



Installation and Operation Manual



Flo-Tech™ Integrated Actuator and Throttle Body

Flo-Tech 33/48/60/68/75

Manual 04141 (Revision G)

IMPORTANT



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.

DEFINITIONS

- **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

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.



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.

NOTICE

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.

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*.

Revisions—Text changes are indicated by a black line alongside the text.

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Chapter 1.

Installation and Operation

General Information

The Flo-Tech™ actuator/throttle body is a family of electrically-actuated throttle/valves which control fuel flow output. The flow output is a function of throttle position. The throttle position responds proportionally to the position command.

The Flo-Tech throttle body is available with 33, 48, 60, 68, and 75 mm bore sizes for various applications. Command input options come in PWM (pulse-width-modulated), 0–5 Vdc, 4–20 mA, and 0–200 mA. The position feedback output signal will vary from 0.5 ± 0.1 Vdc at minimum actuator position to 4.5 ± 0.1 Vdc nominal at maximum actuator position. The PWM command input version will return to minimum actuator position with a command of greater than 96% duty cycle.

Input Command	Input Range	Position Feedback Output	Nominal Actuator Range
PWM	10–90%	$0.5-4.5 \pm 0.1$ Vdc	0–70 degrees
0–5 Vdc	0.5–4.5 Vdc	$0.5-4.5 \pm 0.1$ Vdc	0–70 degrees
4–20 mA	5–19 mA	$0.5-4.5 \pm 0.1$ Vdc	0–70 degrees
0–200 mA	20–180 mA	$0.5-4.5 \pm 0.1$ Vdc	0–70 degrees

The Flo-Tech actuator requires a power supply of 9–32 Vdc. The supply must be capable of providing a sustained 25 W at steady-state and 50 W for transient state conditions for at least 0.25 seconds.

IMPORTANT

To ensure proper start-up operation, make sure that power is applied to the Flo-Tech throttle for at least 200 ms before any position command is applied.

If power to the Flo-Tech will ever be disconnected to prevent battery drain (that is, after a period of key-switch on-time between engine starts), make sure that the command signal is also disconnected, and that the start-up sequence in the first sentence of this Note is again followed.

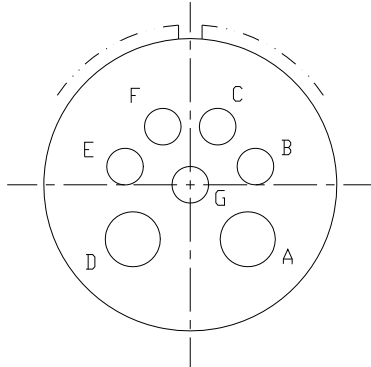
Application

The Flo-Tech throttle body is designed with flow shaping to assist in engine idle stability. The system will provide equivalent maximum flow rate. The system contains a return spring to fully comply with DOT 571.124 specifications.

The Flo-Tech throttle body is designed for direct replacement of manual throttle bodies. It requires no actuators or linkage.

Installation

The Flo-Tech actuator/throttle body may be engine-mounted in any position, in the coolest location possible. Each of the two mounting flanges on the body of the bore has four 10 mm through-mounting holes in a square 74 mm pattern. The base of the Flo-Tech throttle body has an optional bolt pattern that can be used for mounting or support. It uses four M8x0.125 bolts in an 88.9 mm square pattern. Flo-Tech connector options are shown in Figure 1-1. Outline drawings shown in Figure 1-2 describe the different Flo-Tech mounting configurations.



CONNECTOR WIRING
FRONT VIEW

PIN A: POWER (+) / RED
 PIN B: POSITION COMMAND (-) / BLUE
 PIN C: POSITION COMMAND (+) / ORANGE
 PIN D: POWER (-) / BLACK
 PIN E: POSITION FEEDBACK / WHITE
 PIN F: NO CONNECTION
 PIN G: NO CONNECTION

MAY BE PURCHASED FROM:

1. ITT CANNON
P/N: CA3101F-18-9P-A206
2. AMPHENOL BENDIX
P/N: ACS01AF18-9P(025)

MATING CONNECTOR MAY BE PURCHASED FROM:

1. ITT CANNON
P/N CA3106F-18-9S-A206
2. AMPHENOL BENDIX
P/N ACS06AF18-9S(025)

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Figure 1-1a. Bendix Round Connector

NOTES:
6 PIN DEUTSCH CONNECTOR

CONNECTOR PART #: DT04-6P-EP04
WGC P/N 1634-177
CONTACT PIN #: 0460-202-16141
WGC P/N 1634-003
LOCK WEDGE #: W6P
WGC P/N 1634-963
SEALING PLUG #: 114017
WGC P/N 1635-117

MATING CONNECTOR REF INFO:
CONNECTOR: DT06-6S-EP04
WGC P/N: 1634-179
CONTACT SOCKET: 0462-201-16141
WGC P/N: 1634-005
LOCK WEDGE: W6S
WGC P/N: 1634-965
SEALING PLUG: 114017
WGC P/N: 1635-117

1	POWER (+) / RED
2	POWER (-) / BLACK
3	POSITION COMMAND / BLUE WIRE
4	POSITION FEEDBACK / WHITE WIRE
5	NOT USED
6	POSITION COMMAND / ORANGE

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Figure 1-1b. Deutsch Connector

NOTES:
6 PIN PACKARD CONNECTOR
"WEATHER PACK" TYPE

CONNECTOR PART #: 12020786
WGC P/N 1635-985
SEAL PART #: 12015323
WGC P/N 1635-173
MALE PIN PART #: 12089040
WGC P/N 1635-171

MATING CONNECTOR #: 12020926
WGC P/N 1635-991
SEAL PART #: 12015323
WGC P/N SAME AS ABOVE
SOCKET CONTACT #: 12089188
WGC P/N 1635-183
PLUG #: 12010300
WGC P/N 1635-181

A	POWER (+) / RED
B	POWER (-) / BLACK
C	NC
D	POSITION COMMAND (-) / BLUE
E	POSITION COMMAND (+) / ORANGE COMMAND
F	BUFFERED POSITION / WHITE OUTPPUT

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Figure 1-1c. Packard 5-wire Connector

NOTES:

6 PIN PACKARD CONNECTOR
 "WEATHER PACK" TYPE

CONNECTOR PART #: 12020786
 WGC P/N 1635-985
 SEAL PART #: 12015323
 WGC P/N 1635-173
 MALE PIN PART #: 12089040
 WGC P/N 1635-171

 MATING CONNECTOR #: 12020926
 WGC P/N 1635-991
 SEAL PART #: 12015323
 WGC P/N SAME AS ABOVE
 SOCKET CONTACT #: 12089188
 WGC P/N 1635-183
 PLUG #: 12010300
 WGC P/N 1635-181

A	POWER (+) / RED
B	POWER (-) / BLACK
C	+5V / BROWN
D	GROUND / GREEN
E	PWM POSITION / ORANGE COMMAND
F	BUFFERED POSITION / WHITE OUTPUT

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Figure 1-1d. Packard 6-wire Connector

NOTES:

6 PIN PACKARD CONNECTOR
 "WEATHER PACK" TYPE

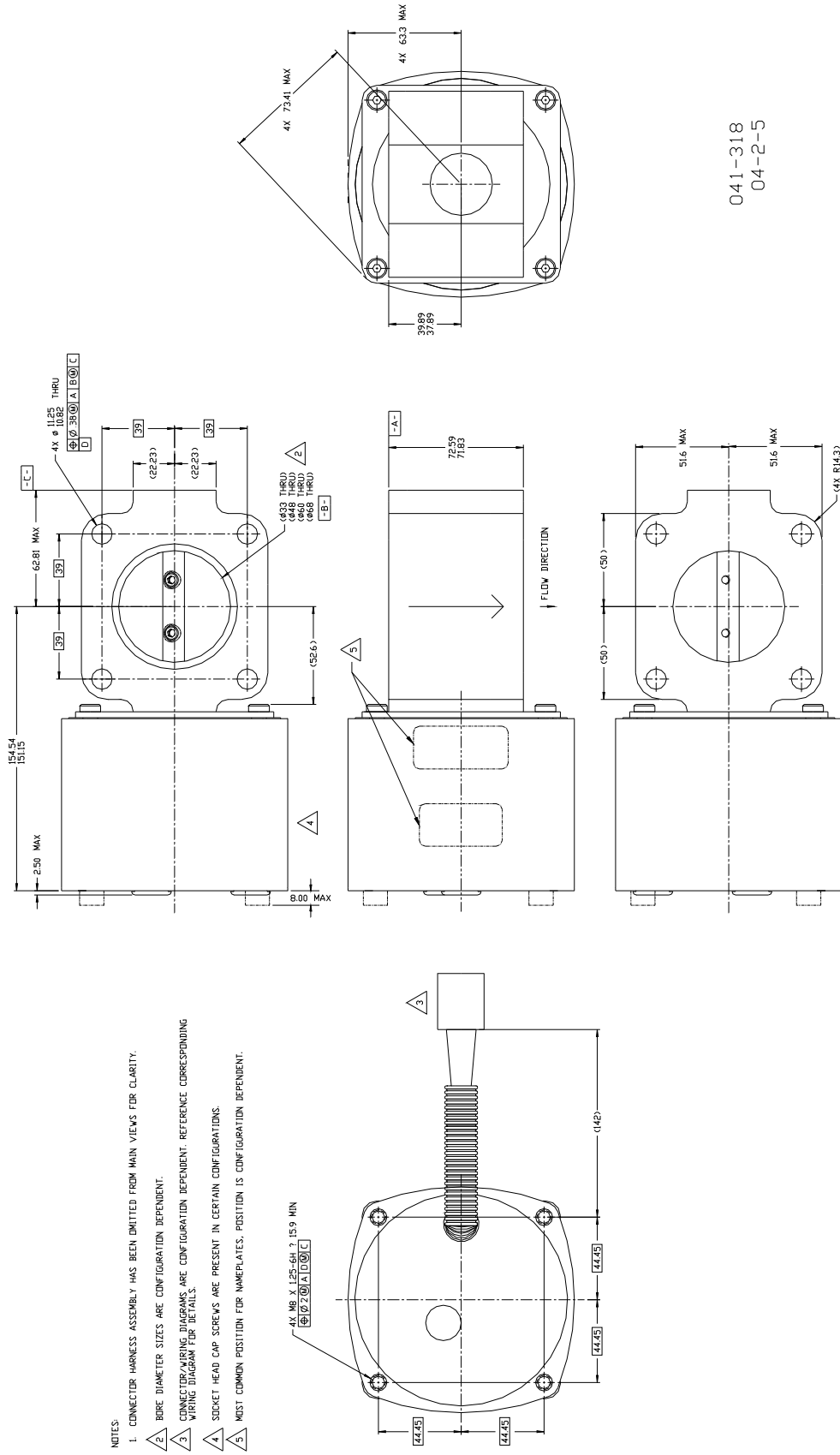
CONNECTOR PART #: 12020786
 WGC P/N 1635-985
 SEAL PART #: 12015323
 WGC P/N 1635-173
 MALE PIN PART #: 12089040
 WGC P/N 1635-171

 MATING CONNECTOR #: 12020926
 WGC P/N 1635-991
 SEAL PART #: 12015323
 WGC P/N SAME AS ABOVE
 SOCKET CONTACT #: 12089188
 WGC P/N 1635-183
 PLUG #: 12010300
 WGC P/N 1635-181

A	POWER (+) / RED
B	POWER (-) / BLACK
C	GROUND / GREEN
D	POSITION COMMAND (-) / BLUE
E	POSITION COMMAND (+) / ORANGE
F	BUFFERED POSITION / WHITE OUTPUT

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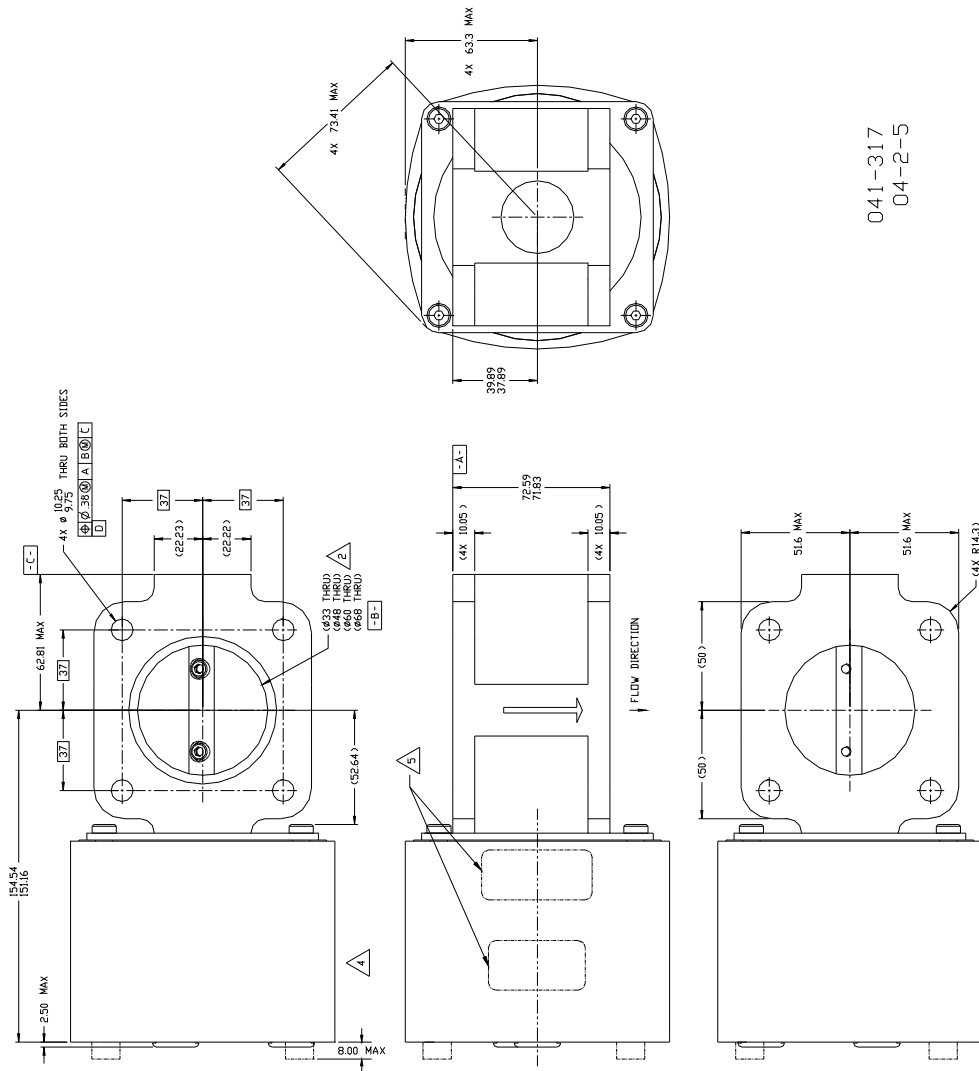
Figure 1-1e. Packard 6-wire 0-5 Vdc Connector



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04-2-5

- NOTES:
- 1. CONNECTOR HARNESS ASSEMBLY HAS BEEN OMITTED FROM MAIN VIEWS FOR CLARITY.
 - 2. BORE DIAMETER SIZES ARE CONFIGURATION DEPENDENT.
 - 3. CONNECTOR WIRING DIAGRAMS ARE CONFIGURATION DEPENDENT. REFERENCE CORRESPONDING WIRING DIAGRAM FOR DETAILS.
 - 4. SOCKET HEAD CAP SCREWS ARE PRESENT IN CERTAIN CONFIGURATIONS.
 - 5. MOST COMMON POSITION FOR NAMEPLATES. POSITION IS CONFIGURATION DEPENDENT.

Figure 1-2a. Flo-Tech Outline Drawing (No Flange Mounting)



041-317
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- NOTES:
1. CONNECTOR HARNESS ASSEMBLY HAS BEEN OMITTED FROM MAIN VIEWS FOR CLARITY.
 2. BORE DIAMETER SIZES ARE CONFIGURATION DEPENDENT.
 3. CONNECTOR/WIRING DIAGRAMS ARE CONFIGURATION DEPENDENT. REFERENCE CORRESPONDING WIRING DIAGRAM FOR DETAILS.
 4. SOCKET HEAD CAP SCREWS ARE PRESENT IN CERTAIN CONFIGURATIONS.
 5. MOST COMMON POSITION FOR NAMEPLATES. POSITION IS CONFIGURATION DEPENDENT.

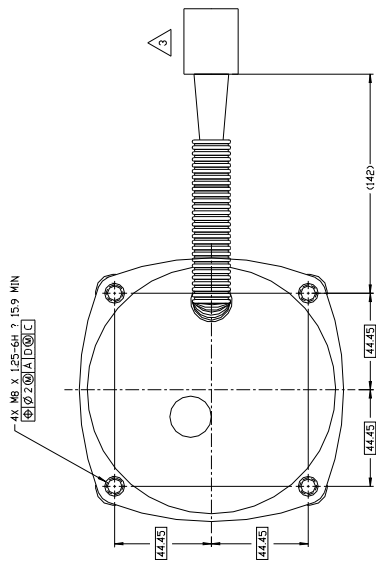


Figure 1-2b. Flo-Tech Outline Drawing (Standard Flange Mounting)

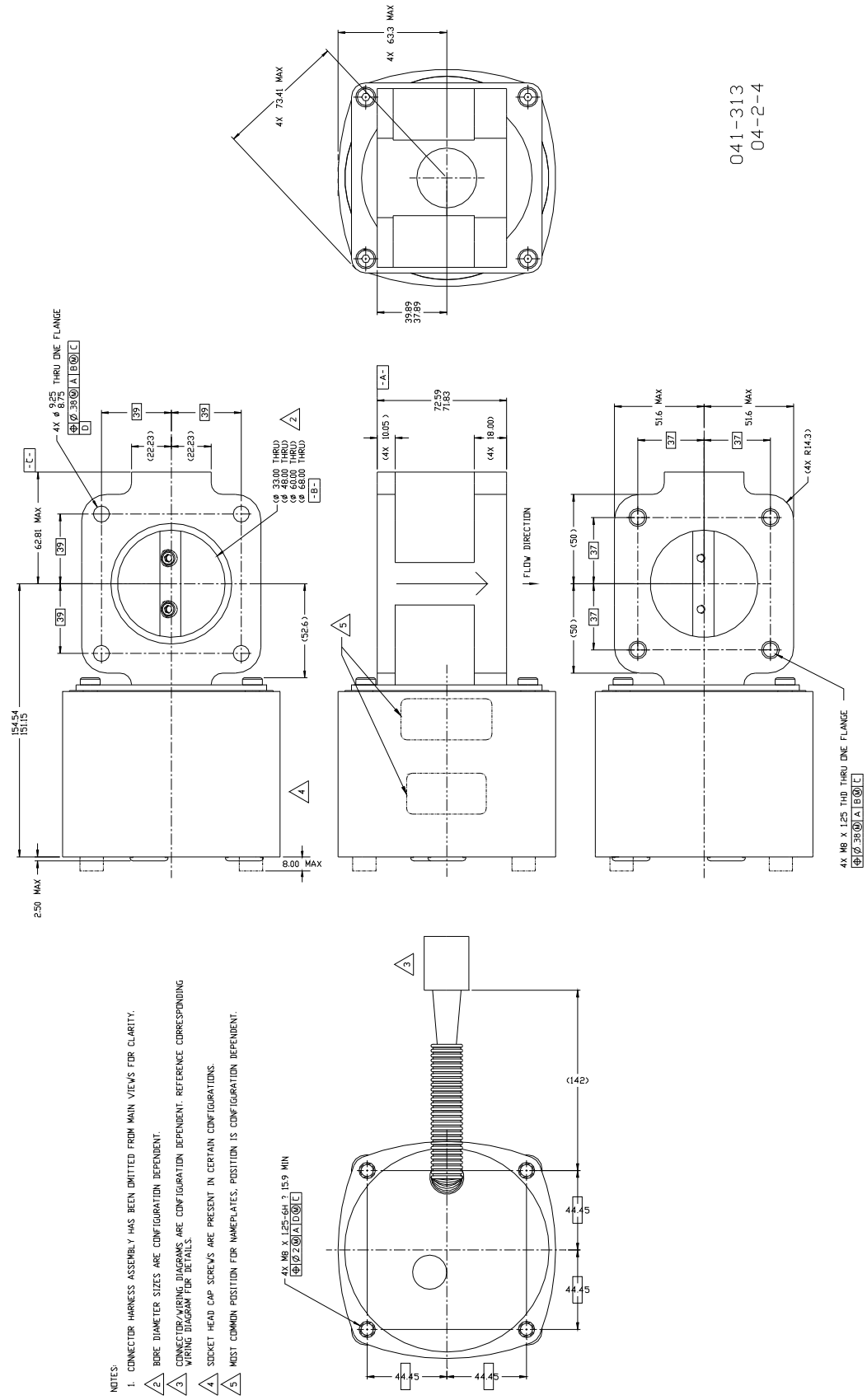
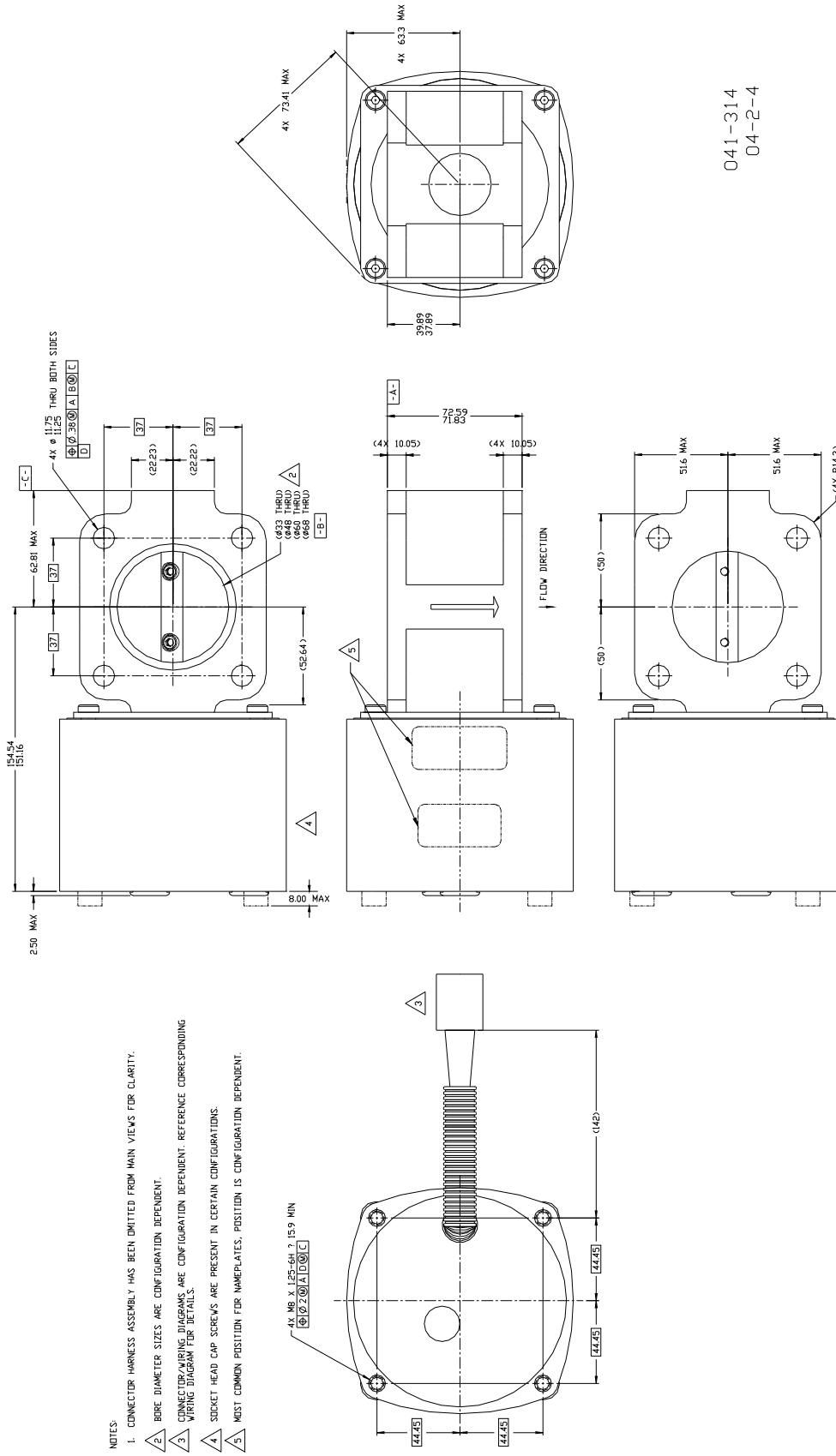
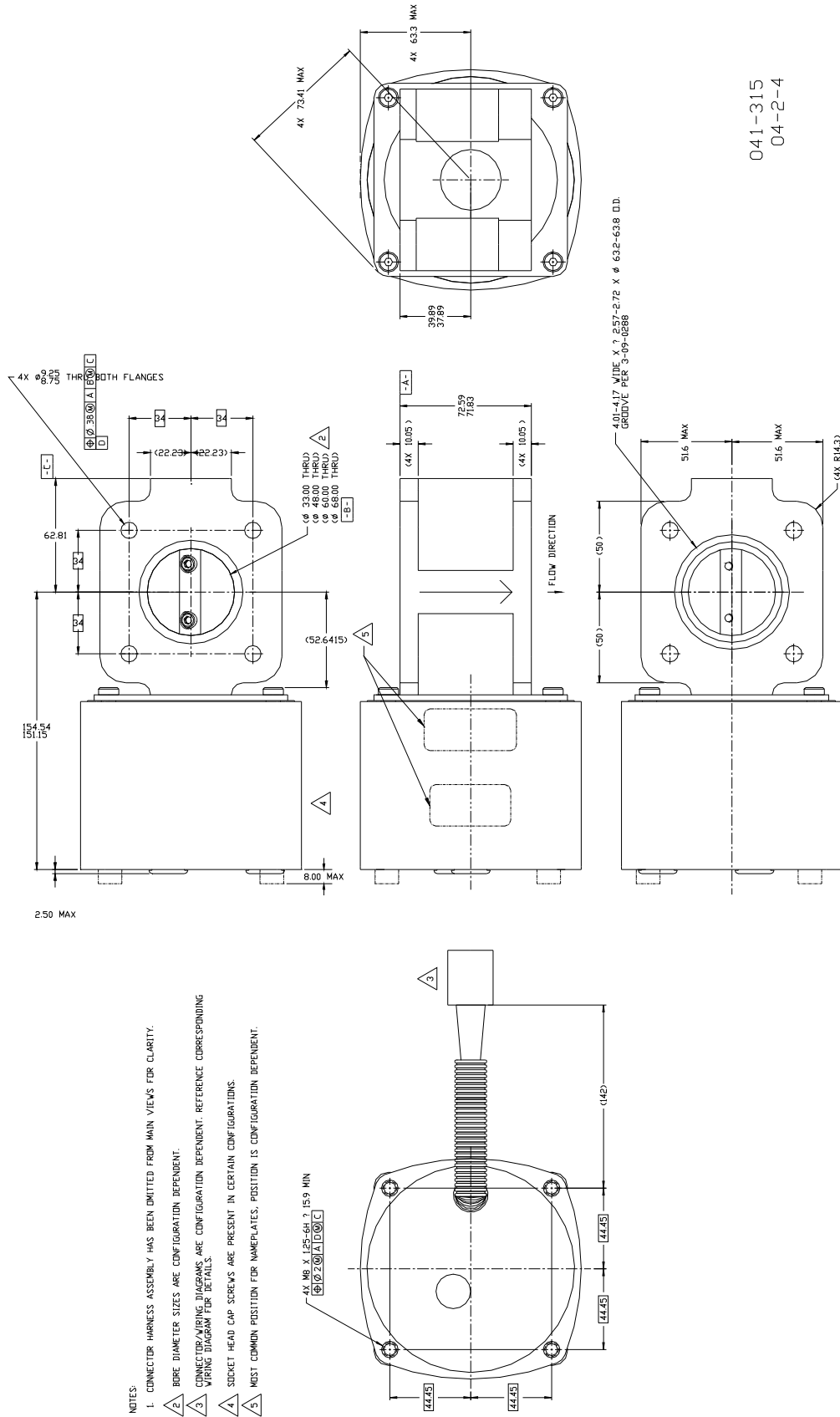


Figure 1-2c. Flo-Tech Outline Drawing (Thick Flange Mounting)



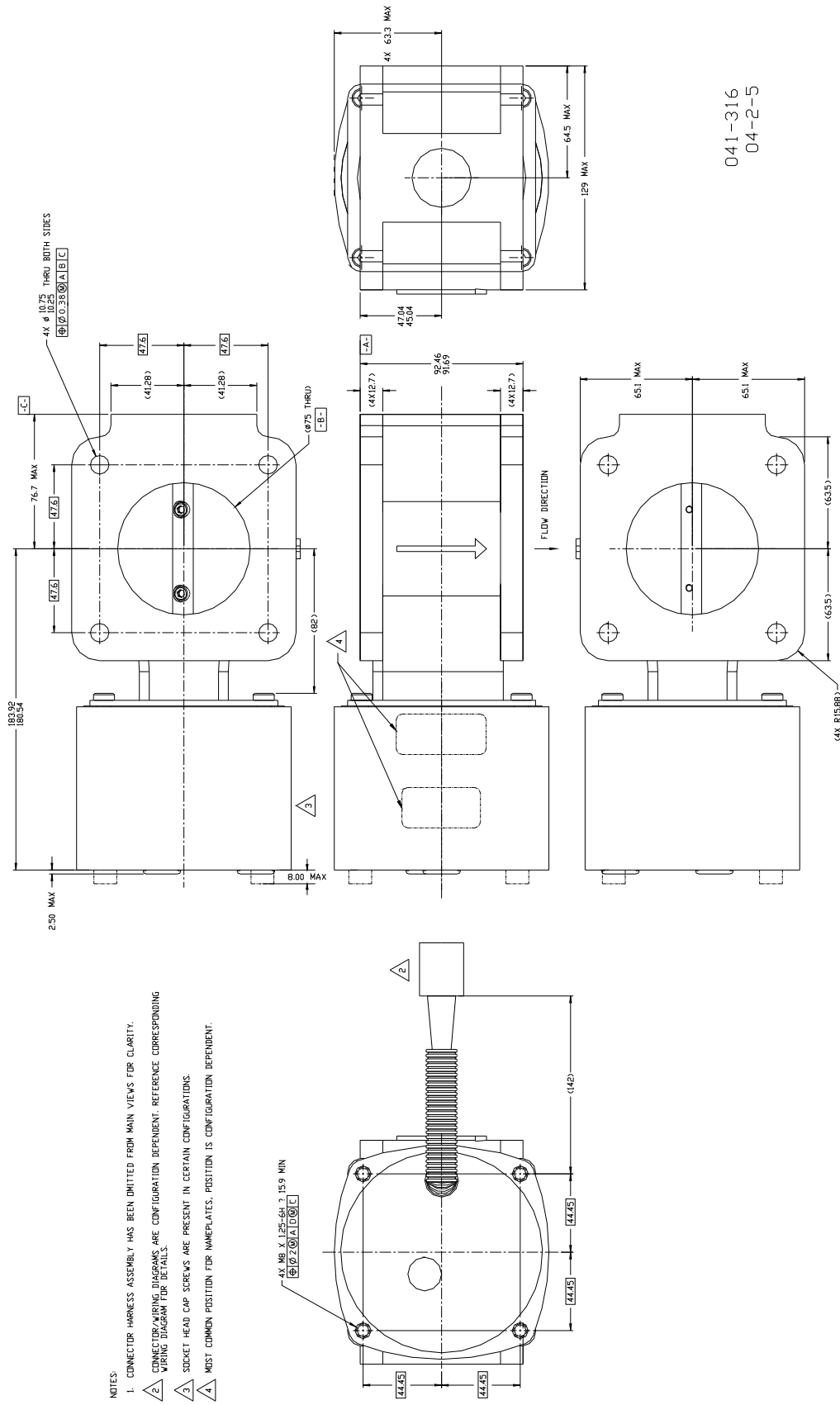
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Figure 1-2d. Flo-Tech Outline Drawing (M10 Flange Mounting)



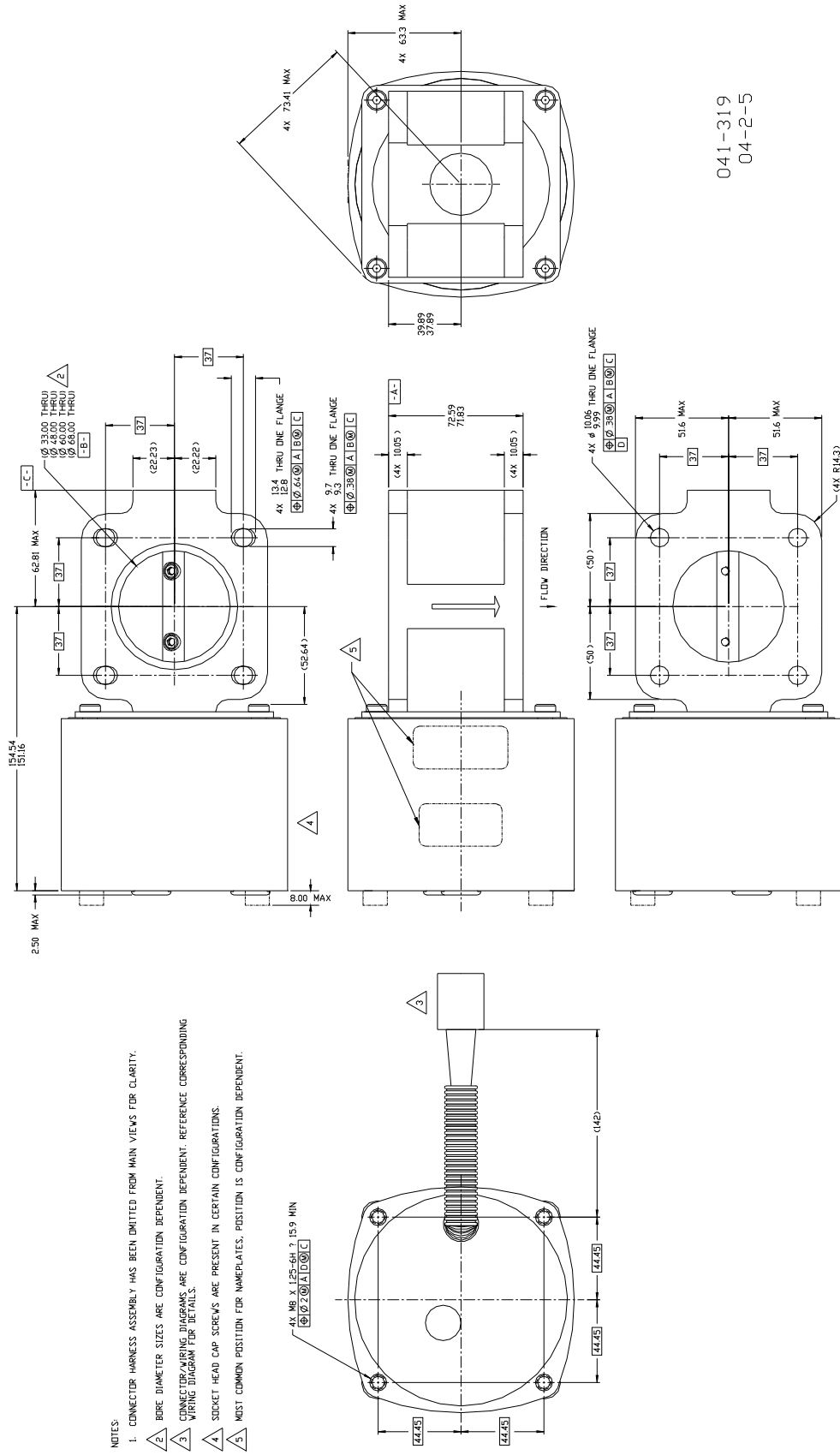
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Figure 1-2e. Flo-Tech Outline Drawing (O-ring Flange Mounting)



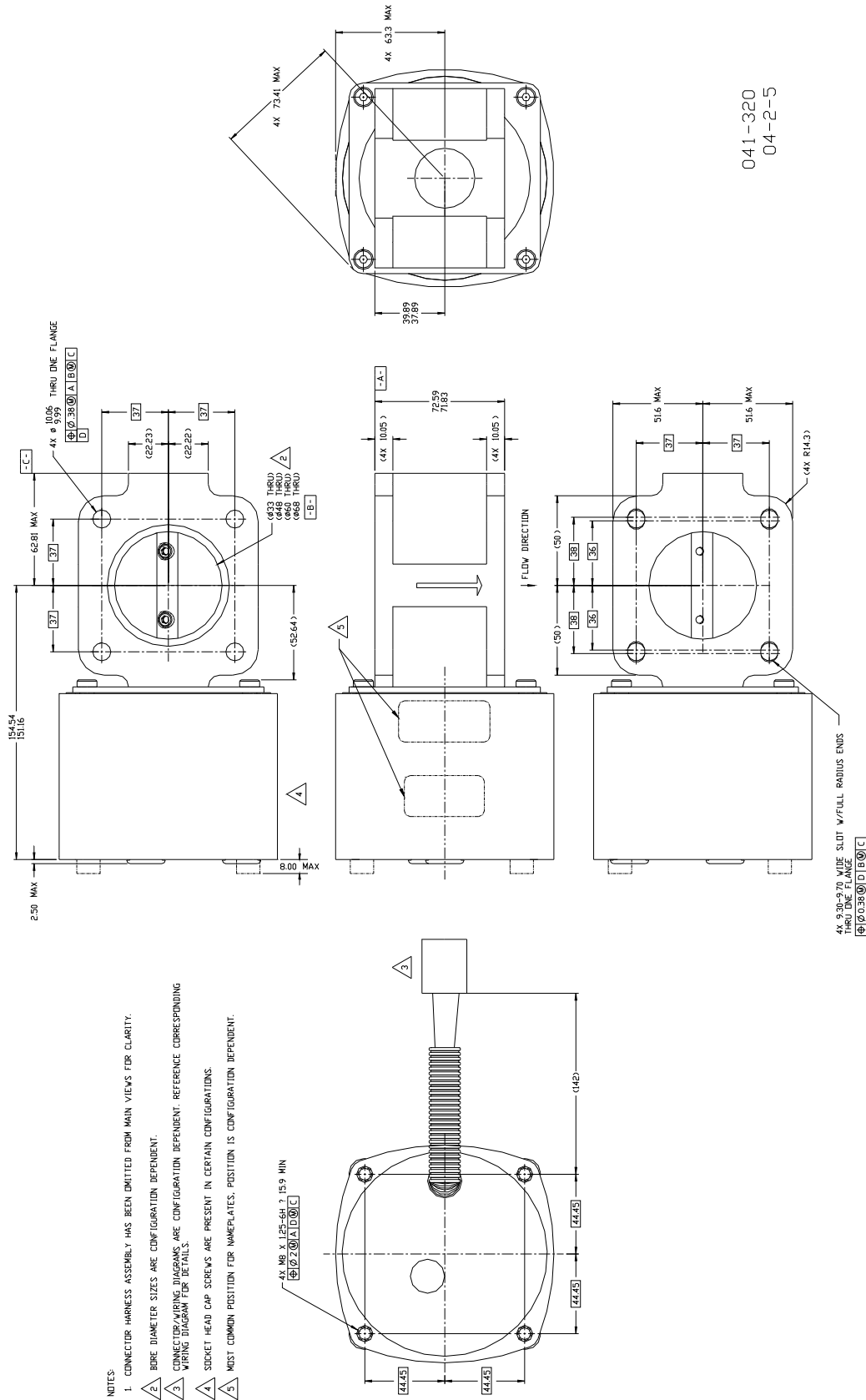
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Figure 1-2f. Flo-Tech Outline Drawing (75 mm Flange Mounting)



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Figure 1-2g. Flo-Tech Outline Drawing (Top Slotted Flange Mounting)



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Figure 1-2h. Flo-Tech Outline Drawing (Bottom Slotted Flange Mounting)

Chapter 2. 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.

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

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 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 and reference www.woodward.com/support, and then **Customer Support**.

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		Engine Systems		Turbine Systems	
Facility	Phone Number	Facility	Phone Number	Facility	Phone Number
Australia	+61 (2) 9758 2322	Australia	+61 (2) 9758 2322	Australia	+61 (2) 9758 2322
Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727	China	+86 (512) 6762 6727	China	+86 (512) 6762 6727
Germany:		Germany:			
Kempen	+49 (0) 21 52 14 51	Stuttgart	+49 (711) 78954-0		
Stuttgart	+49 (711) 78954-0	India	+91 (129) 4097100	India	+91 (129) 4097100
India	+91 (129) 4097100	Japan	+81 (43) 213-2191	Japan	+81 (43) 213-2191
Japan	+81 (43) 213-2191	Korea	+82 (51) 636-7080	Korea	+82 (51) 636-7080
Korea	+82 (51) 636-7080	The Netherlands	+31 (23) 5661111	The Netherlands	+31 (23) 5661111
Poland	+48 12 618 92 00				
United States	+1 (970) 482-5811	United States	+1 (970) 482-5811	United States	+1 (970) 482-5811

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (www.woodward.com/support) for the name of your nearest Woodward distributor or service facility.

For the most current product support and contact information, please refer to the latest version of publication **51337** at www.woodward.com/publications.

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:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Prime Mover Information

Engine/Turbine Model Number _____

Manufacturer _____

Number of Cylinders (if applicable) _____

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

Rating _____

Application _____

Control/Governor Information

Please list all Woodward governors, actuators, and electronic controls in your system:

Woodward Part Number and Revision Letter

Control Description or Governor Type

Serial Number

Woodward Part Number and Revision Letter

Control Description or Governor Type

Serial Number

Woodward Part Number and Revision 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.

Flo-Tech™ Control Specifications

Environment

Weight	6 kg (13 lb)
Operating Temperature	–40 to +105 °C (–40 to +221 °F) housing temperature
Storage Temperature	–55 to +105 °C (–67 to +221 °F)
Operating Environment	Automotive Underhood—water, condensing and non-condensing petrochemicals (oil, fuel, exhaust emissions, gasoline, diesel, natural gas,....)
Media	The proper combustible mixture of engine intake air and natural gas or other Woodward approved media.
Vibration	
Sine Sweep	US MS 810C, M514.2 Curve J (Mod)
Random	US MS 202F, Method 214A, Cond. G
Temperature and Humidity	SAE J1455

Typical Control Characteristics

Inputs

Power Supply	9 to 32 Vdc (12/24 Vdc nominal) Must be able to supply 50 W for 0.25 seconds in transient conditions and 25 W continuous for steady state conditions.
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Outputs

Position Feedback:	
Nominal Actuator Range	0 to 70 degrees
Position Feedback Output	0.5–4.5 ± 0.1 Vdc
Working Pressures	14 to 345 kPa (2 to 50 psia)
Electrical Specifications	
Operating Voltage	9 to 32 Vdc (12/24 Vdc nominal)
Power Requirements	50 W for 0.25 s in transient conditions and 25 W continuous for steady state conditions.

Position Command

Pulse Width Modulated Input Signal (PWM)	duty cycle range 10–90% duty cycle above 95% results in throttle closure input impedance 117.4 kΩ PWM frequency range 500–2000 Hz with amplitude 4–32 Vdc and 10 bit resolution
0–5 Vdc Input Signal	input range 0.5–4.5 Vdc input impedance 152.7 kΩ
4–20 mA Input Signal	input impedance 249 Ω
0–200 mA Input Signal	input impedance 35.7 Ω
Position Feedback	
Nominal Actuator Range	0° to 70°
Position Sensor Output	0.5–4.5 ± 0.1 Vdc @ 77 °F (25 °C)

Temperature Drift	Temperature drift from 25 to 105 °C or from 25 to –40 °C causes the internal position sensor calibration to shift. Under these conditions, the throttle plate starts to open at a sensor output of 0.8 Vdc and is fully open at a sensor output of 4.2 Vdc. The sensor output continues to track the command signal.
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We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **04141G**.



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Email and Website—www.woodward.com

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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.