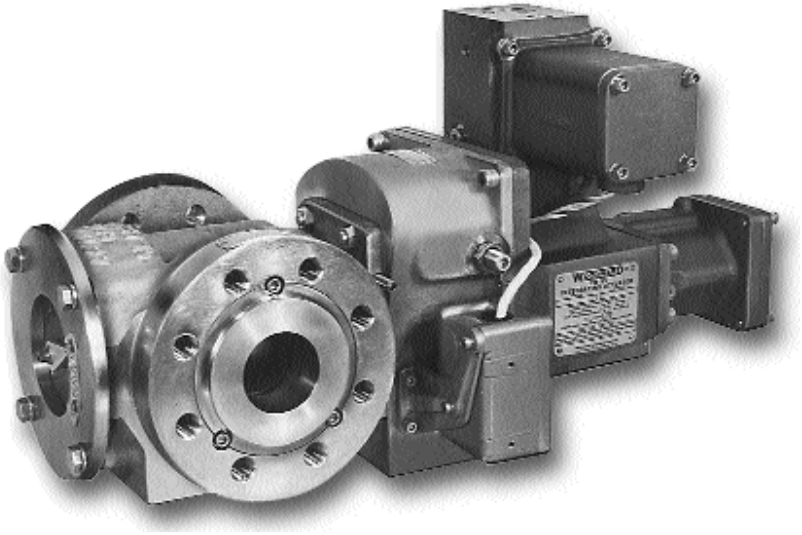
WOODWARD

**Product Manual 40104**
**(Revision F)**
**Original Instructions**



# 3103 Gas Valve with TM-55P Actuator

## Installation and Operation Manual

**General Precautions**

**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.**

**Revisions**

**This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:**

**www.woodward.com/publications**

**The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.**

**Proper Use**

**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.**

**Translated Publications**

**If the cover of this publication states "Translation of the Original Instructions" please note:**

**The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

# Contents



# Illustrations and Tables

# Warnings and Notices

## 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.

**⚠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.**

**NOTICE**

**Battery Charging Device**

**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

**NOTICE**

**Electrostatic Precautions**

**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.

# Chapter 1.
# General Information

## Description

The 3103 gas valve is installed with an adapter to a Woodward TM-55P proportional actuator which receives position commands from an electric control.

The 3103 gas valve is a stainless steel valve capable of metering 23 to 18 144 kg/hr (50 to 40 000 lb/hr) of gas. The valve is a rotary sleeve and shoe type throttling valve. Metering port area is determined by input shaft positioning from the actuator. The valve is spring loaded in the minimum fuel direction.

Valve design incorporates an inlet guide tube directing gas contaminants through the metering port to minimize accumulation in the valve housing. Metering sleeve support bearings are positively sealed from the gas. Internal parts are through hardened stainless steel.

The TM-55 actuator is an electrohydraulic proportional actuator for industrial gas turbine control applications. It is designed for use with all Woodward electronic controls. the TM-55 has an aluminum case with through hardened stainless steel internal parts.

In the actuator, a torque motor servovalve is energized by the electric control to generate a pressure differential applied to the ends of, and to operate, the second stage spool valve. supply pressure is regulated by the spool valve to move a double acting servo piston and provide terminal shaft output. Internal mechanical feedback is standard in the TM-55P actuator. An optional electrical position feedback transducer can be installed at assembly. The actuator is factory adjusted for bias in the minimum fuel direction in the event of a loss of input current.

Hydraulic fluid is sealed from the torque motor by a preformed packing ring between the armature and the servovalve housing, eliminating the accumulation of magnetic contaminants. The hydraulic inlet fitting incorporates a 70 µm absolute filter for additional protection from contaminants in the event of an upstream filter failure.

## References

See also Woodward product specification 40106.

# Chapter 2.
# Installation

## Introduction

Use care while handling and installing the valve/actuator. Abuse can damage seals, installation surfaces, and factory adjustments. Hydraulic and gas connections must be protected by plastic shipping caps or covers whenever the valve/actuator is not connected to the normal piping.

**⚠WARNING**

**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.**

## Receiving

The TM-55 actuator is calibrated and drained of calibration fluid at the factory. It is then placed in a cardboard container filled with urethane foam for delivery to the customer. Additional cleaning or calibration is not necessary before installation or operation.

## Storage

The valve/actuator may be stored as received from the factory for a period of time before installation.

## Installation

See the outline drawing, Figure 2-1, for:

- overall dimensions
- installation hole locations
- hydraulic fitting sizes
- output shaft dimensions
- adjustment locations
- electrical connections

Installation attitude does not affect actuator performance.

Make provisions for proper filtration of the hydraulic fluid that is to be supplied to the TM-55 actuator. Woodward recommends that a 10 µm (nominal) filter be installed in the supply line to the actuator. Hydraulic cleanliness must always be maintained at ISO 4406 20/18/15 or better to ensure proper operation. Care must be taken to keep the immediate area clean and free of dirt and other contaminants.

Make all hydraulic connections that are needed. Supply pressure for the TM-55 actuator can be from either positive displacement or centrifugal type pumps. Woodward recommends the use of a pressure switch to ensure that correct supply pressure is established prior to start-up and continually thereafter.

Make all electrical connections that are required using applicable Woodward electric control manuals. A plant wiring diagram will be supplied upon request. In applications where the TM-55 actuator is not used with a Woodward electric control, electrical input requirements will also be supplied upon request.

There are two overboard drains on the 3103 valve (see Figure 2-1). One is to be plumbed to an area outside the turbine enclosure. Use the overboard drain most convenient for your installation, and plug the one that is not used (DO NOT plug both drains). This drain vents the cavities between the inner and outer seals on both ends of the valve shaft.

Woodward recommends that the end of the line (outside the enclosure) be placed in a small container of clean, lightweight oil to check for gas leakage. This will also prevent a corrosive or salt air atmosphere from corroding the shaft bearings which are in the cavity between the shaft seals.

## 3103 Metered Gas Supply

**Gas Supply Characteristics**

| | |
|---|---|
| Metered Fuel Types: | Natural, propane, ethane, methane service |
| Specific Gravity: | 0.5 to 1.05 |
| Temperature: | –40 to +149 °C (–40 to +300 °F) |
| Contaminants: | <10 µm diameter 30 ppm by volume max |
| (solid particles) | >10 µm diameter 0.3 ppm by volume max |

**Gas Flow Requirements**

| | |
|---|---|
| Inlet Pressure: | 5861 kPa (850 psig) maximum |
| Pressure Differential: | 172 to 5861 kPa (25 to 850 psig) |
| Gas Flow Range: | 23 to 18 144 kg/hr (50 to 40 000 lb/hr) (0.6 sp gr)* |

* Maximum flow capacity is dependent upon available gas conditions.

## TM-55 Hydraulic Fluid Requirements

**TM-55 Supply Characteristics**

| | |
|---|---|
| Fluid Types: | Mineral or synthetic based oil, diesel fuels, kerosenes, gasolines, or light distillate fuels |
| Specific Gravity: | 0.6 to 1.0 |
| Recommended Viscosity: | 0.6 to 400 centistokes |
| External Filter: | 10 µm nominal |
| Hydraulic Cleanliness Level: | ISO 4406 20/18/15 minimum |
| Supply Pressure: | Any nominal level between 2758 and 8274 kPa (400 and 1200 psig) |

**TM-55 Flow Requirements**

| Supply Pressure | Steady State Flow | Max. Transient Flow |
|---|---|---|
| 2758 kPa<br>400 psig | 1.1 L/min<br>0.3 US gal/min | 9.5 L/min<br>2.5 US gal/min |
| 6895 kPa<br>1000 psig | 1.9 L/min<br>0.5 US gal/min | 10.2 L/min<br>2.7 US gal/min |

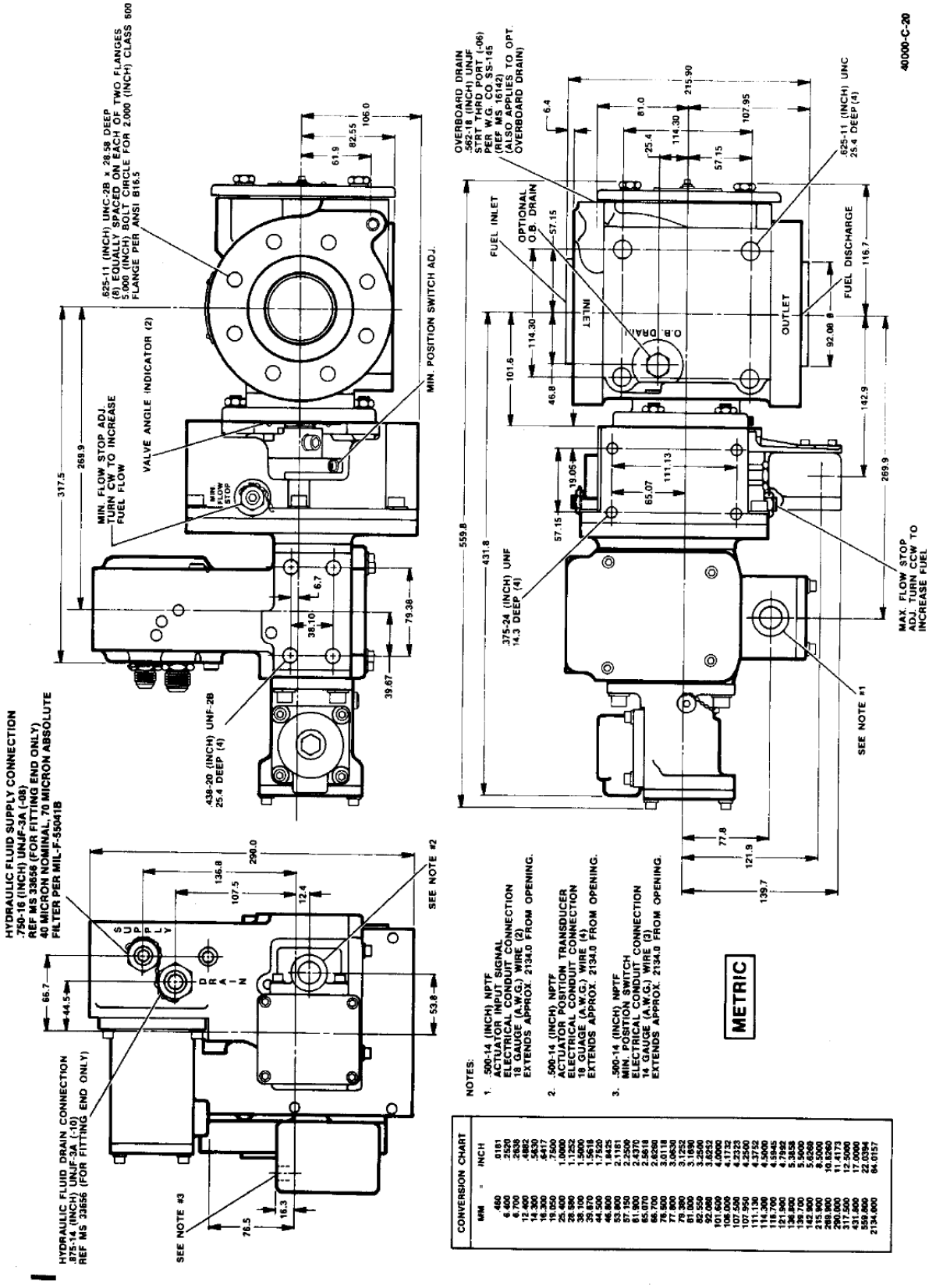



Figure 2-1. Outline Drawing, 3103 Gas Valve With TM-55P Actuator

# Chapter 3.
# Operation and Adjustments

## Initial Operation

Before initial operation of the valve/actuator, check that all previous installation and hookup steps are successfully accomplished, that all electrical connections, and hydraulic and gas fittings are secure and properly attached.

Make certain that correct hydraulic supply pressure to the actuator is established before start-up. Trapped air within the hydraulic system may cause erratic behavior of the actuator during the first few minutes of initial operation. Use applicable Woodward manuals for the particular Woodward electric control to begin prime mover operation.

Woodward recommends adequate Dither be used on all hydraulic actuators to minimize mA threshold and hysteresis which can result from second stage static friction or hydraulic contamination.

Dither is a low amplitude, relatively high frequency periodic signal that is superimposed on the servovalve input current signal. A typical dither signal generated by a Woodward control is: 25 Hz, 0–10 mA (tunable) amplitude, 25% duty cycle, bipolar, square wave.

Adequate Dither is defined as that amount which produces no more than 0.013 mm (0.0005 inch) total oscillation in output shaft position.

**⚠WARNING**

**When first starting the prime mover equipped with the Woodward 3103 Gas Valve/TM-55P Actuator, be prepared to initiate an emergency shutdown in the event of electric control, actuator, valve, linkage, or prime mover failure.**

## Adjustments

Normally, all operating adjustments are made to the 3103 Gas Valve/TM-55P Actuator during factory calibration according to specifications provided by the customer, and should not require further adjustment. Do not attempt adjustments to the actuator unless thoroughly familiar with the proper procedures.

Null current shifts of up to ±4% of maximum rated current (200 mA) can occur due to variations in the following parameters: hydraulic supply and return pressures, hydraulic fluid temperature, servovalve and actuator wear.

Due to the inherent null shifts and position drift of all hydraulic servovalves and proportional actuators, engine control applications must be designed with these errors in mind.

# Chapter 4.
# Principles of Operation

## TM-55 Proportional Actuator

(See Figure 4-1.)

The TM-55P Actuator consists of three basic sections:

- A torque motor servovalve
- A spring centered, four land spool valve
- A double-sided, equal area servo piston linked to the rotary output shaft

The essential element of the TM-55P is the torque motor servovalve which uses a double nozzle and flapper to generate a differential pressure to operate the second stage spool valve. The torque motor received dc current signals from the electric control and applies torque to the single piece armature and flapper which is supported on a torsion flexure. The servovalve uses the flapper as a variable flow restrictor and throttles the flow of hydraulic fluid from a nozzle on each side of the flapper. The two nozzles are supplied hydraulic fluid from the actuator supply pressure inlet via separate, fixed orifices. Differential pressures caused by flapper movement between the nozzles are applied to the ends of the spool valve. During steady state operation, the flapper is centered between the nozzles and the two pressures, Pc1 and Pc2, are approximately equal.

When input current is increased to the torque motor coil, the limited pivotal movement of the flapper to increase (clockwise on the schematic) restricts hydraulic flow from the upper nozzle while flow from the lower nozzle increases. The resulting differential pressure is applied to the ends of the spool valve, lowering it from its spring centered null position.

When lowered, the spool valve directs supply pressure to the top side of the servo piston and, simultaneously, vents the underside to drain at the lower control port. the servo piston then moves down, and through a linkage to the output shaft, increases actuator output position. Servo piston movement also provides position feedback to the servovalve.

An extension of the flapper is held between the feedback spring and level adjusting spring. Increasing servo piston movement increases the feedback spring torque load on the flapper to re-center it. when a force balance is obtained between the torque motor and level adjusting spring and the feedback spring the spool valve is re-centered and further servo movement is halted.

Operation of the actuator is similar in the decrease direction. Movement of the flapper restricts flow from the lower nozzle, while increasing flow of the upper nozzle. The pressure differential this time lifts the spool valve and uncovers ports to direct supply pressure to decrease actuator output position. The re-centering action is provided as servo piston movement decreases compression of the upper spring, the lower spring creates torque to re-center the flapper.

## 3103 Gas Valve and Adapter

Actuator output shaft movement positions the gas valve metering sleeve through a two lever coupling assembly housed within the adapter. the coupling provides a velocity ration to match the different rotary travel strokes of the actuator (45°) with the gas valve (60°).

Gas flow is metered at the valve through a ported rotary sleeve. Gas enters the inlet port (P1) where it is directed through the inlet guide tube to the rotary sleeve metering port. A spring loaded, sharp edged shoe seals against the sleeve. Metered fuel is discharged at the outlet (P2).

## 3103 Compliance to the NACE Standard

This report is in response to inquiries regarding compliance of the 3103 gas valve to NACE standard MR0175-84 item no. 53024 "Material Requirements, Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment". In the course of this study, there were four components found that would be in contact with the gas when the valve is operating that did not conform to the material selection guidelines. However, per paragraph 1.3 of the Standard: “Fluids containing water as a liquid and hydrogen sulfide are considered sour environments and may cause SSC (sulfide stress cracking) of susceptible materials. This phenomenon is affected by complex interactions of parameters including:

- Metal composition, strength, heat treatment, and microstructure.
- pH
- Hydrogen sulfide concentration and total pressure
- Total tensile stress
- Temperature
- Time

The user must determine the environmental conditions in which the metallic materials are to meet the requirements of this Standard. The following guidelines are offered to assist the user in making this judgment.

Tensile stress is required to cause sulfide stress cracking. In addition, there is a stress limit below which SSC will not occur. As SSC is a complex phenomenon, this limit is difficult, if not impossible, to determine. For this reason the stress limits for metallic components are not published in the Standard.

The Woodward 3103 gaseous fuel metering valve was originally designed with dirty, sour gas environments in mind. The demonstrated reliability of the 3103 is estimated at more than 120 000 MTBF. Many of these valves are in service metering "sour" gas and we have never seen SSC failures of the components in question. This suggests that the parts that do not conform to the material selection guides are not subjected to stress levels high enough to initiate sulfide stress cracking. Since, "The guidelines and specific requirements in this Standard are based on satisfactory field experience and/or laboratory data", the 3103 field experience and reliability suggests that the valve is suitable for most gas metering service applications involving gas turbines.

The components that do not conform to the material selection guides in the NACE standard are:

| | | | |
|---|---|---|---|
| 1223-827 | PLUG- EXPANSION | 416 SST | HRC 20-34 |
| 3161-085 | PIN | 17-4 PH SST C H1050 | HRC 33-40 |
| 3400-075 | SLEEVE- METERING | 17-4 PH SST C H1050 | HRC 33-40 |
| 3550-055 | SHOE- METERING | 17-4 PH SST C H1025 | HRC 35-42 |

All other parts in the assembly conform to the Standard or are isolated from the gas in normal operation. 3161-085 is a guide pin for the metering shoe and only serves as an assembly aid. When the valve is in operation, this pin has no tensile load. The remaining parts are all subjected to some form of tensile loading. See attached piece part and assembly drawings.

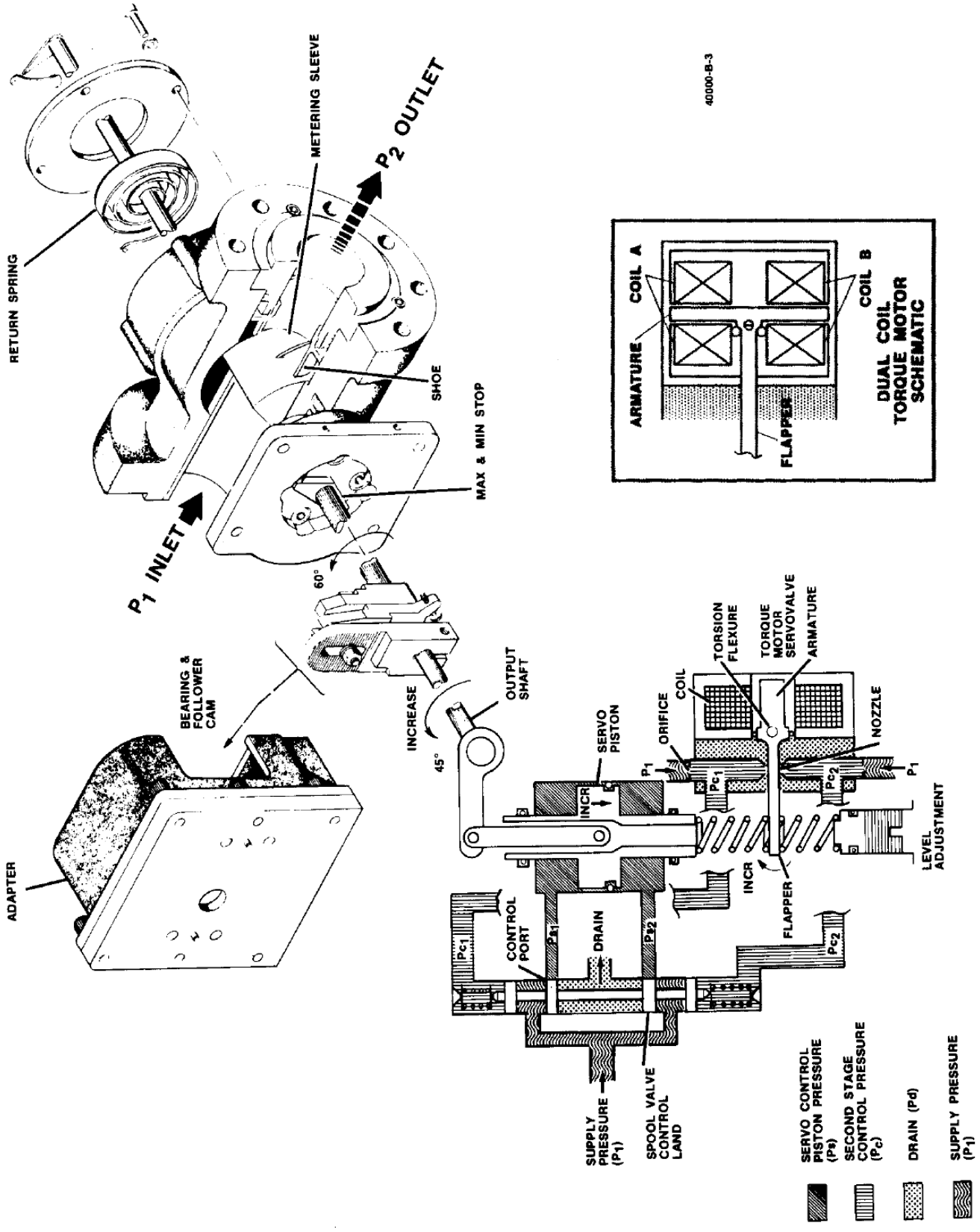



Figure 4-1. Schematic Drawing, 3103 Gas Valve with TM-55P Actuator

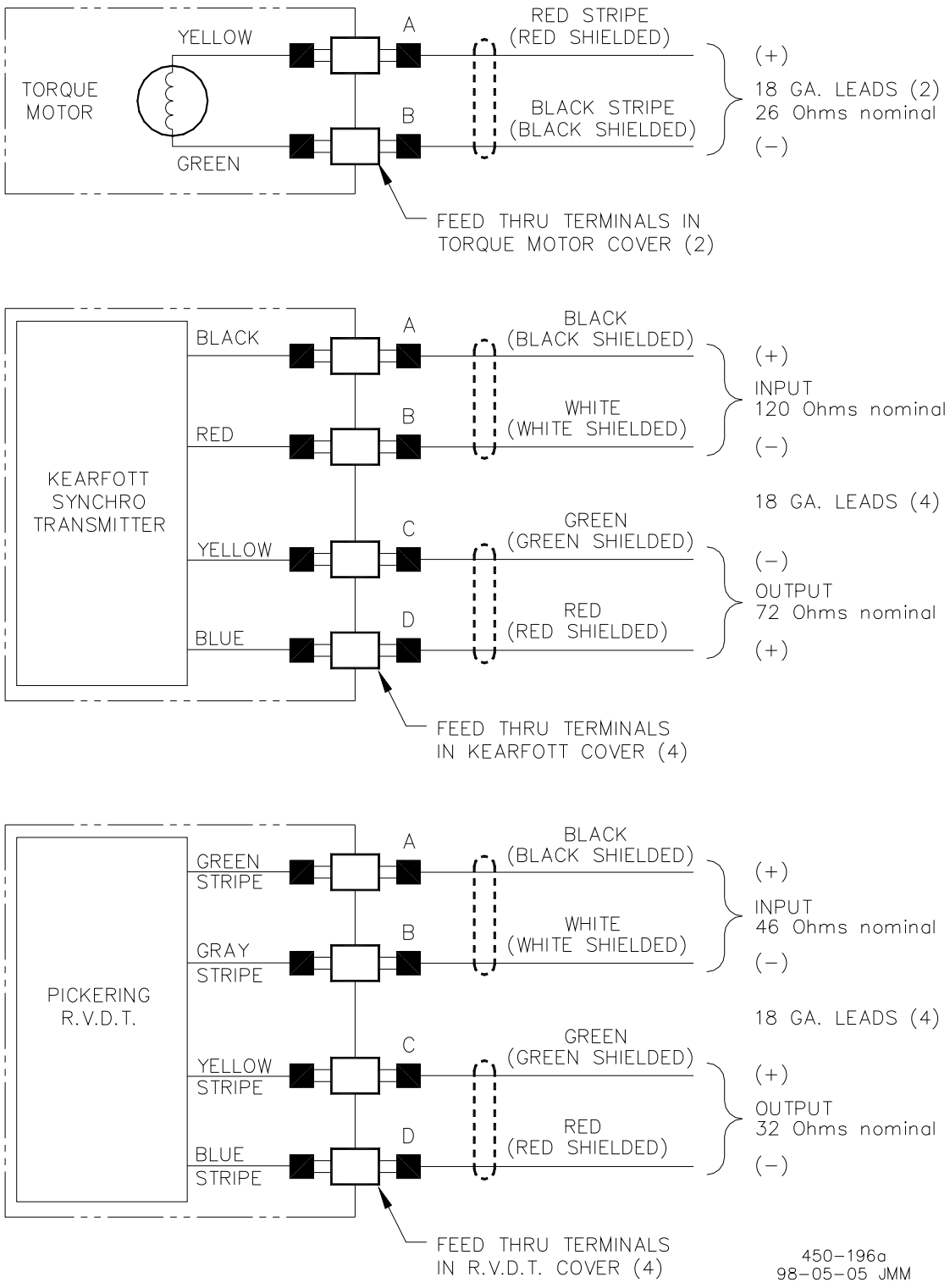



Figure 4-2. Wiring Diagram for TM-55 Actuator

**IMPORTANT** **On feedback transducers, polarity shown indicates feedback output signal in phase with excitation signal.**

# Chapter 5. Maintenance

## Introduction

Contaminant resistance of the 3103 Gas Valve/Actuator is excellent due to design features and high working forces. However, the service life of the actuator is increased with the use of clean supply flow.

## Filter Cleaning

The TM-55P actuator is equipped with a 70 µm filter at the supply inlet. See the outline drawing, Figure 2-1, for its location. If the filter becomes clogged as evidenced by sluggish response, it may be cleaned ultrasonically and back-flushed with a light solvent.

## Troubleshooting

Faults in the governing system are usually revealed as speed variations of the prime mover, but it does not necessarily follow that such speed variations indicate governing system faults. Therefore, when improper speed variations appear, check all components including the turbine for proper operation. Refer to applicable Woodward electric control manuals for assistance in isolating the trouble. If, during the starting sequence, the actuator does not respond to electric control input, check the actuator pressure supply and supply filters.

Disassembly of the TM-55P actuator or 3103 gas valve in the field is not recommended. Under unusual circumstances where disassembly becomes necessary, all work and adjustments should be made only by personnel thoroughly trained in the proper procedures.

When requesting information or service help from Woodward, it is important to include the part number and serial number of the gas valve/actuator in your communication.

**NOTICE**

**When removing or installing the permanent magnet torque motor, take the following precautions to preserve the strength of the magnets, and prevent contamination:**

1. **Do not place motors directly on ferrous (iron) metal surfaces.**
2. **Before assembly, after disassembly, or during storage, keep a minimum of 25 mm (1 inch) of non-magnetic material around each motor.**
3. **Do not place or store motors in an electromagnetic field. Electromagnetic fields exist around electric motors, transformers, demagnetizing coils or plates, and electric wiring.**
4. **Do not drop or bump the motor or motor container. A sharp blow can reorient and weaken the magnetic field of the motor.**
5. **Avoid contamination. Metal chips, dirt, and electrostatically charged particles of plastic and other non-metallic materials will collect on the motor if not protected. Keep the motor in a clean plastic bag within its special container until assembled.**
6. **Use special containers provided for motors when storing or shipping as spare parts.**
7. **Use only non-ferrous (brass, beryllium copper, aluminum) assembly tools in direct contact with the actuator/motor.**

# Chapter 6.
# Service Options

## Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

**OEM and 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 **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

**www.woodward.com/directory**

## Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- 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 is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

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.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

**Flat Rate Repair:** Flat Rate Repair is available for the majority of standard 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. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

**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 and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). 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 authorization 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.

**NOTICE**

**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 offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- 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. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

**Product Training** is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our 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 many of our worldwide locations or 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 us via telephone, email us, or use our website: **www.woodward.com**.

# How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

### Electrical Power Systems

| Facility | Phone Number |
|---|---|
| Brazil | +55 (19) 3708 4800 |
| China | +86 (512) 6762 6727 |
| Germany | +49 (0) 21 52 14 51 |
| India | +91 (129) 4097100 |
| Japan | +81 (43) 213-2191 |
| Korea | +82 (51) 636-7080 |
| Poland | +48 12 295 13 00 |
| United States | +1 (970) 482-5811 |

### Engine Systems

| Facility | Phone Number |
|---|---|
| Brazil | +55 (19) 3708 4800 |
| China | +86 (512) 6762 6727 |
| Germany | +49 (711) 78954-510 |
| India | +91 (129) 4097100 |
| Japan | +81 (43) 213-2191 |
| Korea | +82 (51) 636-7080 |
| The Netherlands | +31 (23) 5661111 |
| United States | +1 (970) 482-5811 |

### Turbine Systems

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

You can also locate your nearest Woodward distributor or service facility on our website at:

**www.woodward.com/directory**

# Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Engine/Turbine Model Number _____

Manufacturer _____

Number of Cylinders (if applicable) _____

Type of Fuel (gas, gaseous, steam, etc) _____

Rating _____

Application _____

**Control/Governor #1**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

**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 _____

*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.*

**We appreciate your comments about the content of our publications.**

**Send comments to: icinfo@woodward.com**

**Please reference publication 40104F.**

B40104:F

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

**Email and Website—www.woodward.com**

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

**Complete address / phone / fax / email information for all locations is available on our website.**

2013/1/Colorado