as the receiving node and with a higher priority (lower value) NAME. The entire 8-byte value of the NAME is used for arbitration with the Arbitrary Address Capable Field as the Most Significant Bit.

The Cannot Claim Address will also be sent out in response to a Request for Address Claimed if the address was unsuccessfully claimed.

The Cannot Claim Address message will be sent out with a 0-153 millisecond pseudo-random delay between the reception of the triggering message and the transmission of the Cannot Claim Address message.

If the TecJet 85 cannot claim an Address a status bit will be set and the valve will shut down.

TecJet 50 Plus NAME
Arbitrary Address Capable Field = No = 0
(See J1939-81 Section 4.1.1.2)
Industry Group Field = Global = 0
(See J1939 Section 3.2.4, J1939-81 Section 4.1.1.3)
Vehicle System Instance Field = First Instance = 0
(See J1939-81 Section 4.1.1.4)
Vehicle System Field = Non-specific system = 0
(See J1939-81 Section 4.1.1.5)
Function Field = Fuel System = 15
(See J1939-81 Section 4.1.1.7)
Function Instance Field = First = 0
(See J1939-81 Section 4.1.1.8)
ECU Instance Field = 1, 2, 3, 4 corresponding to Address 18, 125, 126, 127 respectively
(See J1939-81 Section 4.1.1.9)
Manufacturer Code Field = Woodward Governor Industrial Controls = 153
(See J1939-81 Section 4.1.1.10)
Start executing Power On Self Test

POST Complete - Send Address Claim

Delay Complete - Send Address Claim

Random Delay before sending Address Claimed

Received Request for Address Claim - Reclaim current address

Received Request For Address Claimed

Delay Complete - Send Cannot Claim Address

Contender’s NAME Less than mine - Send Cannot Claim Address

Contender’s NAME greater than mine - Re-claim Current Address

Prioritizing Address Contention During Initialization

Prioritizing Address Contention

Received a contending Address Claim

*Bus-off Error occurred or collision detected

No Contending Address Claim

Received a contending Address Claim

Contender’s NAME greater than mine - Re-claim Current Address

Contender’s NAME Less than mine - Send Cannot Claim Address

Contender’s NAME greater than mine - Re-claim Current Address

Contender’s NAME Less than mine - Send Cannot Claim Address

Cannot Claim Address

Received Request For Address Claimed

Delay before sending Cannot Claim

Normal Message Traffic

Received a contending Address Claim

Delay Complete - Send Cannot Claim Address

Figure 3-1. Address Claimed State Chart
Position Hold Feature

**WARNING**

This feature should only be used by qualified engine operators. This feature will hold the valve at the desired position regardless of the fuel demand from the engine controller, which could result in unexpected engine operation.

The TecJet 110, 85, 50 Plus, and Precision Flow devices have a position hold feature for use in analyzing or troubleshooting engine system operation. This allows qualified operators to bypass the normal flow control function and specify a fixed valve position. This mode is accessed in the Service Tool using the Tools → Position Hold menu which can only be accessed with a password supplied by Woodward.

The current valve position is displayed in the Position Hold dialog box. The valve remains in flow control mode while the Enable Position Hold check-box is unchecked. After the desired position is entered in the Position Hold Setting, checking the Enable Position Hold check-box causes the valve to operate in position hold mode where the valve position is controlled at the Position Hold Setting value. Un-checking the Enable Position Hold check-box restores normal flow control operation. Pressing OK closes the Position Hold window without changing the position hold settings. Position Hold is automatically disabled after 10 minutes. It is also disabled if the service tool connection is lost for more than 10 seconds.

The Position Hold feature requires a valid flow command for position hold to function. The command is not used for positioning, but in order to control the position, the flow command must be valid. The position limiter function is also active so it may not be possible to achieve the desired position without increasing the flow demand. See the section “Position Limiter” earlier in this chapter. To avoid confusion, it is recommended to first achieve the desired flow, note the position, enter this position into the Position Hold setting, then activate the Position Hold feature. This process will avoid interaction with the Position Limiter unless the fuel pressure changes.

**General Specifications**

**Electrical Input Characteristics**
- Input Voltage Range: 18–32 Vdc
- Maximum Steady State Input Current: 4 A at 24 Vdc
- Maximum Transient Input Current: 13 A 24 Vdc

**Mechanical Characteristics**
- Valve Maximum Effective Area: 3710 mm² (5.75 in²)
- Valve Minimum Effective Area: 48.4 mm² (0.075 in²)

Weight: 27 kg (59 lb)
Mounting: See installation drawings

**Fuel connections**
- Filter Requirements: less than 50.0 µm

See outline drawing for additional details.
**Position Response:**
Bandwidth at ±0.5% amplitude => 5 Hz at –3 db (24 V supply)
Bandwidth at ±2% amplitude => 6 Hz at –3 db (24 V supply)

**Step Response Slew Time:**
< 80 ms for a 10–90% and 90–10% step (24 V supply)
Overshoot: < 2% of the step

**Flow Demand Response:**
Flow demand to position demand has latency of < 4.5 ms

**Pressure Change Rejection:**
Same as demanded flow response with addition of 10 ms lag on P1 measurement, 100 ms lag on delta pressure

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**Environmental**

**EMC**
EN61000-6-2: Immunity for Industrial Environments
EN61000-6-4: Emissions for Industrial Environments

**Fuel Type**
The TecJet 85 fuel metering valve is designed to operate primarily on specialty gas such as landfill, digester, or other biogases. The valve is also compatible with normal pipeline quality natural gas. Proper application of the valve for fuel flow, pressure, energy content, etc. is the responsibility of the OEM. The fuel gas flowing through the valve can consist of the components and limits indicated below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaseous hydrocarbons</td>
<td>No limit</td>
</tr>
<tr>
<td>(methane, ethane, propane, etc.):</td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>No limit</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>No limit</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Oxygen</td>
<td>No limit</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>No limit</td>
</tr>
<tr>
<td>Sulfur compounds</td>
<td>&lt; 500 mg/10 kWh ( &lt; 2000 mg/10 kWh)</td>
</tr>
<tr>
<td>including hydrogen sulfide</td>
<td></td>
</tr>
<tr>
<td>Chlorine and fluorine compounds</td>
<td>&lt; 100 mg/10 kWh ( &lt; 400 mg/10 kWh)</td>
</tr>
<tr>
<td>typically chlorofluorocarbons</td>
<td></td>
</tr>
<tr>
<td>Silicon</td>
<td>&lt; 5 mg/10 kWh ( &lt; 20 mg/10 kWh)</td>
</tr>
<tr>
<td>Ammonia</td>
<td>&lt; 50 mg/10 kWh</td>
</tr>
<tr>
<td>Oil or hydrocarbons in liquid</td>
<td></td>
</tr>
<tr>
<td>(mist form):</td>
<td>&lt; 5 mg/10 kWh</td>
</tr>
<tr>
<td>Fine particulates, including silicon (less than 1.0 µm):</td>
<td>&lt; 3 mg/10 kWh</td>
</tr>
</tbody>
</table>

Overall the gas SG should be between 0.4 to 2.0 and energy content between 1 and 9.5 kWh/nm³. The values in ( ) are allowed, but may result in reduced valve life. TecJets running in mine gas applications may need to be periodically internally cleaned per the cleaning procedure described later in this manual. A standard TecJet should not be used for coke gas applications. Coke gas applications require a TecJet that has a special coating on the internal valve bore and internal valve components.
Pressures
Inlet fuel gas pressure (FGP) should normally be between 876 and 1289 mbar absolute. The valve is sized to provide rated flow specified in this specification for operation from 0 to 1500 m. Above this altitude the flow capacity will be reduced with decreasing absolute FGP. The Inlet FGP sensor will compensate for barometric pressure to 3000 m. Pressures below 876 mbar are allowed at high load operation assuming that the gas differential pressure requirements are still met.

The TecJet 85 fuel gas differential pressure (delta-p) should be between 69 and 345 mbar. Delta-p below this range is allowed during cranking and idle conditions, but accuracy of the valve will be reduced. For delta-p above 276 mbar, flow accuracy will also decrease, and a reduction in valve stability may occur. Refer to the Accuracy section later in this chapter for further details.

Minimum proof pressure for the TecJet 85 is 0.52 bar gauge.

Minimum burst pressure for the TecJet 85 is 1.72 bar gauge.

Temperature
The following are the temperature specifications for the TecJet 85:

- Steady State Case Temperature: –20 to +90 °C (–4 to +194 °F)
- Stead State Ambient Temperature: –20 to +85 °C (–4 to 185 °F)*
- Long Term Storage Temperature: –40 to +40 °C (–40 to +104 °F)**
- Short Term Storage Temperature: –40 to +105 °C (–40 to +221 °F)**
- Fuel Gas Inlet Temperature: 0 to 65 °C (32 to 149 °F)

* The actuator case temperature is limited to 95 °C (203 °F). If the actuator is running under high steady-state load continuously, then the ambient temperature should be limited to 75 °C (167 °F).
** The unit is un-powered during storage temperature.

Vibration and Shock
Random Vibration*: Exceeds WGC RV2, 10–2000 Hz @ 0.1 G²/Hz (12.8 Grms)
Shock: Per US MIL-STD-810C, Method 516.2, Procedure 1, (40 g)

* It is recommended that engine vibration data for each new application be evaluated to ensure that TecJet test levels are adequate. Contact Woodward engineering for further details.

Flow Characteristics
Accuracy
The TecJet 85 meters fuel accurately such that the engine starts consistently and accelerates smoothly to idle speed. The required fuel delivery up to 7% of valve maximum rated mass flow is within ±20% of the mass flow demand. Throughout the load range, from idle to 100% load, the TecJet 85 regulates the fuel delivery accurately relative to the fuel flow demand in order to reduce combustion emissions and protect the engine against detonation. The accuracy is within ±10% of the mass flow demand from >7% to 25% of valve maximum rated mass flow and within ±6% of the mass flow demand above 25% of valve maximum rated mass flow. For delta-p above 275 mbar, an additional 1.5%, 1%, and 0.5%, respectively, should be added to the accuracy values stated above. Delta pressure below the minimum specified delta pressure would also significantly affect the accuracy values stated above.
Chapter 4.
Valve Sizing

Figures 4-1 and 4-2 show the maximum and minimum amounts of gas that the TecJet 85 will flow as a function of pressure differential in kPa(d). Figure 4-1 indicates flow values for Specialty Gas, while Figure 4-2 indicates flow values for Natural Gas. Plots for the TecJet 50 Plus are also shown for comparison purposes.

Comparing the TecJet 85 vs Application Maximum Flow Rate
Choose the correct graph depending on your application flow media. Determine the maximum flow rate for your application in a metric mass flow rate (kg/h). Increase this value by 15% to ensure that the TecJet 85 will handle the maximum flow requirement under all conditions. Find this increased flow value on the left-side Y-axis of the graph. Next, determine the approximate valve pressure drop at the actual maximum flow for your application. Locate this value on the X-axis of the graph. Metric (kPa(d)) units are provided. Note that the graphs assume the application outlet pressure is at sea level atmospheric pressure. Take the increased flow rate value and the pressure drop value, and determine where they cross on the graph. This is the maximum flow operating point for your application. This point should fall below the maximum flow plot for the TecJet 85.

Comparing the TecJet 85 vs Application Minimum Flow Rate
Choose the correct graph depending on your application flow media. Determine the minimum flow rate for your application in a metric mass flow rate (kg/h). Reduced this value by 10% to ensure that the TecJet 85 will handle the minimum flow requirement under all conditions. Find this reduced flow value on the right-side Y-axis of the graph. Next, determine the approximate valve pressure drop at the actual minimum flow for your application. Locate this value on the X-axis of the graph. Metric (kPa(d)) units are provided. Note that the graphs assume the application outlet pressure is at sea level atmospheric pressure. Take the reduced flow rate value and the pressure drop value, and determine where they cross on the graph. This is the minimum flow operating point for your application. This point should fall above the minimum flow plot for the TecJet 85.
Figure 4-1. Maximum Specialty Gas Flow Capacity of TecJet 85, 50 Plus, Precision Flow, and 110 (Specialty Gas, SG=1, Sea Level)
Figure 4-2. Minimum Specialty Gas Flow Capacity of TecJet 85, 50 Plus, Precision Flow, and 110 (Specialty Gas, SG=1, Sea Level)
Figure 4-3. Maximum Natural Gas Flow Capacity of TecJet 85, 50 Plus, Precision Flow, and 110
(Natural Gas, SG=0.6, Sea Level)
Figure 4-4. Minimum Natural Gas Flow Capacity of TecJet 85, 50 Plus, Precision Flow, and 110 (Natural Gas, SG=0.6, Sea Level)
Chapter 5. Troubleshooting

The tables in this chapter refer to status indications, warnings, and errors that can be viewed on the service tool. See Chapter 6 for information on installing the service tool.

**WARNING**

The actions described may not be appropriate for all situations. The operator should verify that any actions taken while troubleshooting will not take equipment outside of specification, and will not damage property or result in dangerous situations. Also check with the local safety authority.

### STATUS INDICATIONS

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
<th>Possible Cause</th>
<th>Possible Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Not Reached</td>
<td>The Flow demand is greater than the maximum flow possible for the present conditions.</td>
<td>Inlet Gas pressure and/or the pressure across the valve too low, excessive pressure drop in fuel system.</td>
<td>Check if the filters, valve(s) and other restrictions upstream of the TecJet 85 valve are clean and operating correctly. Adjust the inlet gas pressure to the correct value. Verify the configured (Analog or PWM flow demand) or received (EGS CAN or Jenbacher CAN flow demand) gas parameters. Check the valve sizing for this engine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inlet gas pressure and/or the pressure across the valve is too low, pressure regulator problem.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gas properties do not match used gas parameters</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The wrong size TecJet has been chosen for this application.</td>
<td></td>
</tr>
<tr>
<td>Zero Pressure Detected</td>
<td>The differential pressure across the valve is less than 6 mbar.</td>
<td>Engine is not running, fuel pressure is not present at the valve inlet.</td>
<td>Status indication, no action required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excessive pressure drop in fuel system.</td>
<td>Check if the filters, valve(s) and other restrictions upstream of the TecJet 85 valve are clean and operating correctly. Adjust the inlet gas pressure to the correct value.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pressure regulator problem.</td>
<td></td>
</tr>
</tbody>
</table>
### STATUS INDICATIONS

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
<th>Possible Cause</th>
<th>Possible Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero Flow Detected (Flow demand source is Jenbacher CAN or EGS)</td>
<td>If the CAN Flow Demand Failed warning is not active, the received value is zero. If the CAN Flow Demand Failed warning is active, the time between flow demand messages exceeds the CAN flow demand timeout value. See the CAN Flow Demand Failed entry in the warnings section.</td>
<td>ECM is requesting zero flow.</td>
<td>Status indication, no action required.</td>
</tr>
<tr>
<td>Zero Flow Detected (Flow demand source is PWM)</td>
<td>If the PWM flow demand high/low warnings are not active, the flow demand is zero. If the PWM Flow Demand High or PWM Flow Demand Low warning is active, the flow demand is out of range. See the corresponding entries in the warnings section.</td>
<td>ECM is requesting zero flow.</td>
<td>Status indication, no action required.</td>
</tr>
<tr>
<td>Zero Flow Detected (Flow demand source is Analog 4-20)</td>
<td>If the Analog Flow Demand Low/High warnings are not active, the flow demand is zero. If the Analog Flow Demand Low or Analog Flow Demand High warning is active, the flow demand is out of range. See the corresponding entries in the warnings section.</td>
<td>ECM is requesting zero flow.</td>
<td>Status indication, no action required.</td>
</tr>
<tr>
<td>Warning</td>
<td>Description</td>
<td>Possible Cause</td>
<td>Possible Actions</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Analog Flow Demand High</td>
<td>The analog flow demand exceeds the analog flow demand maximum fail limit.</td>
<td>Analog input wiring problem.</td>
<td>Check the analog input wiring for shorts, open connections and intermitted contacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analog input current is out of range.</td>
<td>Ensure that the analog input signal is within the configured range. The service tool displays the analog input current and the range limits.</td>
</tr>
<tr>
<td>Analog Flow Demand Low</td>
<td>The analog flow demand is below the analog flow demand minimum fail limit.</td>
<td>Analog input wiring problem.</td>
<td>Check the analog input wiring for shorts, open connections and intermitted contacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analog input current is out of range.</td>
<td>Ensure that the analog input signal is within the configured range. The service tool displays the analog input current and the range limits.</td>
</tr>
<tr>
<td>CAN Flow Demand Failed</td>
<td>The CAN flow demand is not being received. The time between messages must be less than the CAN flow demand timeout value.</td>
<td>Incorrect TecJet Number</td>
<td>Check the CAN ID inputs to the valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECM is not sending Qgn messages, or is not sending to the correct TecJet number</td>
<td>Verify that the ECM is powered up and sending valid Qgn messages, and that the correct TecJet ID numbers are selected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAN termination problem</td>
<td>Check if the CANbus has the right termination resistor connected at both ends of the bus.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAN wiring problem</td>
<td>Check the CAN wiring for shorts, open connections, interchanged connections, and intermittent contacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAN noise problem</td>
<td>Verify that the CAN wiring is installed according to the installation instruction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CANbus incompatibility with ECM, e.g., baud rate.</td>
<td>Verify ECM CANbus compatibility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAN traffic overload</td>
<td>Verify that there is not excessive CAN traffic that has higher priority than the TecJet 85 flow demand message.</td>
</tr>
<tr>
<td>Warning</td>
<td>Description</td>
<td>Possible Cause</td>
<td>Possible Actions</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Coil Current High</td>
<td>There is an internal problem with either the torque motor that operates the valve or with the electronics used to control the torque motor. Depending on the problem, the valve is either unable to operate properly or is unable to achieve full performance.</td>
<td>Internal fault.</td>
<td>Replace valve.</td>
</tr>
<tr>
<td>coil Current Low</td>
<td>There is an internal problem with either the torque motor that operates the valve or with the electronics used to control the torque motor. Depending on the problem, the valve is either unable to operate properly or is unable to achieve full performance.</td>
<td>Internal fault.</td>
<td>Replace valve.</td>
</tr>
<tr>
<td>Delta P High</td>
<td>The Delta Pressure value exceeds the delta pressure high warning threshold.</td>
<td>Warning threshold improperly configured.</td>
<td>Configure warning threshold for value appropriate to the application. Adjust pressure regulator.</td>
</tr>
<tr>
<td>Delta P Low</td>
<td>The Delta Pressure value is below the delta pressure low warning threshold.</td>
<td>Warning threshold improperly configured.</td>
<td>Configure warning threshold for value appropriate to the application. Verify that gas flow is in the direction of the arrow on the valve.</td>
</tr>
<tr>
<td>Electrical</td>
<td>The valve internal temperature has risen too high to allow full-power operation. The torque available to move the valve is reduced and the valve may not meet specified performance levels.</td>
<td>Valve ambient temperature is too high. Internal fault.</td>
<td>Reduce ambient temperature. Replace the valve.</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronics</td>
<td>The internal electronics temperature sensor has failed to a high value. The valve may not reach specified performance.</td>
<td>Internal fault.</td>
<td>Replace the valve.</td>
</tr>
<tr>
<td>Warning</td>
<td>Description</td>
<td>Possible Cause</td>
<td>Possible Actions</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Electronics Temperature Low</td>
<td>The internal electronics temperature sensor has failed to a low value. The valve may not reach specified performance.</td>
<td>Internal fault.</td>
<td>Replace the valve.</td>
</tr>
<tr>
<td>Fuel Gas Pressure High</td>
<td>The Fuel Gas Pressure value exceeds the fuel gas pressure high warning threshold.</td>
<td>Warning threshold improperly configured.</td>
<td>Configure warning threshold for value appropriate to the application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pressure regulator adjusted too high.</td>
<td>Adjust pressure regulator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Faulty or slow pressure regulator.</td>
<td>Verify proper pressure regulator operation.</td>
</tr>
<tr>
<td>Fuel Gas Pressure Low</td>
<td>The Fuel Gas Pressure value is below the fuel gas pressure low warning threshold.</td>
<td>Warning threshold improperly configured.</td>
<td>Configure warning threshold for value appropriate to the application and the elevation of the site.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improper engine shutdown sequence.</td>
<td>Verify proper engine shutdown sequence.</td>
</tr>
<tr>
<td>Fuel Gas Pressure Sensor High</td>
<td>The Fuel Gas Pressure sensor has failed to a high value. The fuel gas pressure value is derived from the default downstream pressure table instead.</td>
<td>Internal fault.</td>
<td>Replace valve.</td>
</tr>
<tr>
<td>Fuel Gas Pressure Sensor Low</td>
<td>The Fuel Gas Pressure sensor has failed to a low value. The fuel gas pressure value is derived from the default downstream pressure table instead.</td>
<td>Internal fault.</td>
<td>Replace valve.</td>
</tr>
<tr>
<td>Fuel Gas Temperature High</td>
<td>The Fuel Gas Temperature value exceeds the fuel gas temperature high warning threshold.</td>
<td>Warning threshold improperly configured.</td>
<td>Configure warning threshold for value appropriate to the application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel temperature is above warning threshold.</td>
<td>Correct fuel temperature problem.</td>
</tr>
<tr>
<td>Fuel Gas Temperature Low</td>
<td>The Fuel Gas Temperature value is below the fuel gas temperature low warning threshold.</td>
<td>Warning threshold improperly configured.</td>
<td>Configure warning threshold for value appropriate to the application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel temperature is below warning threshold.</td>
<td>Correct fuel temperature problem.</td>
</tr>
<tr>
<td>Fuel Gas Temperature Sensor High</td>
<td>The Fuel Gas Temperature sensor has failed to a high value and the default fuel gas temperature is being used instead.</td>
<td>Internal fault.</td>
<td>Replace valve.</td>
</tr>
<tr>
<td>Warning</td>
<td>Description</td>
<td>Possible Cause</td>
<td>Possible Actions</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fuel Gas Temperature Sensor Low</td>
<td>The Fuel Gas Temperature sensor has failed to a low value and the default fuel gas temperature is being used instead.</td>
<td>Internal fault.</td>
<td>Replace valve.</td>
</tr>
<tr>
<td>Input Voltage High</td>
<td>The battery voltage seen by the valve is above the limit specified in the manual.</td>
<td>Faulty battery or supply.</td>
<td>Check battery or supply for correct operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Faulty or no battery charger.</td>
<td>Check battery charger for correct operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improper wiring.</td>
<td>Check wiring for correct size, length, contacts, fuses.</td>
</tr>
<tr>
<td>Input Voltage Low</td>
<td>The battery voltage seen by the valve is below the limit specified in the manual.</td>
<td>Faulty battery or supply.</td>
<td>Check battery or supply for correct operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Faulty or no battery charger.</td>
<td>Check battery charger for correct operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improper wiring.</td>
<td>Check wiring for correct size, length, contacts, fuses.</td>
</tr>
<tr>
<td>PWM Flow Demand High</td>
<td>The PWM flow demand exceeds the PWM flow demand maximum duty cycle fail limit.</td>
<td>PWM wiring problem.</td>
<td>Check the PWM input wiring for shorts, open connections and intermittent contacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PWM frequency is out of range.</td>
<td>Verify that the PWM frequency from the ECM is within specified limits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PWM duty cycle is out of range.</td>
<td>Ensure that the PWM signal is within the configured range. The service tool displays the PWM frequency, duty cycle, and range limits.</td>
</tr>
<tr>
<td>PWM Flow Demand Low</td>
<td>The PWM flow demand is below the PWM flow demand minimum duty cycle fail limit.</td>
<td>PWM wiring problem.</td>
<td>Check the PWM input wiring for shorts, open connections and intermittent contacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PWM frequency is out of range.</td>
<td>Verify that the PWM frequency from the ECM is within specified limits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PWM duty cycle is out of range.</td>
<td>Ensure that the PWM signal is within the configured range. The service tool displays the PWM frequency, duty cycle, and range limits.</td>
</tr>
</tbody>
</table>
When an error occurs, the valve closes, if possible. It will not attempt to operate again until power to the valve is cycled. If the error persists, the valve must be replaced.

<table>
<thead>
<tr>
<th>Error</th>
<th>Description</th>
<th>Possible Cause</th>
<th>Possible Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutdown</td>
<td>One or more of the errors below is active.</td>
<td>See additional errors listed below.</td>
<td>See additional actions listed below.</td>
</tr>
<tr>
<td>Internal Error</td>
<td>The valve has detected an internal error that prevents it from operating.</td>
<td>High voltage or current spike experienced by the device</td>
<td>Cycle power Or Replace valve</td>
</tr>
<tr>
<td>Delta P Sensor High</td>
<td>The delta P sensor has failed to a high value.</td>
<td>The voltage at the delta P sensor is greater than 4.75 V</td>
<td>Correct voltage Or Replace valve</td>
</tr>
<tr>
<td>Delta P Sensor Low</td>
<td>The delta P sensor has failed to a low value.</td>
<td>The voltage at the delta P sensor is less than 0.25 V</td>
<td>Correct voltage Or Replace valve</td>
</tr>
<tr>
<td>Position Sensor High</td>
<td>The position sensor has failed to a high value.</td>
<td>Indicates that the Valve Position value has exceeded the position sensor's electrical high limit.</td>
<td>Correct voltage Or Replace valve</td>
</tr>
<tr>
<td>Position Sensor Low</td>
<td>The position sensor has failed to a low value.</td>
<td>Indicates that the Valve Position value has exceeded the position sensor's electrical low limit.</td>
<td>Correct voltage Or Replace valve</td>
</tr>
<tr>
<td>Position Error</td>
<td>The actuator was not able to position the valve properly.</td>
<td>Mechanical binding</td>
<td>Remove binding Or Replace valve</td>
</tr>
<tr>
<td>Invalid Harness ID Detected</td>
<td>Harness ID is set to a value other than 2.</td>
<td>Incorrect setting at CAN ID1 (H) and CAN ID2 (G) inputs Or Defective harness or harness connector.</td>
<td>Correct voltages at CAN ID1 (H) and CAN ID2(G) inputs Or Replace harness Or Replace valve</td>
</tr>
<tr>
<td>Invalid Harness ID Detected</td>
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<td>Correct voltages at CAN ID1 (H) and CAN ID2(G) inputs Or Replace harness Or Replace valve</td>
</tr>
</tbody>
</table>
Chapter 6. Service Tool

Overview

The Service Tool software is used to configure, setup, and troubleshoot the TecJet 85 control. This chapter describes the installation and use of the TecJet Service Tool and provides detailed instructions for configuring and setting up the TecJet 85 control for customer-specific applications.

Many TecJet 85 units are delivered pre-configured and calibrated with OEM specific settings. These units do not require the use of the Service Tool. However, the Service Tool is a valuable troubleshooting aid.

Description

The TecJet Service Tool software resides on a PC (personal computer) and communicates to the TecJet 85 control via RS-232 connection.

A breakout harness (1249-1120) is available to provide a convenient DB9 connection for the RS-232 port while maintaining the other connections through the harness.

Installation

The TecJet Service Tool is available at www.woodward.com/software.aspx. Select software product “TecJet Service Tool”. Follow the installation instructions given on that page.

An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.

System Requirements

The following hardware is required to work with the TecJet 85 control:
- PC-compatible laptop or desktop computer
  - Microsoft Windows XP, 2000, Vista, 7 (32 and 64 bit versions)*
  - 300 MHz Pentium CPU
  - 64 MB of RAM
  - Minimum 800 by 600 pixel screen with 256 colors
- Serial Port
- Serial Extension Cable
- Communication/data link harness.

* Due to security enhancements that have been made to the Windows 7 operating system (OS), it is advised that the user have administrative privileges when the PC Service tool is to be installed and run on a PC/Laptop with this OS.
What to do Next

After the software is installed, install the communication harness and connect a straight-through 9-pin serial communications cable between the RS-232 breakout and an unused serial port on your computer. Power must be applied to the TecJet 85 control for the Service Tool to connect.

Run the Service Tool program and, when prompted, select an available com port. This will connect the Service Tool to the TecJet 85 control. Once connected to the control, the Overview screen (Figure 6-2) will open and populate with current values and the status bar will display 'connected'. The TecJet 85 Demand Source and active Control Status messages are also displayed in an area common to all screens.

There is a potential for serial port damage when communicating with the TecJet 85 control. This is caused by a difference in AC voltage between neutral and earth ground. If the PC RS-232 port ground is referenced to AC neutral, and the TecJet 85 control is referenced to battery ground (AC earth ground), a large amount of current can be experienced. To avoid this situation, we strongly recommend placing an isolation transformer between the AC outlet and the PC or run a laptop with the AC power disconnected.

Service Tool Help

Online Service Tool help is available and included with the installation of the Service Tool product. Help can be accessed from the Service Tool 'Help' menu located on the main screen.

Service Tool Security

There are no password security levels provided by the TecJet Service Tool.
Troubleshooting the Driver

The Service Tool has six (6) screens for troubleshooting driver parameters:

- Overview (Figure 6-2)
- Troubleshooting (Figure 6-3)
- Warnings (Figure 6-4)
- Errors (Figure 6-5)
- Configuration (Figure 6-6)
- Identification (Figure 6-7)

Screen Navigation

Service Tool screens can be selected for viewing by clicking the various tabs provided on the main and edit configuration screens.

Overview Screen

The Overview screen is the default screen that opens when connecting the TecJet Service Tool to the TecJet 85 control. The Overview screen displays TecJet 85 flow parameters and the valve position. The status bar, common to all screens, displays the communication, warning and error status. The triangular warning symbol turns yellow with a warning is active. The round error symbol turns red with an error is active.

Figure 6-2. Overview Screen
Gas Flow
Displayed value of the Gas flow in liters per second (L/s).

Flow Demand
Displayed value of the flow demand received via PWM in normal liters per second (n-L/s).

Gas Density
Displayed value of the fuel gas normal density at flowing temperature (FGT) and pressure (FGP) as used by the flow algorithm in grams/cubic meter (g/m³).

Fuel Gas Temperature (FGT)
Displayed value of the inlet fuel gas temperature in degrees Celsius (°C).

Fuel Gas Pressure (FGP)
Displayed value of the inlet fuel gas pressure in millibar absolute (mbar).

ΔP
Displayed value of the valve differential pressure in millibar (mbar).

Valve Position
Displayed value of the valve position in radians (rad).

* CAN Normal Density
Displayed value of the gas specific gravity divided by air density (1290.0) in grams/cubic meter (g/m³). CAN. Displayed for modes: EGS-1, GECM, EGS-2, CANopen, CANopen PWM.

* Can Gas K Factor (ratio of specific heats)
Displayed value of the fuel gas ratio of specific heats used by the flow algorithm and configured via CAN. Displayed for modes: EGS-2, CANopen, CANopen PWM.

Troubleshooting Screen
Select the Troubleshooting tab to view general TecJet 85 control parameters.

Electronics Temperature
Displayed value of the electronics temperature sensor in degrees Celsius.

Coil Current
Displayed value of the estimated actuator coil current in amperes.

Input Supply
Displayed value of the input power in volts.

Running Hours
Displayed value of the running hours.

Reset Running Hours
To reset the running hours to zero, click the ‘Reset Running Hours’ button.

Keyswitch Input Status
Displayed status of the keyswitch input. Value is active or inactive.

PWM Frequency
Displayed value of the measured PWM frequency in hertz.
Figure 6-3. Troubleshooting Screen

**PWM Duty Cycle**
Displayed value of the measured PWM duty cycle in percent.

**CAN Status**
Displayed value of the CAN status (e.g., error passive, stuff error, etc.).

**Reset CAN Status**
To clear the displayed CAN status, click the ‘Reset CAN Status’ button.

**CAN Id**
Displayed value of the CAN identification number. Value is 1, 2, 3 or 4.

**CAN Rx Error Count**
Displayed value of the CAN receive error counter.

**CAN Tx Error Count**
Displayed value of the CAN transmit error counter.
Warnings Screen

Select the Warnings tab to view TecJet 85 active or previously active warning conditions. Warnings indicate a problem has occurred that needs attention but the valve attempts continued operation. This screen dynamically populates based on the TecJet 85 configuration. If a function is not programmed, then it will not appear. A Reset Warnings button is provided to clear inactive warnings.

![Warnings Screen Image]

Figure 6-4. Warnings Screen

**IMPORTANT** Refer to Troubleshooting, Chapter 6, for a description of each displayed Warning plus possible causes and remedial actions.
Errors Screen

Select the Errors tab to view active TecJet 85 error conditions. Errors indicate a serious problem has occurred and the valve is not able to operate. This screen dynamically populates based on the TecJet 85 configuration. If a function is not programmed, then it will not appear.

**Shutdown**
Indicates the valve is closed or attempting to close due to a detected error.

**Internal Fault**
Indicates an internal fault has occurred that prevents normal operation of the valve.

**ΔP Sensor High**
Indicates the Delta Pressure value has exceeded the delta pressure sensor's electrical high limit threshold.

**ΔP Sensor Low**
Indicates the Delta Pressure value has exceeded the delta pressure sensor's electrical low limit threshold.

**Position Sensor High**
Indicates that the Valve Position value has exceeded the position sensor's electrical high limit threshold.

![Errors Screen](image-url)
Position Sensor Low
Indicates that the Valve Position value has exceeded the position sensor's electrical low limit threshold.

Position Error
Indicates the position feedback is not following the position demand. Position Error detection logic is designed to account for normal actuator response times to prevent unwarranted position error indications during transient conditions.

**IMPORTANT** The TecJet 85 valve will not attempt to operate again, following a detected error, until power to the valve is cycled. If an error persists, the valve must be replaced.

**Configuration Screen**
Select the Configuration tab to view the TecJet 85 configuration. This screen dynamically populates based on the existing TecJet 85 configuration. If a function is not programmed, then it will not appear. The configuration settings are grouped into 4 or 5 sub-screens. Select a sub-tab to view the configuration settings for that group.

Figure 6-6. Configuration Screen
Identification Screen

Select the Identification tab to view TecJet 85 identification information.

![Identification Screen](image)

**Figure 6-7. Identification Screen**

**Software Part Number**
Displayed software part number and revision letter.

**Serial Number**
Displayed TecJet 85 valve serial number.

**Hardware Part Number**
Displayed TecJet 85 valve part number and revision letter.

**Configuring the Driver**

The Service Tool has six (6) screens for editing the driver configuration:
- Edit TecJet Configuration, General (Figure 6-8)
- Edit TecJet Configuration, Flow (Figure 6-9)
- Edit TecJet Configuration, Failed Sensor Defaults (Figure 6-10)
- Edit TecJet Configuration, Filters (Figure 6-11)
- Edit TecJet Configuration, CAN (Figure 6-12a/b)
Edit Configuration

To change the TecJet 85 configuration, click the Edit Configuration button on the Configuration screen (see Figure 6-6).

This opens an Edit TecJet Configuration screen, (e.g., Figure 6-8), to permit driver configuration setting changes. The configuration settings are provided in a common area of the Edit TecJet Configuration screen and on several tabbed screens.

**IMPORTANT**

Configuration changes will not take effect until they are loaded to the control. Review ALL settings shown on ALL tabbed Edit TecJet Configuration screens to verify all configuration settings are correct before loading the settings to the control.

Edit TecJet Configuration, General

This is an edit screen for general control configuration settings. To change a value, highlight the value and type the desired value. The status bar displays the valid adjustable range for the highlighted value.

![Edit TecJet Configuration, General](image)

Figure 6-8. Edit TecJet Configuration, General
**Low Temperature**
Sets the temperature, in ºC, which triggers a Fuel Gas Temperature Low warning indication.
Adjustable range: -40 to 25º C

**High Temperature**
Sets the temperature, in ºC, which triggers a Fuel Gas Temperature High warning indication.
Adjustable range: 25 to 90º C

**Low Pressure**
Sets the pressure, in millibar, which triggers a Fuel Gas Pressure Low warning indication.
Adjustable range: 0 to 1600 mbar

**High Pressure**
Sets the pressure, in millibar, which triggers a Fuel Gas Pressure High warning indication.
Adjustable range: 0 to 1600 mbar

**Low ΔP**
Sets the differential pressure, in millibar, which triggers a ΔP Low warning indication.
Adjustable range: 0 to 1600 mbar

**High ΔP**
Sets the pressure, in millibar, which triggers a ΔP High warning indication.
Adjustable range: 0 to 1600 mbar

**K**
Sets the ratio of specific heats.
Adjustable range: 1.0 to 2.0

**Denisty**
Sets the gas density.
Adjustable range: 400.0 to 2600.0

**Edit TecJet Configuration, Flow**

This screen provides for editing the Flow configuration settings used by the control. To change a value, highlight the value and type the desired value. The status bar displays the valid adjustable range for the highlighted value.

**PWM Duty Cycle Minimum**
Sets the PWM duty cycle, in percent, which triggers a PWM Flow Demand Low warning.
Adjustable range: 2-50 %

**PWM Duty Cycle Maximum**
Sets the PWM duty cycle, in percent, which triggers a PWM Flow Demand High warning.
Adjustable range: 50–98%
Scaling
Sets the low and high values for scaling the PWM demand source versus fuel flow. The duty cycle range set by the scaling/low/duty cycle and scaling/high/duty cycle settings will cause the TecJet 85 valve to deliver the corresponding fuel flow set by the scaling/low/flow and scaling/high/flow settings. Intermediate values are linearly interpolated between these low and high settings.

- **Scaling, Duty Cycle, Low**
  Sets the PWM duty cycle, which corresponds to the Low Flow setting.
  Adjustable range: 5-95 %

- **Scaling, Duty Cycle, High**
  Sets the PWM duty cycle, which corresponds to the High Flow setting.
  Adjustable range: 5-95 %

- **Scaling, Flow, Low**
  Sets the flow, in kg/hour, for the corresponding Low Duty Cycle setting.
  Adjustable range: 0–2000 n-LI/s (normal liters per second)

- **Scaling, Flow, High**
  Reports the flow, in kg/hour, for the corresponding High Duty Cycle setting.
  Adjustable range: 0–2000 n-LI/s (normal liters per second)

- **CAN Flow Demand Time Out**
  Determines the timeout period for the Flow Demand Failed warning.
  Adjustable range: 10 to 10,000 ms. Only available in modes: Jenbacher CAN, EGS-1, EGS-2
Edit TecJet Configuration, Failed Sensor Defaults

This screen provides for editing the Failed Sensor Default configuration settings used by the control in the event a sensor input fails. To change a value, highlight the value and type the desired value. The status bar displays the valid adjustable range for the highlighted value.

<table>
<thead>
<tr>
<th>General</th>
<th>Flow</th>
<th>Failed Sensor Defaults</th>
<th>Filters</th>
<th>CAN</th>
</tr>
</thead>
</table>

**Fuel Gas Temperature Sensor**

Default Temperature: 23.0 °C

**Fuel Gas Pressure Sensor**

Default Downstream Pressure:

<table>
<thead>
<tr>
<th>Flow Demand (NL/s)</th>
<th>FGP-ΔP (mbar abs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>58.0</td>
</tr>
<tr>
<td>3</td>
<td>116.0</td>
</tr>
<tr>
<td>4</td>
<td>174.0</td>
</tr>
</tbody>
</table>

Figure 6-10. Edit TecJet Configuration, Failed Sensor Defaults

**Default Temperature**

Sets the temperature, in °C, the control will use to continue operation upon failure of the fuel gas temperature sensor.

Adjustable range: 0 to 60 °C

**Default Downstream Pressure**

This sets an estimated pressure, in millibar absolute, that the control will use to continue operation upon failure of the fuel gas pressure sensor.

Estimate is based on a 4-point curve of the flow demand, in normal liters/second, versus default downstream pressure, in millibar absolute.

(Estimated FGP = Default Downstream Pressure + ΔP).

- **Flow Demand [1-4]**
  
  Sets the flow demand [1-4], in normal liters/second, which corresponds to the default downstream pressure setting.

  Adjustable range: 0–2000 L/s (normal)

- **FGP- ΔP [1-4]**

  Sets the default downstream pressure [1-4], in mbar abs, for the corresponding flow demand [1-4] settings.

  Adjustable range: 0–2000 mbar abs
Edit TecJet Configuration, Filters

This screen provides for editing various input signal filter configuration settings. To change a value, highlight the value and type the desired value. The status bar displays the valid adjustable range for the highlighted value. The filters are provided for system troubleshooting purposes, and should be set to 0 in normal applications.

![Figure 6-11. Edit TecJet Configuration, Filters](image)

**ΔP Filter Time Constant**
Sets the Delta P sensor time constant. There is a single-pole lag between the delta P sensor and the flow algorithm.
Adjustable range: 0 to 5 sec

**Fuel Gas Pressure Filter Time Constant**
Sets the Fuel Gas Pressure sensor time constant. There is a single-pole lag between the fuel gas pressure sensor and the flow algorithm.
Adjustable range: 0 to 5 sec

**Fuel Gas Temperature Filter Time Constant**
Sets the Fuel Gas Temperature sensor time constant. There is a single-pole lag between the fuel gas temperature sensor and the flow algorithm.
Adjustable range: 0 to 5 sec

**Flow Demand Filter Time Constant**
Sets the Flow Demand time constant. There is a single-pole lag between the flow demand value and the flow algorithm.
Adjustable range: 0 to 5 sec
Edit TecJet Configuration, CAN

This screen provides for editing CAN communication configuration settings. To select a 'Default' or 'User Configured' baud rate, click the radio button adjacent to the each choice.

![Figure 6-12a. Edit TecJet Configuration, CAN (Default)](image)

**Baud Rate, Default**
Sets the default baud rate of the CAN communication in kbps.
Adjustable range: 10, 50, 100, 125, 250, 500, or 1000 kbps.

![Figure 6-12b. Edit TecJet Configuration, CAN (User Configured)](image)

**Baud Rate, User Configured**
Provides user settings for more flexible control of the CAN parameters. This option should be used by advanced users only. The baud rate of the CAN communication is calculated from these settings as follows:

\[
\text{Baud Rate} = \frac{40E6}{[(\text{BRP} + 1) \times (\text{TSEG1} + \text{TSEG2} + 1)]}
\]

- **Baud Rate Prescaler (BRP)**
  Sets the baud rate prescaler in the CAN controller.
  Adjustable range: 0–255

- **TSEG01**
  Sets the Tseg1 value in the CAN controller. Tseg1 combines the PROP_SEG and PHASE_SEG1 segments of the CAN protocol.
  Adjustable range: 3–16

- **TSEG02**
  Sets the Tseg2 value in the CAN controller. Tseg2 defines the PHASE_SEG2 segment of the CAN protocol.
  Adjustable range: 2–8

- **Synchronization Jump Width**
  Determines the synchronization jump width in the CAN controller.
  Adjustable range: 1–4
Review ALL settings shown on ALL tabbed Edit TecJet Configuration screens to verify that all configuration settings are correct before loading settings to the control. Configuration changes do not take effect until they are loaded to the control.

To load the configuration changes to the TecJet 85 control, click the ‘OK’ button on the Edit TecJet Configuration screen (Figure 6-13). A Loading Configuration message will appear to verify the configuration settings are being loaded to the control. The Edit TecJet Configuration screen closes after the settings are loaded.

Click the ‘Cancel’ button to exit the Edit TecJet Configuration screen without saving the configuration changes to the control. A message will appear asking for verification that the configuration changes are not to be saved to the control.
Chapter 7.
Maintenance

General

Build-up of deposits near the metering area of the TecJet 85 can develop depending on the quality of the gas being metered. This build-up can affect the performance of the TecJet and may appear as degradation of actual flow vs command flow accuracy, or as flow control instability.

Limits of Applicability

Periodic cleaning may be needed to ensure the best operation of the TecJet. It is the customer's responsibility to monitor the need for valid scheduled maintenance, as this will vary depending on the quality of the gas in the particular application.

The procedure below has been tested and validated for a particular gas environment (mineral deposits); the applicability to other gaseous environment needs to be validated by the OEM at the customer site.

Cleaning Procedure

When cleaning the metering element and the inside of the valve body, do not use sharp objects that may scrape or dent the metering elements, as this could degrade the accuracy of the valve. Any damage to the internal geometry of the TecJet, especially the valve plate or bore area around the valve plate, will change the calibration of the valve and void the warranty. High pressure washing is not recommended. There are no components of the TecJet that are replaceable or serviceable. Make sure that the power is disconnected before removing the TecJet 85 main connector.

A petrochemical solvent is recommended to clean (wash and brush) the valve when minimal film/patina build up is observed.

In applications where solids (mineral deposits) are found in the gas, the following procedure should be used (this procedure can be performed at the site):

- Position the TecJet in the fully open position.
- Place a plugged piece of tubing over the P1 probe to completely seal the probe.
- Place a plug in the P2 port to completely seal it.
- Cap/seal the inlet flange of the TecJet.
- Fill the TecJet with a solution of 60 °C water and 2 tablespoons of Dawn (or equivalent) dishwashing detergent.
- Cap/seal the outlet flange of the TecJet.
- Leave soap solution in the TecJet for 24 to 30 hours.
- Remove the cap/seal on the outlet flange of the TecJet.
- Dump the soap solution out of TecJet.
- Fill the TecJet with fresh 60 °C tap water and move the water around in the valve bore with a long plastic rod or equivalent.
- Dump the rinse water out of the TecJet.
- Fill the TecJet again with fresh 60 °C tap water and move the water around in the valve bore with a long plastic rod or equivalent.
- Dump the rinse water out of the TecJet.
- Remove the cap/seal on the inlet flange of the TecJet.
- Inspect the valve plate and bore area around the valve plate for any remaining contamination.
- Use a soft plastic brush, or equivalent, to gently remove any remaining contamination and rinse with tap water as necessary.
- Remove the tubing from the P1 probe.
- Remove the plug from the P2 port.
- Leave the valve bore open to air until completely dry.
- If contamination has been successfully removed, return the valve to service.
- If contamination still exists on the valve plate and/or bore area around the valve plate, the unit will need to be replaced with a new unit.
Chapter 8.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:
1. Consult the troubleshooting guide in the manual.
2. Contact the OE Manufacturer or Packager of your system.
3. Contact the Woodward Business Partner serving your area.
4. Contact Woodward technical assistance via email (EngineHelpDesk@Woodward.com) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A Full-Service Distributor has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An Authorized Independent Service Facility (AISF) provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A Recognized Engine Retrofitter (RER) is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at www.woodward.com/directory.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture
Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in “like-new” condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.
Engineering Services

Woodward’s Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

**Technical Support** is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward’s worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

**Product Training** is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

**Field Service** engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at [www.woodward.com/directory](http://www.woodward.com/directory).

**Contacting Woodward’s Support Organization**

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at [www.woodward.com/directory](http://www.woodward.com/directory).

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

### Products Used In Electrical Power Systems

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<tr>
<td>China</td>
<td>+86 (512) 6762 6727</td>
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<td>Germany:</td>
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<tr>
<td>Kempen</td>
<td>+49 (0) 21 52 14 51</td>
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<td>Stuttgart</td>
<td>+49 (711) 78954-510</td>
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<tr>
<td>India</td>
<td>+91 (129) 4097100</td>
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<tr>
<td>Japan</td>
<td>+81 (43) 213-2191</td>
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<tr>
<td>Korea</td>
<td>+82 (51) 636-7080</td>
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<tr>
<td>Poland</td>
<td>+48 12 295 13 00</td>
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<tr>
<td>United States</td>
<td>+1 (970) 482-5811</td>
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### Products Used In Engine Systems

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<td>Germany</td>
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<td>Japan</td>
<td>+81 (43) 213-2191</td>
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<tr>
<td>Korea</td>
<td>+82 (51) 636-7080</td>
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<tr>
<td>The Netherlands</td>
<td>+31 (23) 5661111</td>
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<tr>
<td>United States</td>
<td>+1 (970) 482-5811</td>
</tr>
</tbody>
</table>

### Products Used In Industrial Turbomachinery Systems

<table>
<thead>
<tr>
<th>Facility</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>+55 (19) 3708 4800</td>
</tr>
<tr>
<td>China</td>
<td>+86 (512) 6762 6727</td>
</tr>
<tr>
<td>India</td>
<td>+91 (129) 4097100</td>
</tr>
<tr>
<td>Japan</td>
<td>+81 (43) 213-2191</td>
</tr>
<tr>
<td>Korea</td>
<td>+82 (51) 636-7080</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>+31 (23) 5661111</td>
</tr>
<tr>
<td>Poland</td>
<td>+48 12 295 13 00</td>
</tr>
<tr>
<td>United States</td>
<td>+1 (970) 482-5811</td>
</tr>
</tbody>
</table>

For the most current product support and contact information, please visit our website directory at [www.woodward.com/directory](http://www.woodward.com/directory).
Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

<table>
<thead>
<tr>
<th><strong>General</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Your Name</td>
<td></td>
</tr>
<tr>
<td>Site Location</td>
<td></td>
</tr>
<tr>
<td>Phone Number</td>
<td></td>
</tr>
<tr>
<td>Fax Number</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Prime Mover Information</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Engine Model Number</td>
<td></td>
</tr>
<tr>
<td>Number of Cylinders</td>
<td></td>
</tr>
<tr>
<td>Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.)</td>
<td></td>
</tr>
<tr>
<td>Power Output Rating</td>
<td></td>
</tr>
<tr>
<td>Application (power generation, marine, etc.)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Control/Governor Information</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Control/Governor #1</td>
<td></td>
</tr>
<tr>
<td>Woodward Part Number &amp; Rev. Letter</td>
<td></td>
</tr>
<tr>
<td>Control Description or Governor Type</td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
</tbody>
</table>

| Control/Governor #2 |  |
| Woodward Part Number & Rev. Letter |  |
| Control Description or Governor Type |  |
| Serial Number |  |

| Control/Governor #3 |  |
| Woodward Part Number & Rev. Letter |  |
| Control Description or Governor Type |  |
| Serial Number |  |

| **Symptoms** |  |
| Description |  |

*If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.*
Revision History

Changes in Revision A—

- Updated Regulatory Compliance section
- Added new Declaration of Conformity and Declaration of Incorporation
DECLARATION OF CONFORMITY

EU DoC No.: 00244-04-EU-02-02
Manufacturer’s Name: WOODWARD, INC.
Manufacturer’s Contact Address: 3800 Wilson Avenue
Loveland, CO 80538 USA
Model Name(s)/Number(s): TecJet 50 Plus, TecJet 85, TecJet 110, High Pressure TecJet
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:

Applicable Standards:
- EN61000-6-4, 2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments
- EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

This declaration of conformity is issued under the sole responsibility of the manufacturer. We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Christopher Perkins
Full Name
Engineering Manager
Position
Woodward, Fort Collins, CO, USA
Place
Date

05 - APR - 2016
DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC

File name: 00244-04-EU-02-03
Manufacturer’s Name: WOODWARD INC.
Manufacturer’s Address: 3800 Wilson Ave.
Loveland, CO 80538 USA

Model Names: TecJet 50 Plus, TecJet 85, TecJet 110, High Pressure TecJet

This product complies, where applicable, with the following
Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

The person authorized to compile the technical documentation:

Name: Dominik Kanin, Managing Director
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepołomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward Inc. of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

[Signature]

Christopher Perkins
Full Name
Engineering Manager
Position
Woodward Inc., Fort Collins, CO, USA
Place
Date

Document: 5-09-1182 (rev. 16)
We appreciate your comments about the content of our publications.
Send comments to: icinfo@woodward.com
Please reference publication 26701B.