

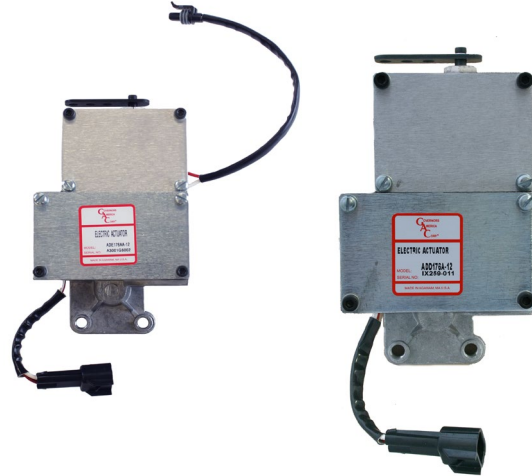
176 Series Integral Electrical Actuator

1 INTRODUCTION

GAC's 176 Series Integrated Pump Mounted Actuators are field proven proportional actuators designed to mount directly to fuel injection Bosch-style "A" pumps to achieve an integrated proportional servo fuel package.

Since the design has no sliding parts and its components are sealed; outstanding reliability results with no maintenance required. The design is versatile with numerous options and mounting kits available in order to adapt to other fuel pumps. Capabilities include:

- ◇ Adjustable MAX Fuel Limits
- ◇ Manual Shut-Off Mechanism
- ◇ Left-Hand Rack
- ◇ Replaces Mechanical Governor
- ◇ Feedback Position Sensor Available
- ◇ Fast Response < 35 ms (10 - 90 %)
- ◇ Connects Directly to the Fuel Control Rack



2 SELECTION CHART

Part Number	System Voltage		Stop Lever	Cold Start Solenoid	Mating Connector Included	Feedback Sensor
	12	24				
ADD176A-12						
ADD176A-24						
ADD176AF-12						
ADD176AF-24						
ADE176AA-12						
ADE176AA-24						
ADE176AF-12						
ADE176AF-24						

KITS / CONNECTORS

KITS / CONNECTORS	PN
Camshaft Bearing Retainer	KT176A
Bosch RSV - Left Hand Rack Installation	KT176-A-RS-L
Installation - Included with Actuator	KT291
Actuator Mating Connector	EC1300
Actuator Replacement Connector	EC1310
Cold Start Solenoid Mating Connector	EC1350
Feedback Sensor Mating Connector	EC1515
Actuator Mating Cable Harness (6 ft.)	CH1215
Feedback Mating Cable Harness (6 ft.)	CH1515

3 SPECIFICATIONS

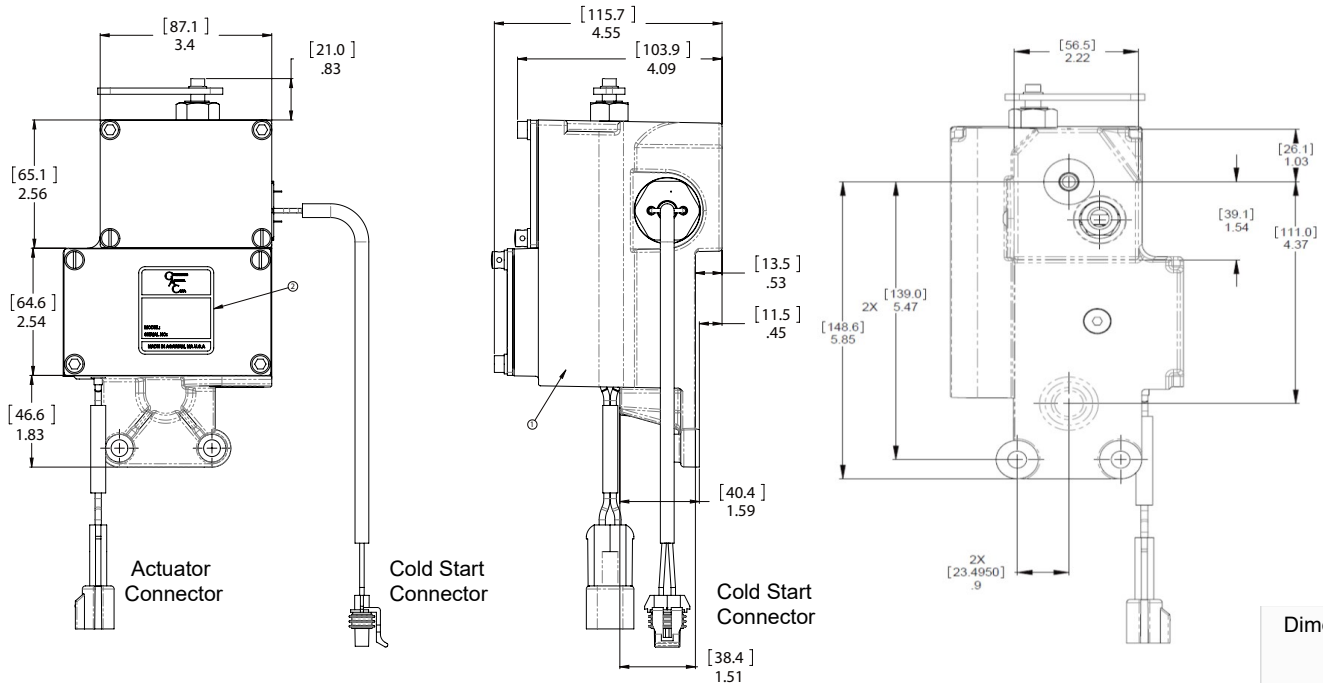
PERFORMANCE	
Force	6.2 lbf (27.5 N)
Max Operating Stroke	0.80 in (21 mm)
Response Time (10 - 90 %)	< 35 ms
ELECTRICAL POWER INPUT	
Operating Voltage	12 V DC or 24 V DC
Nominal Operating Current	4.0 A @12 V DC 2.0 A @24 V DC
Max Continuous Current	5.8 A @12 V DC 3.1 A @24 V DC
Coil Resistance	1.9 ± 0.2 Ω @12 V DC 7.1 ± 0.5 Ω @24 V DC
Cold Start MIN Operating Voltage	6 V @12 V DC 12 V @24 V DC
Cold Start Coil Resistance	1.0 ± 0.2 Ω @12 V DC 3.9 ± 0.2 Ω @24 V DC

ENVIRONMENTAL	
Operating Temperature	-40 to 257 °F (-40 to 125 °C)
Relative Humidity	Up to 100 %
Vibration	12g @ 20 to 500 Hz
Shock	20g @ 11 ms
All Surface Finishes	Fungus Proof and Corrosion Resistant
PHYSICAL	
Dimensions	See Section 4
Weight	4.94 lbf (1.84 kgf)
ADE176AA Cold Start	5.44 lbf (2.47 kgf)
COMPLIANCE / STANDARDS	
Agency	CE and RoHS Requirements

4 DIMENSIONS

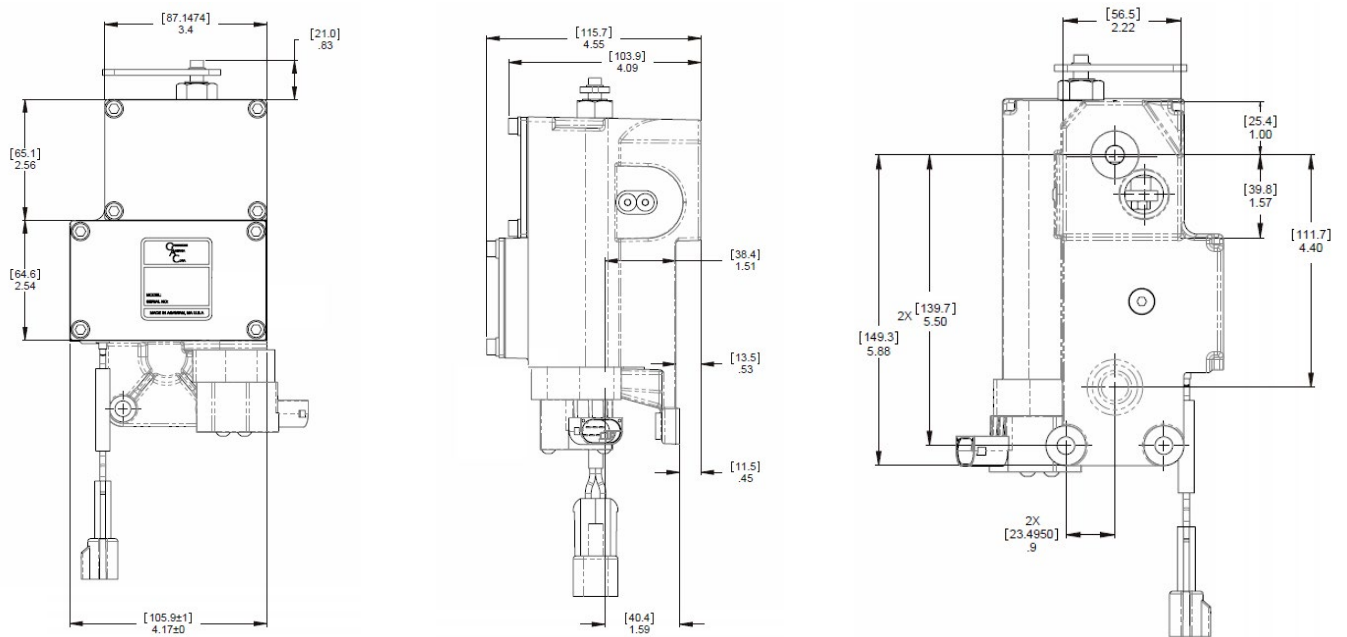
The following figures show dimensions for two 176 Series models. The base dimensions are the same for all 176 Series actuators. The installation kit KT291 is included with all actuators. Additional installation and connector/harnesses may be needed depending on your use. See Section 2 for available Kits / Harnesses. Additional installation details are available from your GAC representative.

ADE176AA



Dimension Units
[mm]
in

ADD176AF

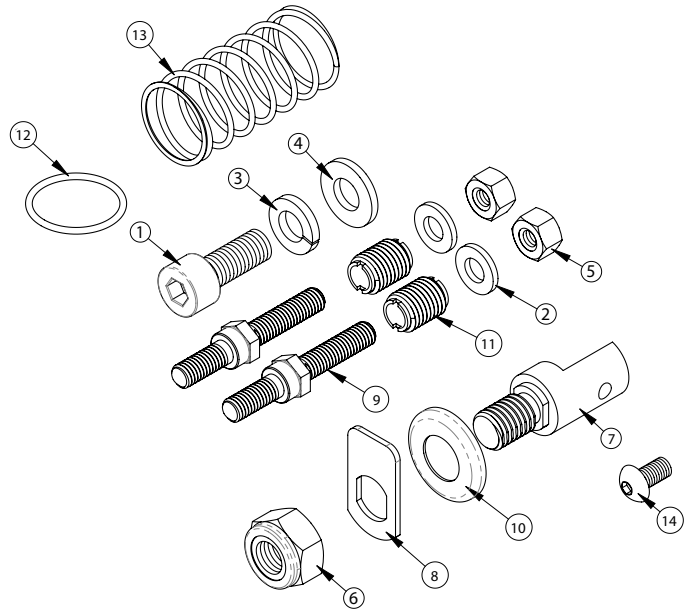


5 INSTALLATION KITS

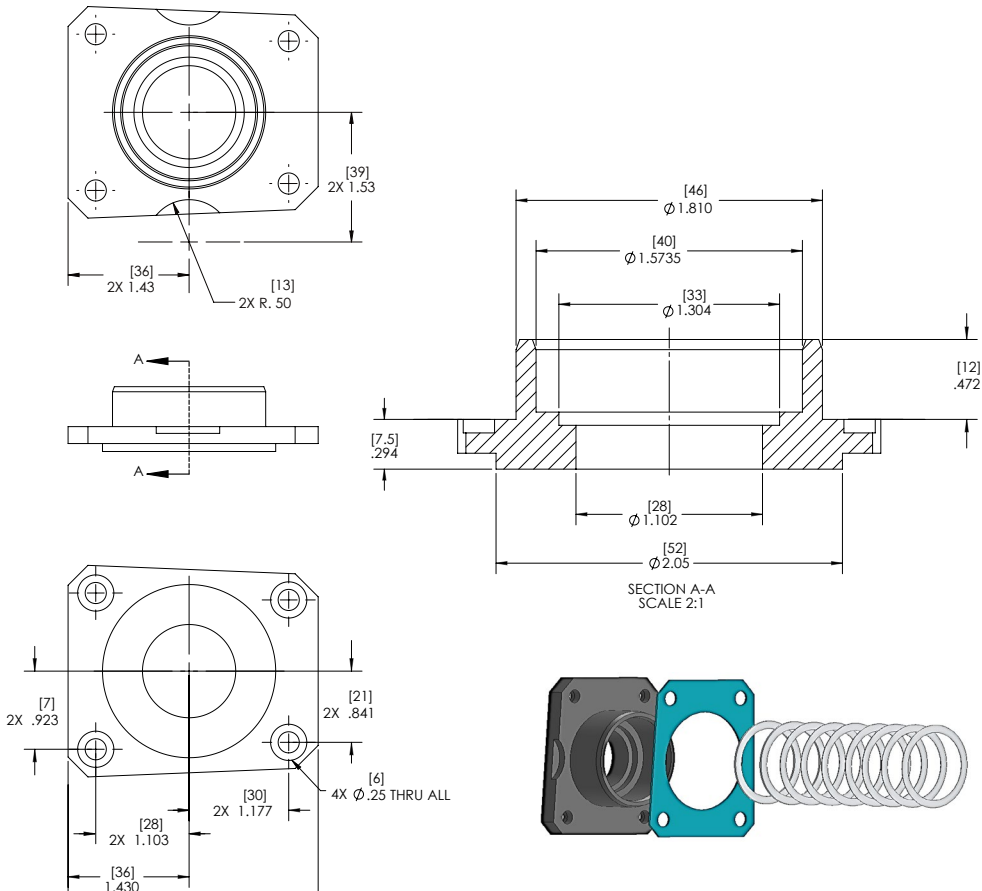
A variety of installation kits are available for the 176 Series, Kit KT291 is included with all actuators. See Section 2 for available Kits / Harnesses. Additional installation details are available from your GAC representative.

KT291 INSTALLATION KIT - INCLUDED WITH ACTUATOR

KT291 PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	HEX BOLT, M8
2	2	FLAT WASHER, M6
3	1	SPRING WASHER, M8
4	1	FLAT WASHER, M8
5	2	LOCKNUT, M6
6	1	LOCKNUT, M10
7	1	RACK LINK </td
8	1	SHUTOFF PLATE
9	2	MOUNTING RETAINER
10	1	SPRING RETAINER
11	2	ADJUSTING SCREW, SLOTTED
12	1	O-RING SEAL
13	1	RACK RETURN SPRING
14	1	BUTTONHEAD, HEX SCREW, M5 X 10



KT176A BEARING KIT - SOLD SEPARATELY



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INSTALLATION



If the Bosch "A" size fuel injection pump with left hand rack (as viewed from rear) is equipped with a mechanical governor, it must be removed. GAC recommends that this modification be performed by a qualified fuel injection service facility.

PREPARING THE FUEL INJECTION PUMP

NOTE The following procedure lists the general steps required to remove the mechanical governor. The mechanical governor will release oil during removal.

1. Remove the rear housing from the mechanical governor and disconnect the governor linkage from the fuel rack.
2. Remove the flyweight assembly with special tools, Bosch part number KDEP-2998 and KDEP-2918, can be obtained from an authorized Bosch service center, with KDEP-1068 tappet holding tools needed during reassembly.
3. Remove the intermediate governor housing which leaves only the rack and camshaft protruding from the pump. Remove the camshaft bearing from the governor cover and press it into the bearing plate provided with KT176A, which must be ordered separately. The plate must have countersunk holes to accommodate recessing the mounting screws.
4. Install tappet holding tools, Bosch part number KDEP-1068, to remove the tappet spring load from the camshaft.
5. Install the bearing and cover assembly with its gasket onto the pump using the four original governor cover screws to temporarily retain the bearing plate and release the tappets of all cylinders.
6. Measure the camshaft end-play by moving the shaft axially from one mechanical stop to the other. Total travel should be 0.05mm to 0.2mm (0.002" to 0.008"), adjust the shim pack behind the camshaft bearing as required to meet specification.

INSTALLING THE ACTUATOR

All hardware needed to attach the actuator to the pump is located in KT291, included with the actuator.



Do not use the 176 Series actuator on a 32-volt system. Contact the factory for assistance.



An overspeed shutdown device, independent of the governor system, should be used to prevent loss of engine control which may cause personal injury or equipment damage. Do not rely exclusively on the governor system electric actuator to prevent overspeed. A secondary shutoff device, such as a fuel solenoid must be used.

1. Clean the mounting surface of the pump with a clean dry cloth.
2. Attach the rack link (Figure 1 (1)) to the left hand side of the fuel rack with an M5 x 10mm screw (2) (that includes a patch of adhesive) .
3. Tighten the screw to 6 - 8 Nm (53-71 in-lbs) so that the link is aligned axially on the rack.
4. Remove the lower screws of the bearing retainer plate and replace them with the mounting retainers (Figure 2 (3)).
5. Attach the mounting retainers with the shorter end thread into the pump and torque to 9 N•m.

FIGURE 1

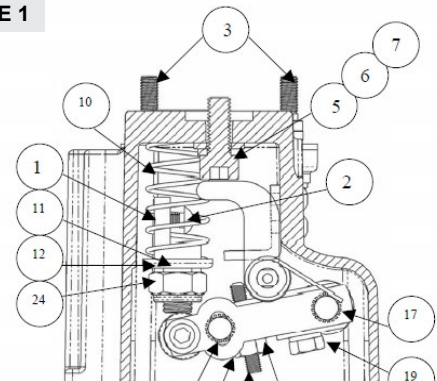
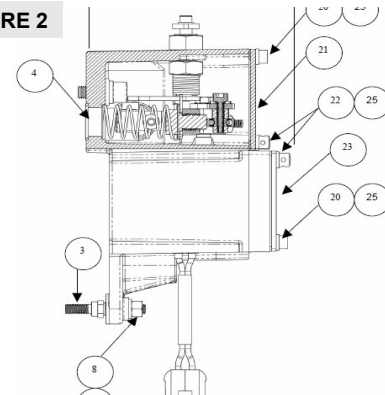


FIGURE 2

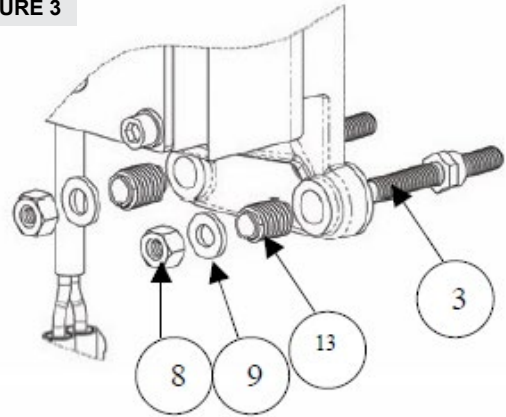


6

INSTALLATION (CONTINUED)

6. Insert adjusting sleeve screws (Figure 3 (13)) into threaded lower mounting holes on the actuator.
7. Temporarily place the actuator over the rack and mounting retainers and onto the pump face. Check that the actuator is flat and it contacts both the pump face and the shoulders of the mounting retainers. If necessary, adjust the screws (13). The upper and lower mounting points of the actuator must be equally supported.
8. Remove the actuator from the pump.

FIGURE 3



9. Remove both of the actuator covers. DO NOT remove the lever (Figure 4 (16)) from the actuator shaft.
10. Place the O-ring seal into the groove (Figure 5 (4)) on the mounting face of the actuator. Apply a small amount of grease to the O-ring to hold it in place.
11. Swing the armature out of the actuator so that the lever (Figure 4 (16)) is out of the way.
12. Guide the actuator over the rack and onto the lower mounting retaining studs (Figure 5(3)).

FIGURE 4

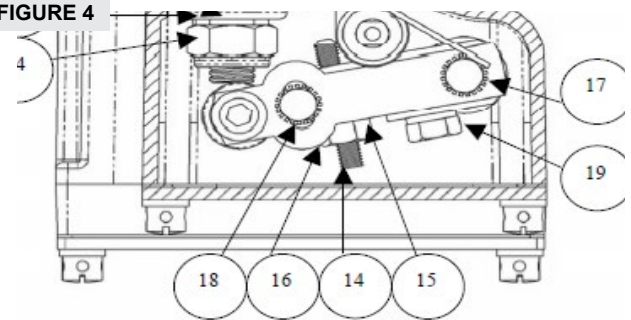
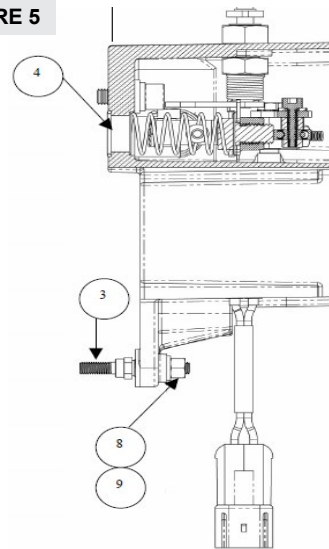
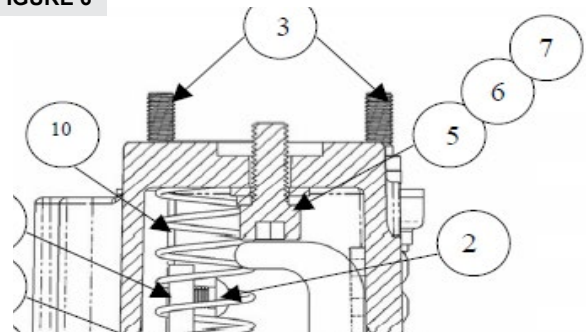


FIGURE 5



13. Attach the top of the actuator to the pump with the M8 x 16 mm socket head screw (Figure 6 (5)), lock washer (6) and flat washer (7). Torque to 29 N•m.
14. Use M6 hex nuts (Figure 5 (8) and flat washers (9) to secure the lower position of the actuator. Torque the nuts to 9 N•m.
15. Pull on the rack so that it is as far out of the pump as possible. Check that it moves freely.

FIGURE 6



6 INSTALLATION (CONTINUED)

16. Place the return spring (Figure 7 (10)) over the rack. Place the spring retainer (11), the shut-off plate (12), and the M10 locking nut (24) over the threads on the rack link (1). The flats on the shut-off plate (12) must engage the flats on the link (1).
17. Tighten the nut to 6 – 8 N•m and ensure that the shut-off plate is vertical and secure.



Setting high fuel levels may cause the maximum fuel adjusting screw to hit the top cover, which can change the minimum fuel position. This could lead to a dangerous condition. When setting fuel levels above 17mm, ensure that the adjusting screw does not contact the top cover at minimum level. Make sure that the cold start magnet is de-energized when adjusting the actuator with the cold start option.

18. Test the engagement of the shut-off mechanism with the rack linkage. Swing the lever back into the actuator. Push on the armature to ensure that the rack linkage operates smoothly and returns immediately when released.
19. Reattach the lower actuator cover (Figure 8 (23)) and tighten the screws (20, 22) to 2 – 3 N•m.

20. Loosen the mounting screw (Figure 9 (17)) and the fastener screw (18) so the lever (16) can be adjusted in its slot (Fig.1). Adjust the lever so that the bearing pushes the rack 0.5 - 0.7 mm away from its stop position. Hold the lever in this position and tighten the screws (18) and (17) to 7 N•m. The rack is now adjusted.
21. Confirm that the operating lever screw (19) is tightened to 13 N•m. Inspect the assembly to make sure all screws are tight.
22. The lever has a maximum fuel adjustment set screw (14). This screw is used to restrict the fuel rack from 1 to 14.5 mm. With the fuel pump operating on the engine, the maximum fuel setting can be set to provide specific horsepower. For the final maximum fuel setting, it is recommended that a thread locking fluid, such as Loctite 243, be applied to the threads of the fuel setting screw.
23. Hold the screw in the required position with the appropriate hex-key and tighten the lock-nut (15) to 8.0 – 8.8 N•m.
24. Move the manual shut-off lever to the stop position and ensure that the fuel is completely shutoff and the engine stops.
25. With the engine shut down, install the upper chamber cover (Figure 8 (21)) with the four screws (20, 22) and flat washers (25). Note that when installed, the internal lever (Figure 9 (16)) or its stop screw (14) must not hit the cover.
26. Tighten the screws to 2 – 3 N•m. Check for any oil leaks. Lock wire the screws (Figure 8 (22)) for tamper resistance.

FIGURE 7

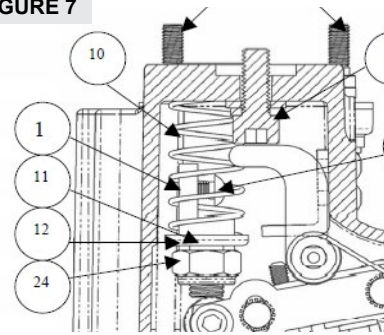


FIGURE 8

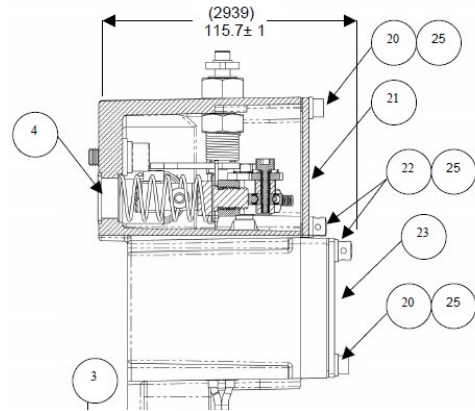
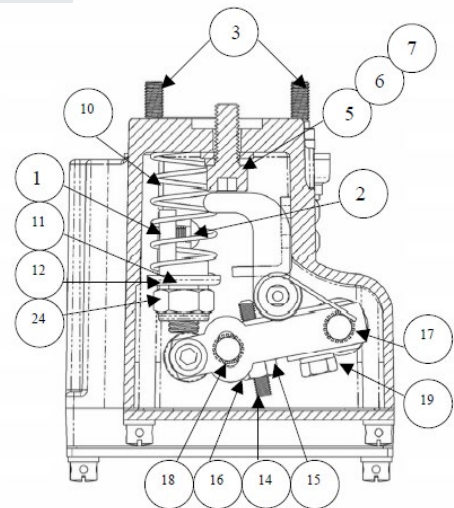


FIGURE 9



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WIRING

The 176 Series Integral Electric Actuator is prewired for 12 or 24 V DC operation. Use the included cable harness or make up a cable harness to connect the actuator to the speed control unit. See your speed control unit installation guide for more information.

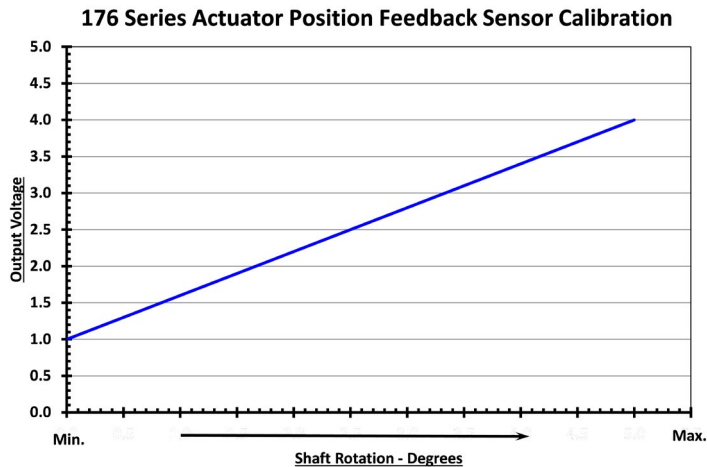


Do not use the 176 Series actuator on a 32-volt system. Contact your GAC representative for assistance.

NOTE

Minimum of 16 AWG wire should be used for the connection between actuator and speed control. The position feedback sensor can use 18 AWG if desired.

176 F- VERSIONS ONLY - FEEDBACK SENSOR CALIBRATION



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TROUBLESHOOTING

If the actuator does not start or testing should be completed using your speed controller.

1. Energize the actuator to full fuel following the steps in your speed control units installation manual.
2. Manually move the actuator through its range using the stop lever. No binding or sticking should occur.
3. See the troubleshooting section of your speed control unit's installation manual for additional testing.