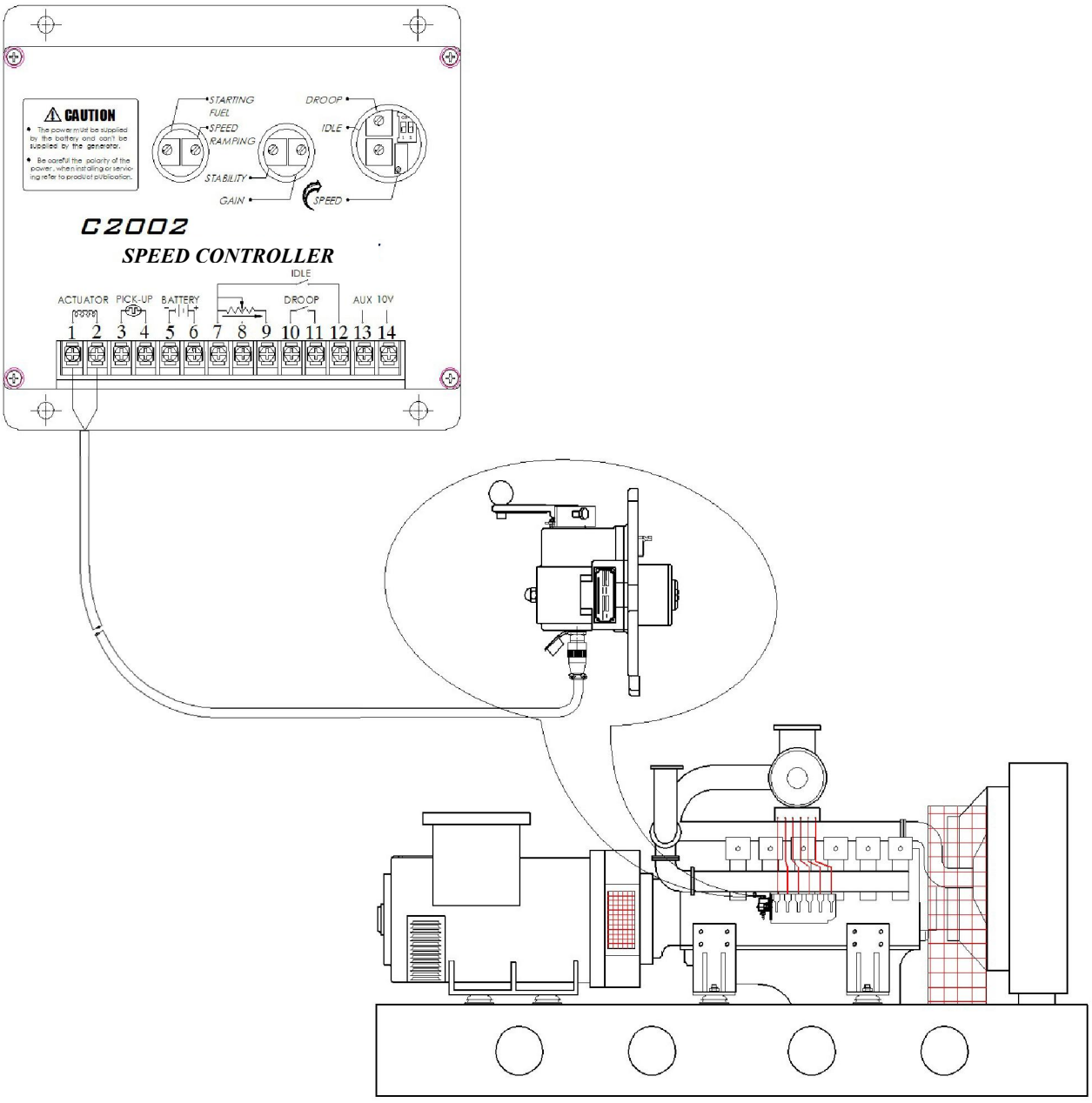
FORTRUST®

ESG2002 series

ELECTRONIC GOVERNOR

INSTRUCTION



Foreword

This manual mainly introduced the working principle of the electronic speed control system, system composition, Regulation, operation, maintenance and simple troubleshooting method, suitable for a certain understanding, to the engine and the electronic governor routine installation, use and repair personnel. Recommend the product specification in the workplace, and strictly follow the method given here to operate.

Caution

- Speed sensor to the electronic control system shall not be shared with other systems, or they may cause serious consequences.
- You can't rely on the electronic speed control system to prevent engine over speed, and over speed protection device installed independently, effectively in the engine system.
- Before starting the engine should confirm the fuel injection pump rod in oil cut-off position, push and pull the fuel rack should be flexible and no jam.

CATALOGUE

1 The Principle Of The Electronic Governor System

Electronic governor, with its simple structure, high reliability, convenient operation, easy function extension and high cost performance, applies to all kinds of diesel generating sets, vehicles and marine diesel engines.

Its normal type is all-electronic single pulse speed and close loop position structure, provided with functions of non-corresponding or corresponding control, speed and rated speed during running maximum fuel supply control, emergency stop and etc.

It is also capable of adding other control functions according to the customer's particular requirements.

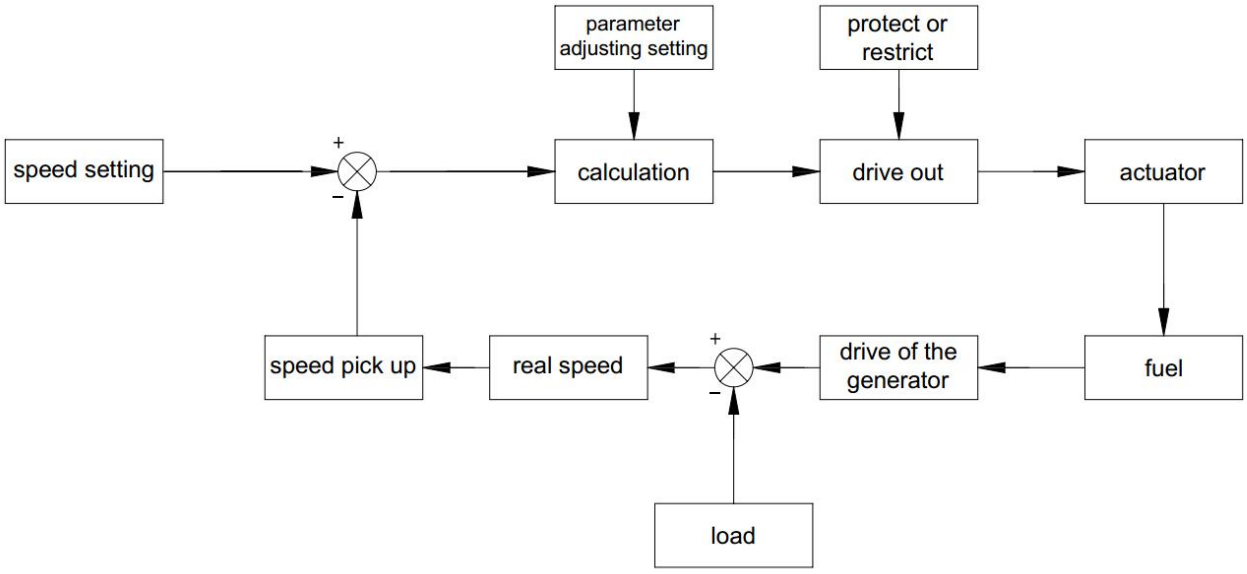


Figure 1.1 Electronic governor system

2 The Structure Of The Electronic Governor System

2.1 Speed Control Unit

2.1.1 The basic electronic characteristics

- SUPPLY VOLTAGE : DC 24V（Scope 18V～32V）or DC12V（Scope9V～16V）
- SUPPLLY CONSUMPTION : < 0.1A (static state)
- SPEED FLUCTUATION RATIO : ≤ ±0.25%
- STEADY STATE SPEED DROOP : 0~5% Adjustable
- AMBIENT TEMP. : -40℃ ~ +85℃
- RELATIVE HUMIDITY : <95%

2.1.2 The outline and installing size of the C2002 speed control unit

The speed control unit is installed on the control box or fixed other peripheral equipment in the engine. It should be installed in the place of air drying and temperature suitable. If it be installed in the place of more water and humidity, the speed control unit should be mounted vertically. Its outline and installing size refers to figure 2.1.2

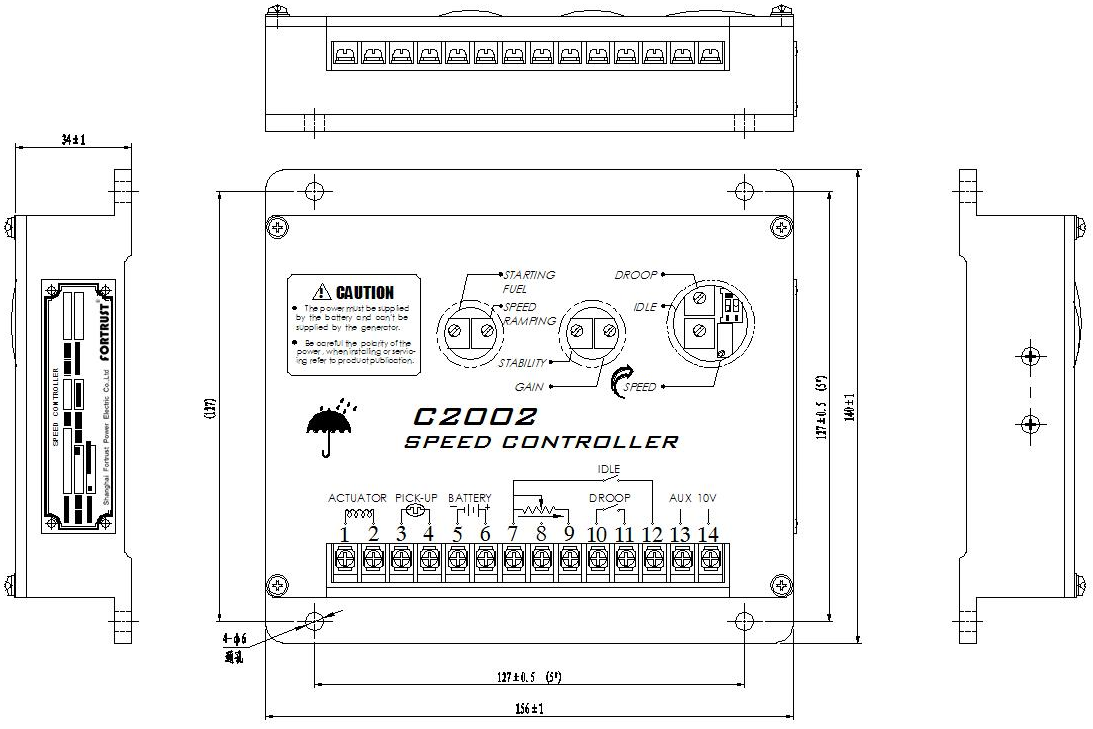


Figure 2.1.2 The outline and installing size of the C2002 speed control unit

2.1.3 Connection diagram of the C2002 speed control unit

2.1.3.1 C2002 speed control unit's connection diagram for normal generator set refers to figure 2.1.3.1

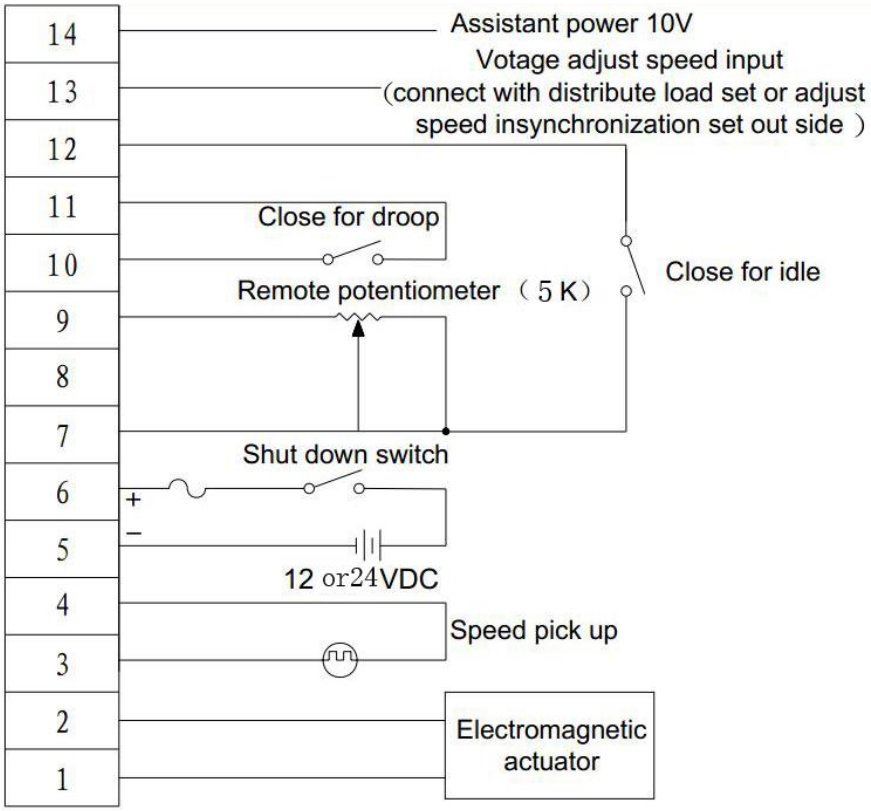


Figure 2.1.3.1 Connection diagram of the C2002 speed control unit for normal generator set

Terminal	Wire harness	
	Less than 6 meters	More than 6 meters
1、2 shall connect with the actuator winding end	1 mm²	2.5 mm²
3、4 shall connect with a speed sensor (the minimum operation signal are both 2.5V AC)	0.5 mm²	1 mm²
5、6 shall connect with the battery (reference to the controller voltage value)	1 mm²	2.5 mm²
7、9 shall connect with the Speed Potentiometer	The signal points are millampere level current, so it can be used 0.5 mm2 ~ 1 mm2 wire harness to connect. In a strong magnetic field environment, you shall use the shield lines to connect , shielding net shall connect the grounded end of the controller effectively.	
7、12 shall connect with the idle switch		
10、11 shall connect with the droop switch		
13 is the access terminal (as input signals for synchronizer, load distribution, ramp generator access points which for the combined machine or extraordinary setting)		
14 is the auxiliary power output for +10V DC, load should be less than 20mA		

- The Electromagnetic Actuator connects to Terminals 1 and 2 and battery connects to Terminals 5 and 6. Terminals 1, 2, 5, and 6 should be #16 AWG (1 ㎜ sq) or larger. Long cables require an increased wire size to minimize voltage drops. The battery positive (+) input, Terminal 6, should be fused for 15 amps as illustrated.
- Magnetic speed sensor connects to Terminal 3 and 4 *MUST BE TWISTED AND/OR SHIELDED* for their entire length. The speed sensor cable shield should only be connected to Terminal 4. The shield should be insulated to insure no other part of the shield comes in connect with engine ground, otherwise stray speed signals may be introduced into the speed control unit to stop the engine.
- The remote potentiometer connects to Terminal 7 and 9. If it resistance is 5KΩ, speed adjusting range is 2400HZ.
- Speed droop connects to Terminal 10 and 11. When the Terminal 10 and 11 is off, speed droop is 0; When the Terminal 10 and 11 is closed, speed droop range is 0-5%.
- Rated and idle speed switch connects to Terminal 7 and 12. The switch close for idle, the switch off for rated speed.
- Terminal 13 receives input signal from load distribution device, automatic synchronizer device and other governor system auxiliary device.
- Terminal 14 output +10 volt regulated supply.

2.2 The Electromagnetic Actuator

The Electromagnetic Actuator is the executive element of the electronic governor. ESG2002 series speed control unit that is single-loop control mode can matching all kinds of electromagnetic actuator, such as A800C-W、A900C-W、A1000C-W-d1、A2000C-W-d1、A08A-W、A1AWL、A1AWT、A3A-W、A3B、CA2-W.

The following introduction can be divided into external and internal type respectively according to the actuator of the installation.

2.2.1 Internal type Actuator

Internal installation refers to the electromagnetic actuator part instead of the high pressure oil pump mechanical governor attached directly to the high pressure oil pump body as an organic whole, internal actuator rack and the high pressure oil pump rack and linkage. Actuator external parking hand handle, and can be realized by adjusting the handle is the location of the parking of the bulk oil limited. ESG2002 series can match internal actuator such asA800C-W、A900C-W、A1000C-W-d1、A2000C-W-d1、A08A-W、A3A-W、CA2-W.

2.2.1.1 A800C-W electromagnetic actuator

- WORKING VOLTAGE: DC24V
- WORKING TORQUE: 0.8 N.m
- WORKING STROKE: 17mm

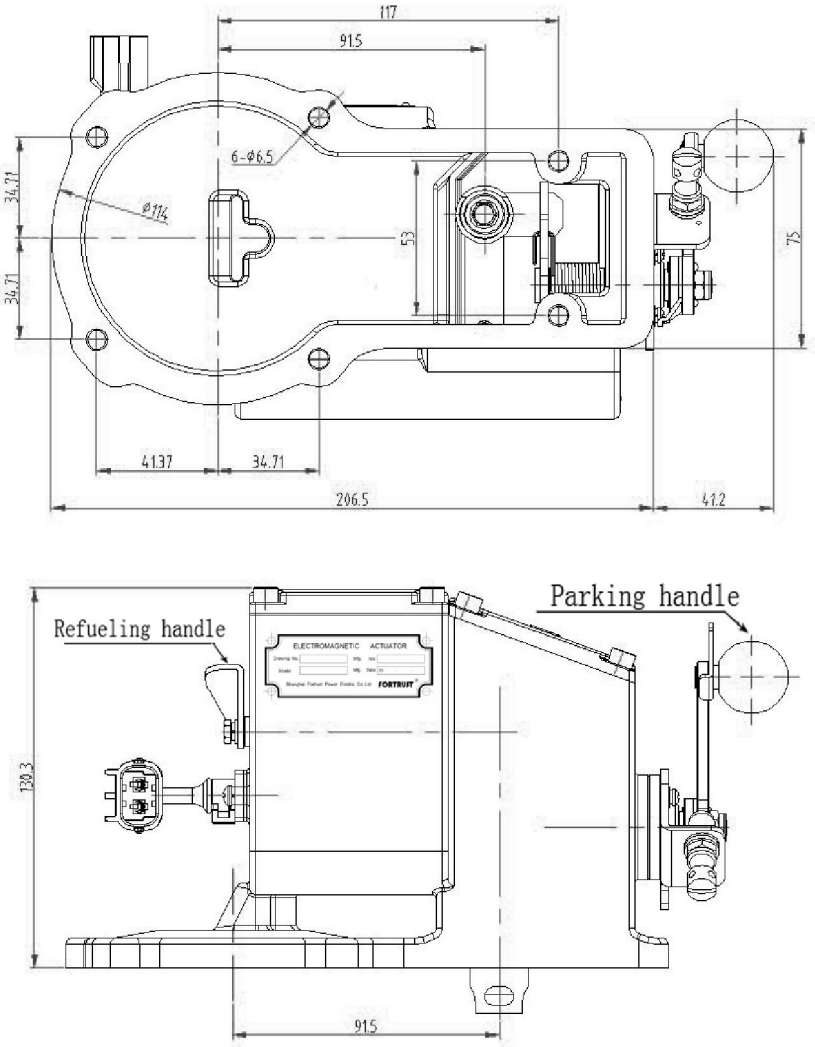


Figure 2.2.1.1 The outline and installing size of the A800C-W electromagnetic actuator

2.2.1.2 A900C-W electromagnetic actuator

- WORKING VOLTAGE: DC24V
- WORKING TORQUE: 0.9N.m
- WORKING STROKE: 22.5 mm

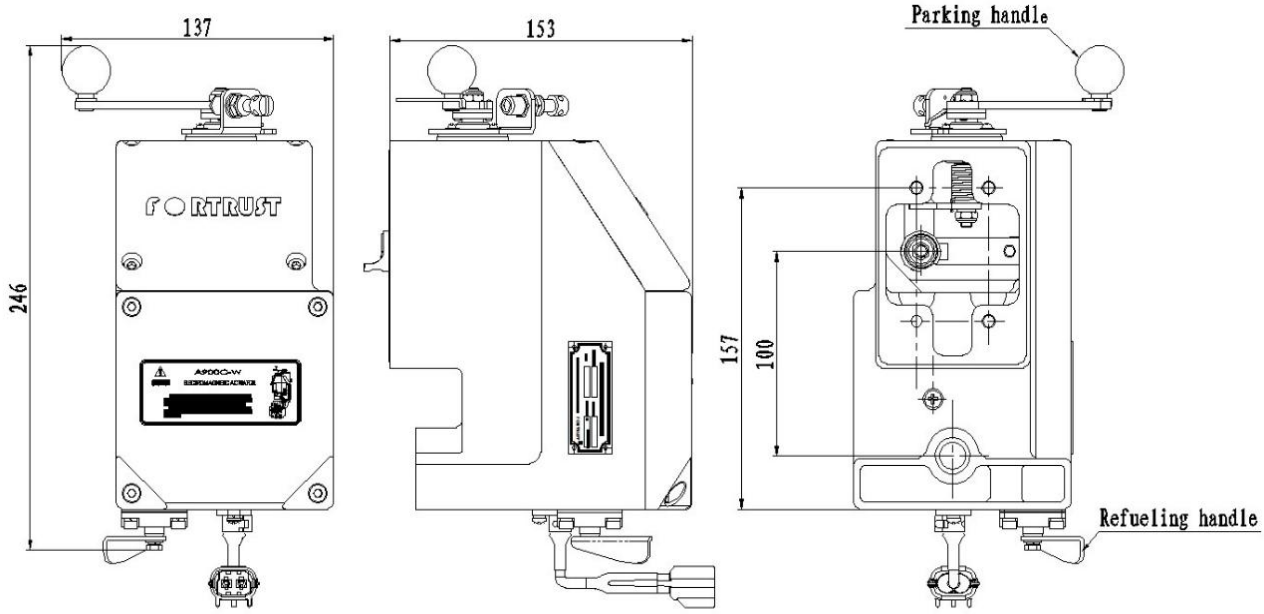


Figure 2.2.1.2 The outline and installing size of the A900C-W electromagnetic actuator

2.2.1.3 A1000C-W-d1 electromagnetic actuator

- WORKING VOLTAGE: DC24V、DC12V optional (order specify)
- WORKING TORQUE: 1 N.m
- WORKING STROKE: 22 mm

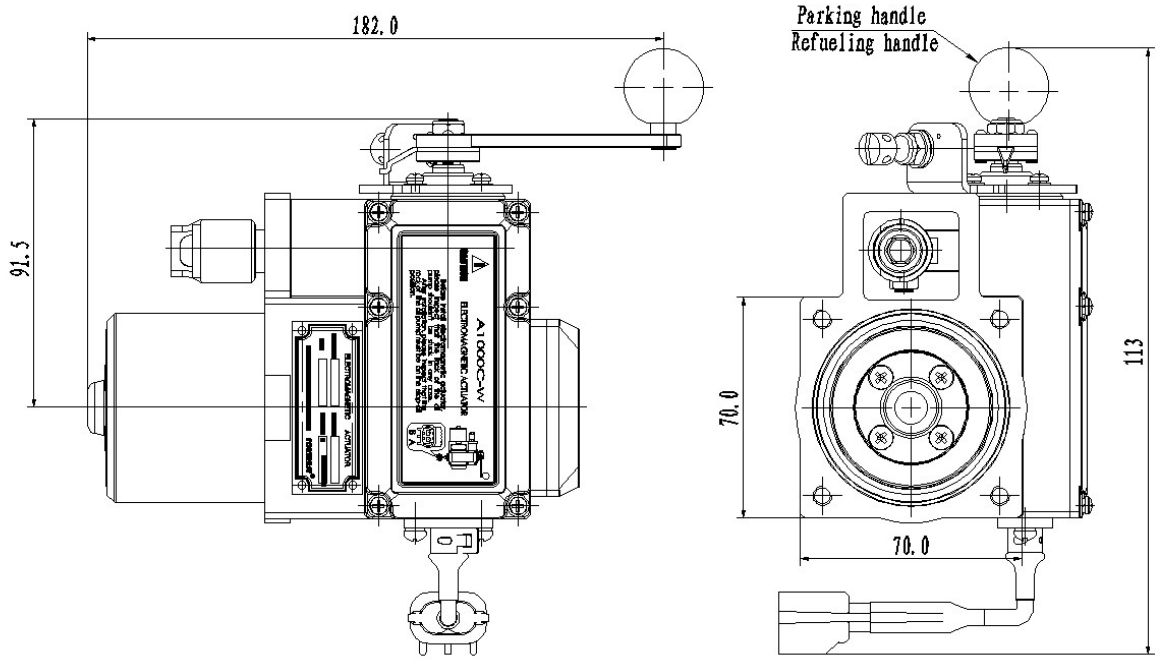


Figure 2.2.1.3 The outline and installing size of the A1000C-W-d1 electromagnetic actuator

2.2.1.4 A2000C-W-d1 electromagnetic actuator

- WORKING VOLTAGE: DC24V
- WORKING TORQUE: 2 N.m
- WORKING STROKE: 22mm

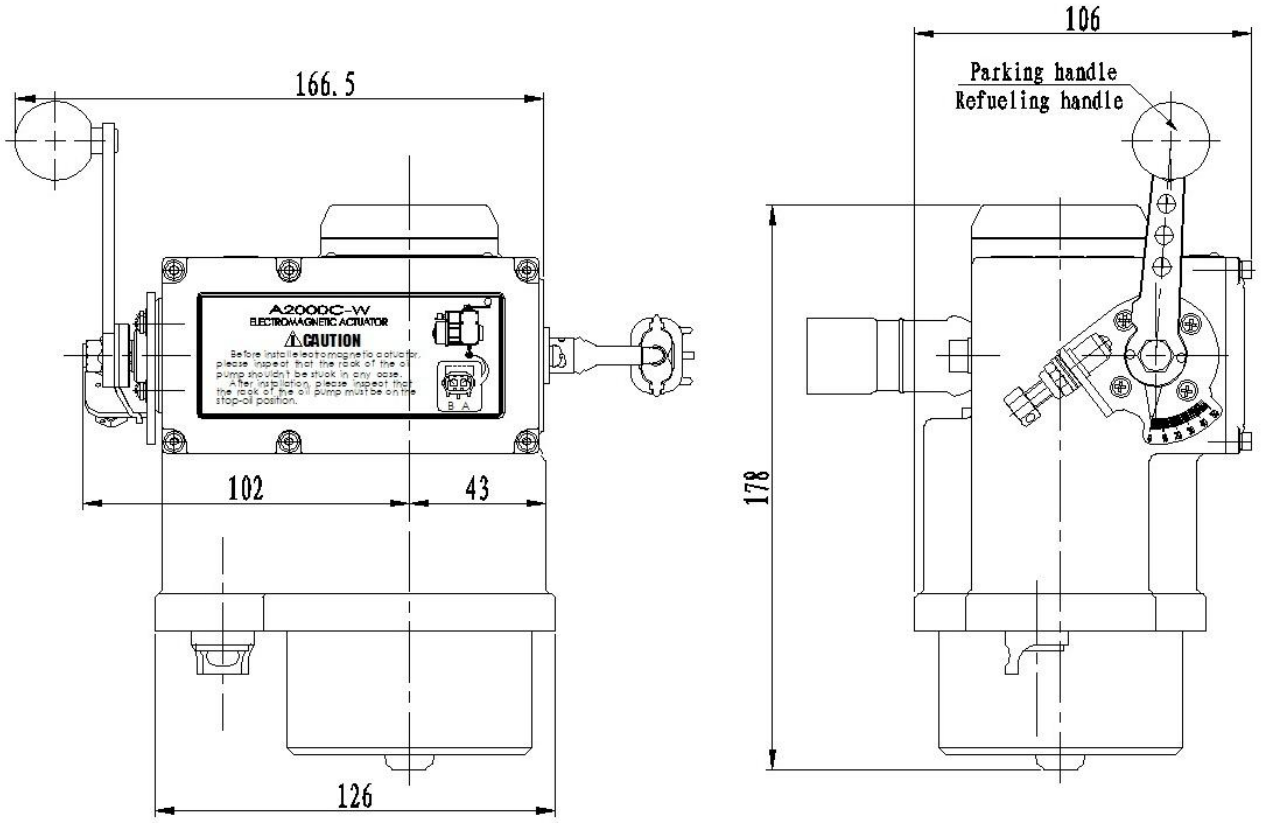


Figure 2.2.1.4 The outline and installing size of the A2000C-W-d1 electromagnetic actuator

2.2.1.5 A08A-W electromagnetic actuator

☑WORKING VOLTAGE: DC24V、DC12V optional (order specify)

☑WORKING TORQUE: 0.8N.m

☑WORKING STROKE: 18mm

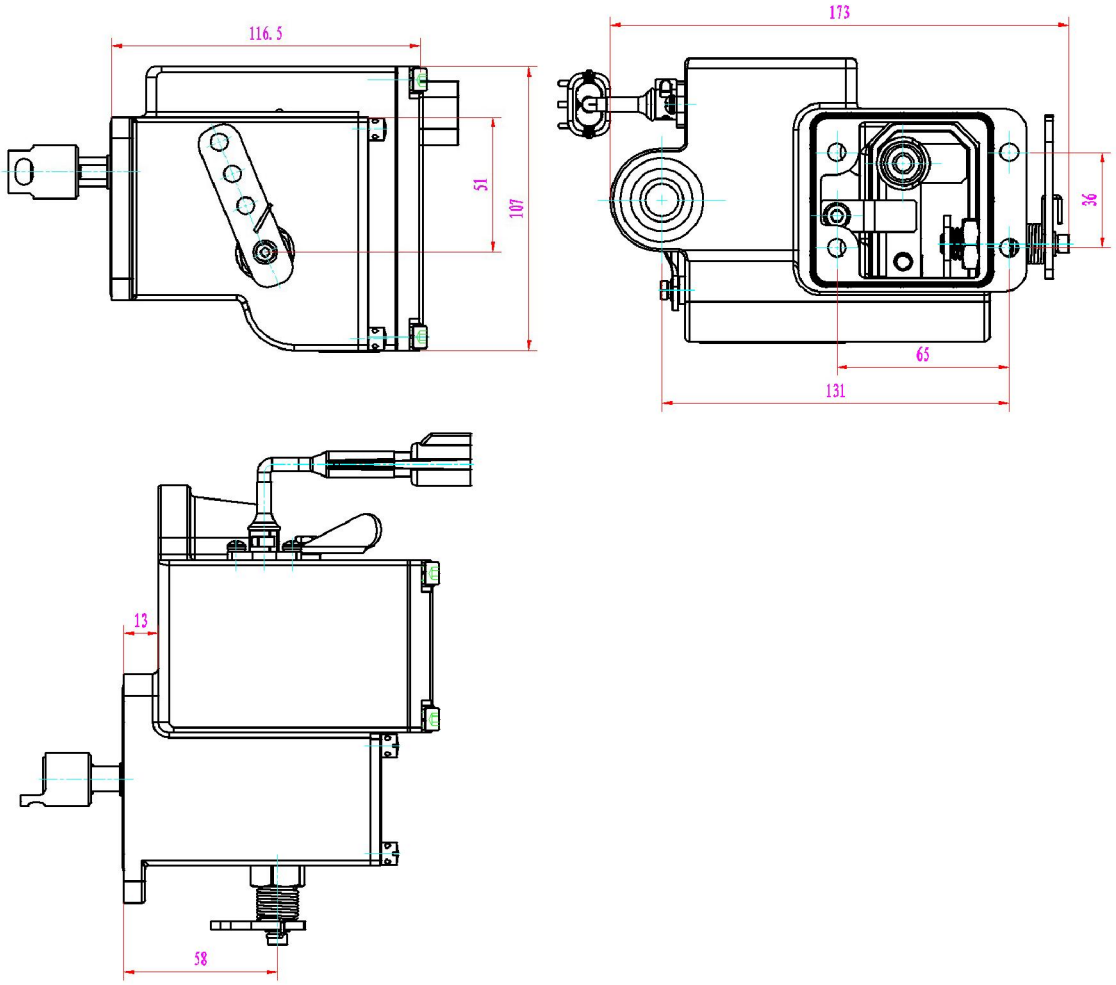


Figure 2.2.1.5 The outline and installing size of the A08A-W electromagnetic actuator

2.2.1.6 A3A-W electromagnetic actuator

☑WORKING VOLTAGE: DC24V、DC12V optional (order specify)

☑WORKING TORQUE: 0.9Nm

☑WORKING STROKE: 19mm

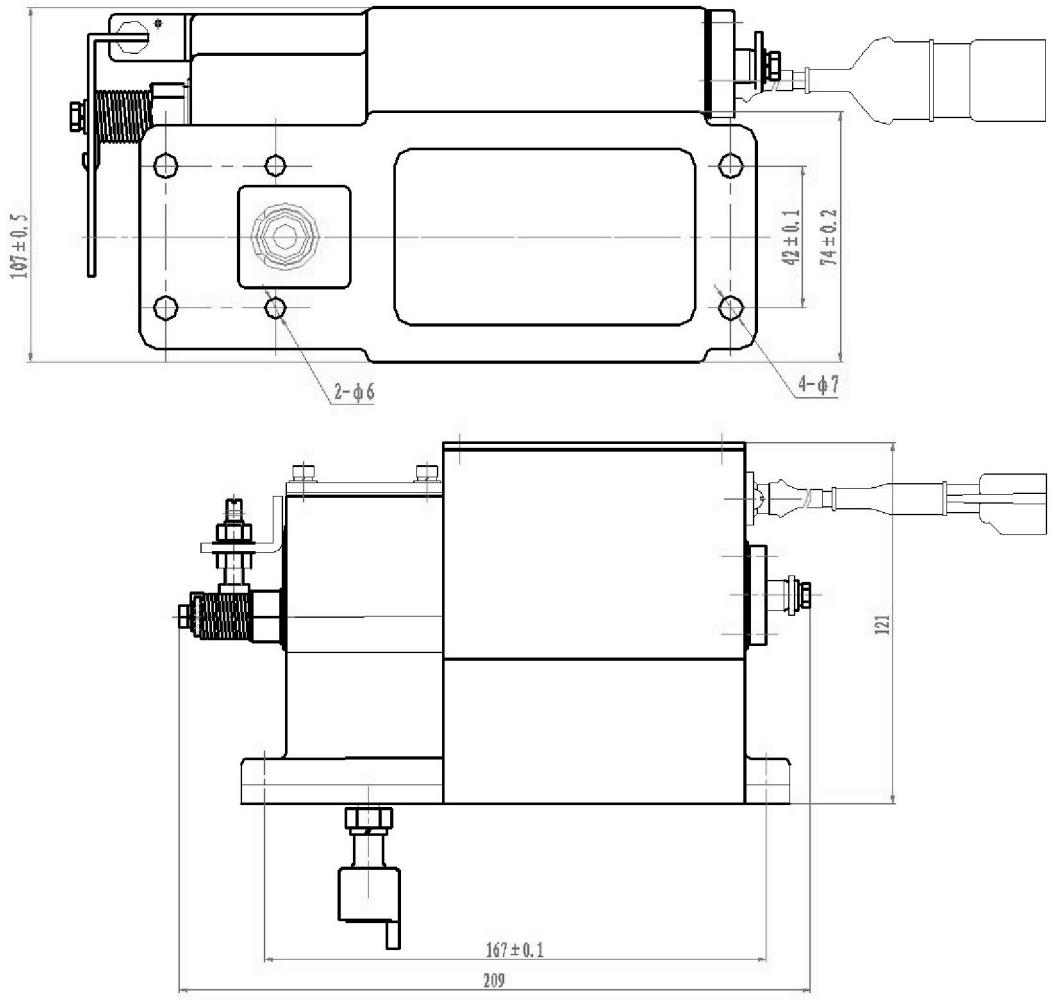


Figure 2.2.1.6 The outline and installing size of the A3A-W electromagnetic actuator

2.2.1.7 CA2-W electromagnetic actuator

☑WORKING VOLTAGE: DC24V

☑WORKING TORQUE: 1.2N.m

☑WORKING STROKE: 20mm

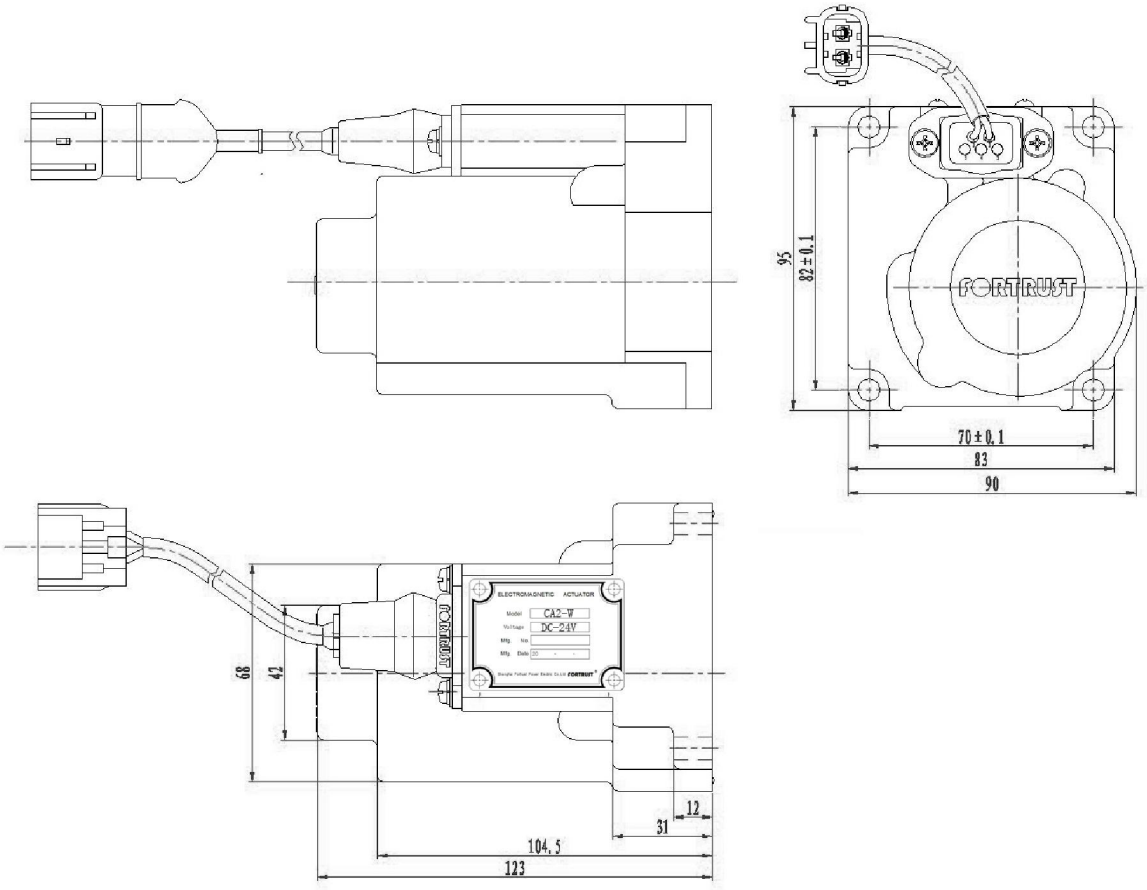


Figure 2.2.1.7 The outline and installing size of the CA2-W electromagnetic actuator

2.2.2 External type installation

External installation refers to the oil supply handle through electromagnetic actuators linkage with mechanical governor cut-out handle connected to the pump in the actuator，on the connection handle to set the different installation hole, by changing the location of the mounting holes can meet different stroke and the pump torque, and this kind of connection mode is more suitable for the complete assembly of diesel engine and governor. ESG2002 series can match the external actuator,such as A3B、A1AW.

2.2.2.1 A1AWL electromagnetic actuator

☑WORKING VOLTAGE: DC24V、DC12V optional (order specify)

☑WORKING TORQUE: 1N.m

☑WORKING STROKE: 21mm

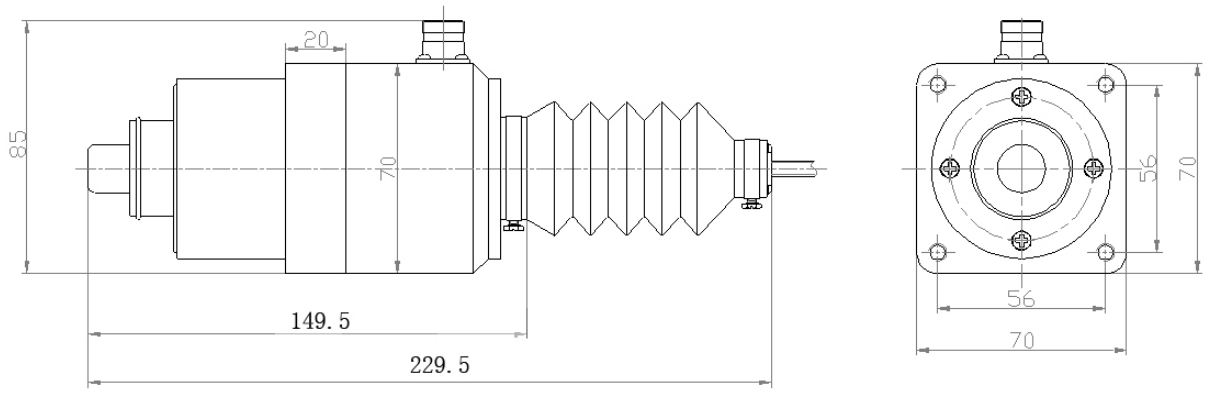


Figure 2.2.2.1 The outline and installing size of the A1AWL electromagnetic actuator

2.2.2.2 A1AWT electromagnetic actuator

☑WORKING VOLTAGE: DC24V、DC12V optional (order specify)

☑WORKING TORQUE: 1N.m

☑WORKING STROKE: 21mm

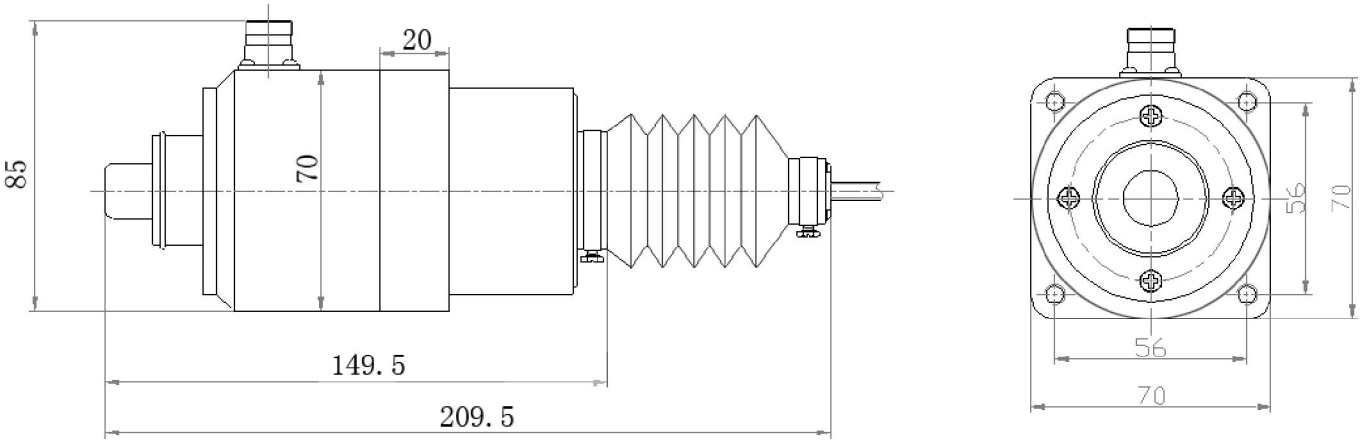


Figure 2.2.2.2 The outline and installing size of the A1AWT electromagnetic actuator

2.2.2.3 A3B electromagnetic actuator

☑WORKING VOLTAGE: DC24V、DC12V optional (order specify)

☑WORKING TORQUE: 0.9N.m

☑WORKING STROKE: 25°

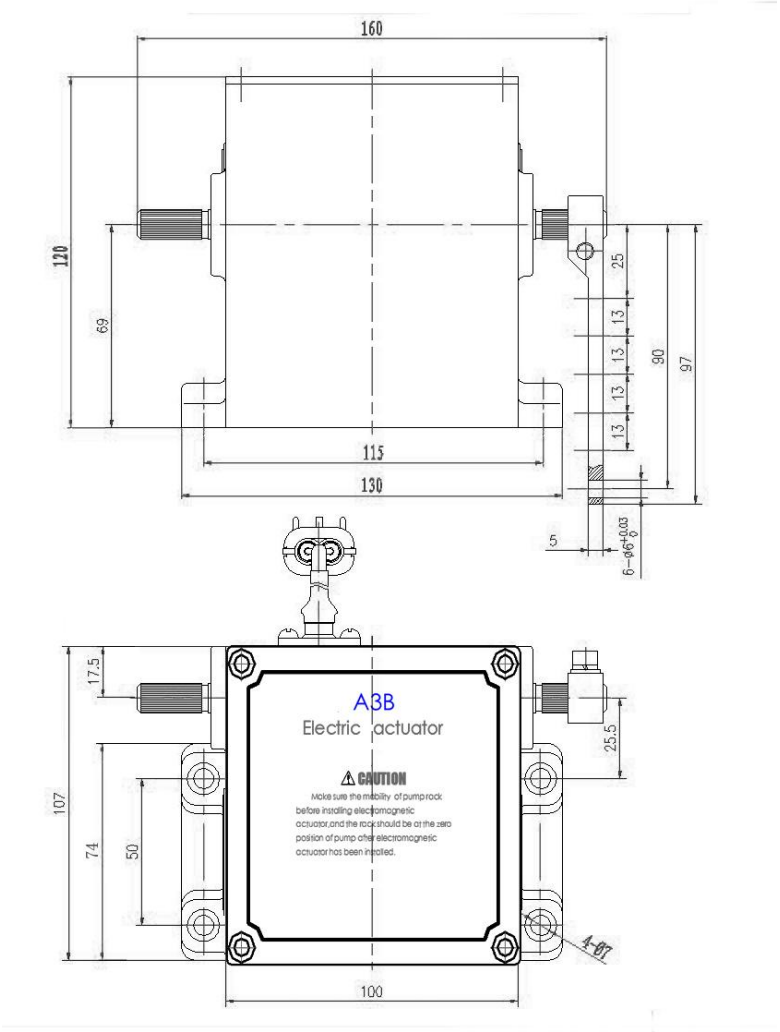


Figure 2.2.2.3 The outline and installing size of the A3B electromagnetic actuator

2.3 Speed Pick-up

The Speed Pick-up of the Electromagnetic Governor is Speed Pick-up of magnetoelectricity, inner structure of which are made of sensor, loop, alnico and plug. Its structure refers to figure 2.3. The gap between the magnetic speed sensor and the ring gear teeth should not be any smaller than 0.02 in. (0.45 mm). Usually, backing out the speed sensor 3/4 turn after touching the ring gear tooth will achieve a satisfactory air gap.

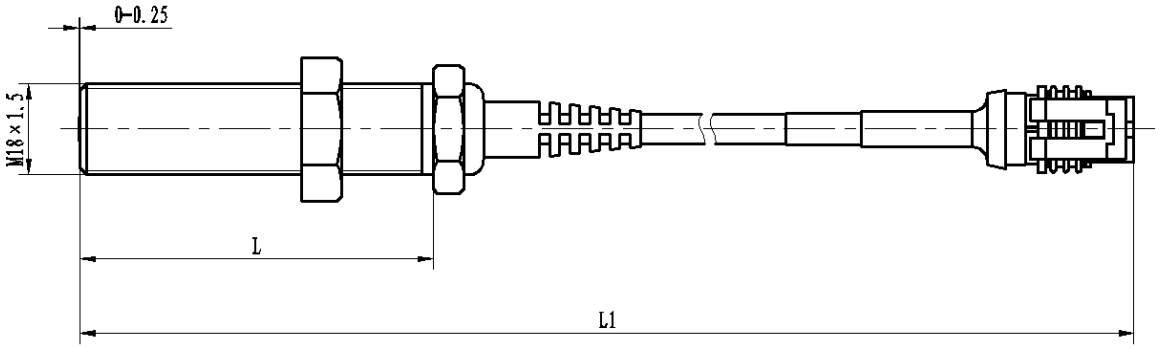


Figure 2.3 The outline and installing size of series speed pick-up（M16、M18、 inch series can choose This chart is M18 ）

TM18X1.5-(L)A series speed pick-up		
Product Model	L(MM)	L1(MM)±0.5MM
TM18X1.5-50A-00	50	315
TM18X1.5-70A-00	70	330
TM18X1.5-90A-00	90	353
TM18X1.5-130A-00	130	392

＊ We can provide rotate speed sensors according to customer orders.

Cautions: the use of speed sensor to the electronic control system shall not be shared with other system, otherwise it may cause very serious consequences!

3 Installing and Debugging

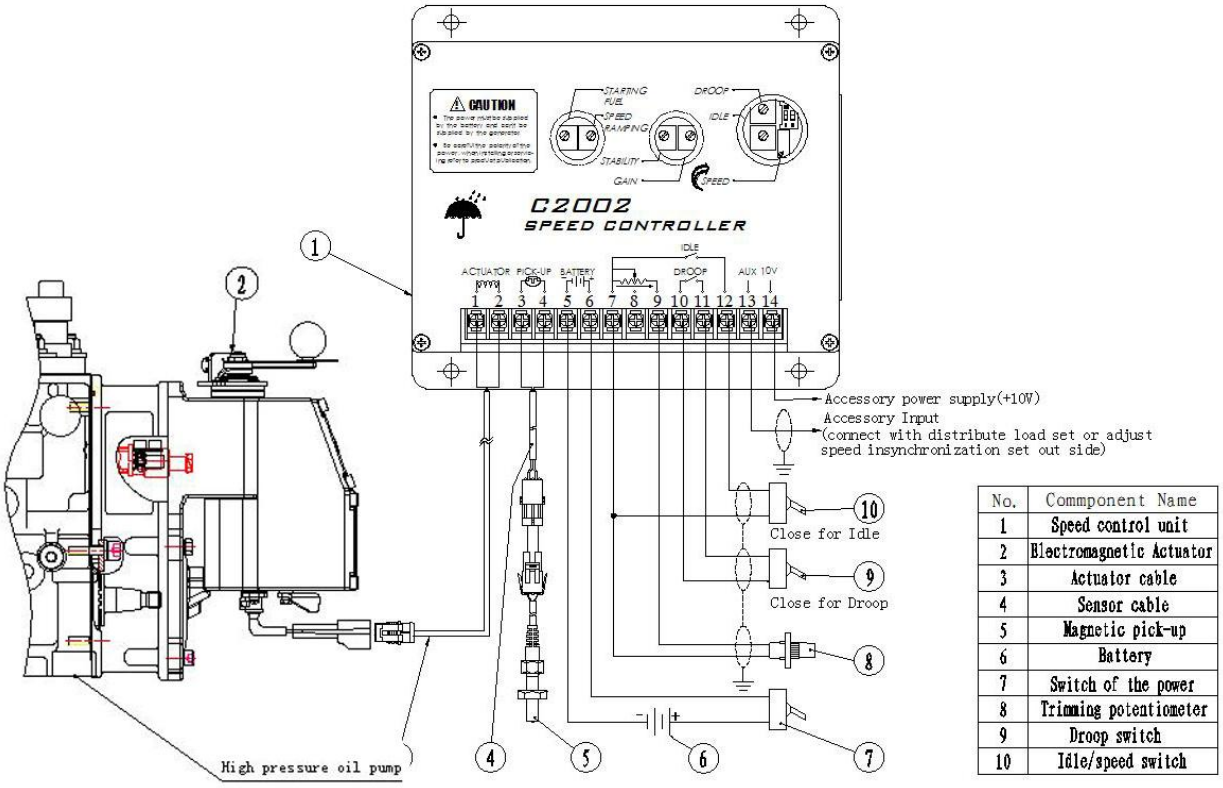
3.1 Installing Of The Electronic Governor

The C2002 speed control unit is rugged enough to be placed in a control cabinet or engine mounted enclosure with other dedicated control equipment. If water、mist or condensation may be in contact with the controller, it should be mounted vertically. This will allow the fluid to drain away from the speed control unit.

Warning !

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

3.2 Connection Diagram Of The ESG2002 Series Electronic Governor System



No.	Commponent Name
1	Speed control unit
2	Electromagnetic Actuator
3	Actuator cable
4	Sensor cable
5	Magnetic pick-up
6	Battery
7	Switch of the power
8	Trimming potentiometer
9	Droop switch
10	Idle/speed switch

Figure 3.2 Connection diagram of the ESG2002 series electronic governor system

3.3 Adjustments before Starting Engine

Check to insure the **GAIN** and **STABILITY** adjustments, normally this value is set mid position by factory.

Leave factory conditions of Red State Switch is  , namely RSW-1, RSW-3 = OFF, RSW-2 = ON.

Rated and idle speed of the speed control unit had been set by factory. Normally, this value is near from the user's engine working rotate speed value. In practice, after some adjustments, controller can achieve rated and idle speed, and the stability would be very well.

3.4 Adjustment of the Controller after Starting

3.4.1 Crank the engine with D.C. power applied to the governor system. Start fuel quantity varies with environmental temperature of engine start. Though adjusting start fuel quantity potentiometer; exhaust smoke from the engine can be adjusted to the best state.

3.4.2 The governor system should control the engine at low idle speed. If the engine is unstable after starting, turn the **GAIN** and **STABILITY** adjustments counterclockwise until the engine is stable.

3.4.3 The governed speed set point is increased by clockwise rotation of the **SPEED** adjustment control. Remote speed adjustment can be obtained with an optional Speed Trim Control.

3.4.4 Once the engine is at the operating speed and at no load, the following governor performance adjustments can be made.

3.4.4.1 Rotate the **GAIN** adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further counterclockwise to insure stable performance.

3.4.4.2 Rotate the **STABILITY** adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further counterclockwise to insure stable performance.

3.4.4.3 Gain and stability adjustments may require minor changes after engine load is applied. Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to further optimize the adjustments.

3.4.5 After the governor speed setting has been adjusted, place the optional external selector switch in the **IDLE** position. The idle speed set point is increased by clockwise rotation of the **IDLE** adjustment control.

When the engine is at idle speed, the speed control unit applies droop to the governor system to insure stable operation.

3.4.6 Through the above adjustments engine still unable to stability, it needs to be adjusted Red State Switch now, figure 3.4.6 four cases (a: RSW-1、RSW-3 = ON、RSW-2 = OFF; b: RSW-1、RSW-2 = OFF、RSW-3 = ON; c: RSW-1、RSW-2 = ON、RSW-3 = OFF; d: RSW-1、RSW-3 = OFF、RSW-2 = ON). After every adjusting Red State Switch go on the 3.4.4.1 and 3.4.4.2 adjusting procedure again. If it is still unable to stability, should inspect engine and fuel pump for service condition. And then, contact with manufacturer.

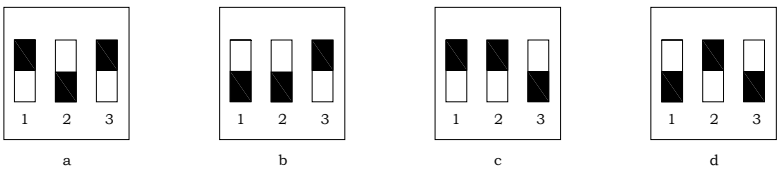


Figure 3.4.6 Red State Switch

3.5 Speed Droop Operation

3.5.1 Droop is typically used for the paralleling of engine driven generators.

3.5.2 Place the optional external selector switch in the **DROOP** position, that is connected Terminals 10 and 11. Droop is increased by clockwise rotation of the **DROOP** adjustment control. When in droop operation, the engine speed will decrease as engine load increases. The percentage of droop is based on current change from no load to full load of the actuator.

3.5.3 After the droop level has been adjusted, the rated engine speed setting may need to be reset. Check the engine speed and adjust the speed setting accordingly.

3.6 Accessory Input

3.6.1 When the Auxiliary Terminal 13 accepts input signals from load sharing units, auto synchronizers and other governor system accessories are directly connected to this terminal. It is recommended that this connection form accessories should be shielded as it is a sensitive input terminal.

3.6.2 When an accessory is connected to Terminal 13, the speed will decrease and the speed adjustment must be reset.

3.7 Accessory Output

The +10Volt regulated supply, Terminal 14, can be utilized to provide power to **FORTRUST** governor system accessories. Up to 20mA of current can be drawn from this supply. Ground reference is Terminal 7. Caution - a short circuit on this terminal can damage the speed control unit.

4 System Troubleshooting

4.1 Fault judgment of the electronic governor

The fault of the electronic governor will cause the engine performance degradation which may lead the engine shut down. If you can judge this is the fault of the electronic governor , you just shall change the electronic governor ; if there are something trouble with the engine and the auxiliary system which incarnate the engine speed less than the using requirement , and then the problem can't solve even you replace the electronic governor. Thus you shall analyze the problem comprehensively and validate to determine it.

This chapter provides the program flow of typical fault judgment and treatment:

- Engine cannot start
- Engine speed instability
- Engine shut down during the running period
- Engine speed fell sharply after loading
- Engine over speed

4.1.1 Engine can not start

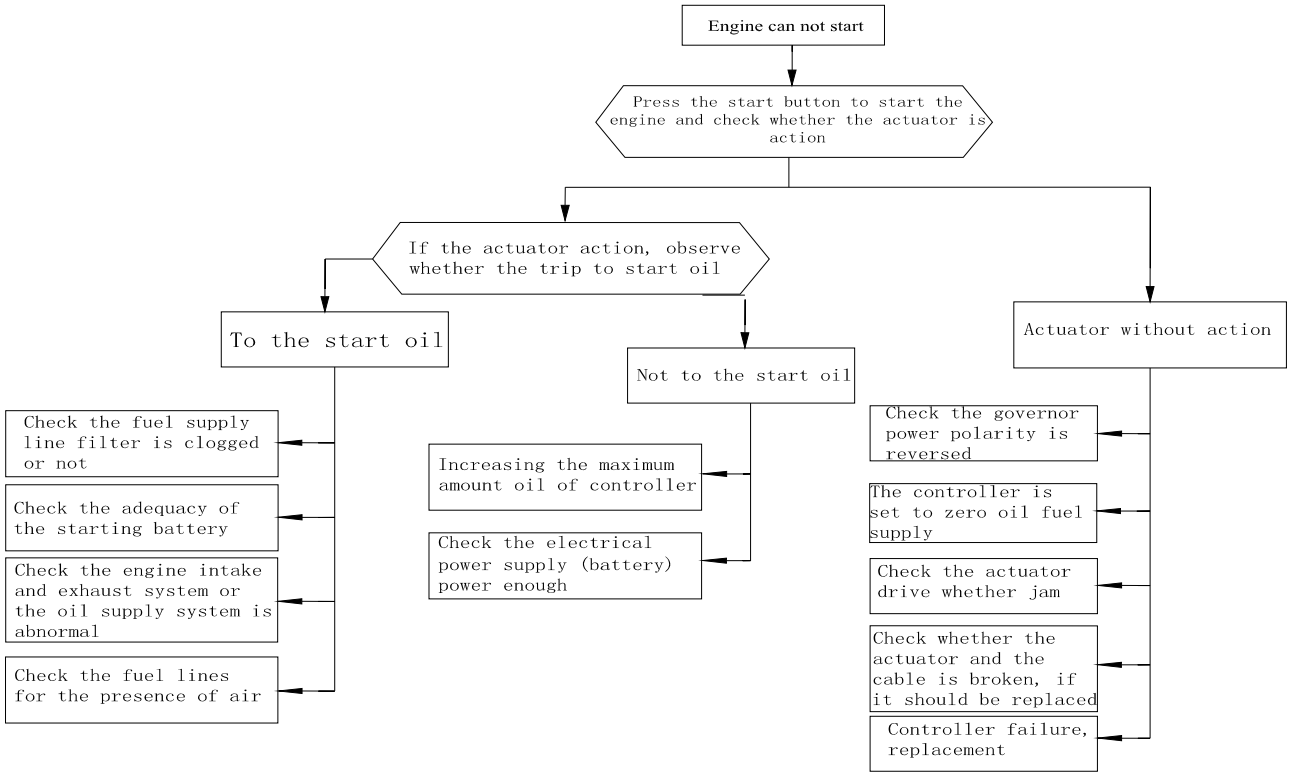


Figure 4.1.1 Engine cannot start

4.1.2 Engine speed instability

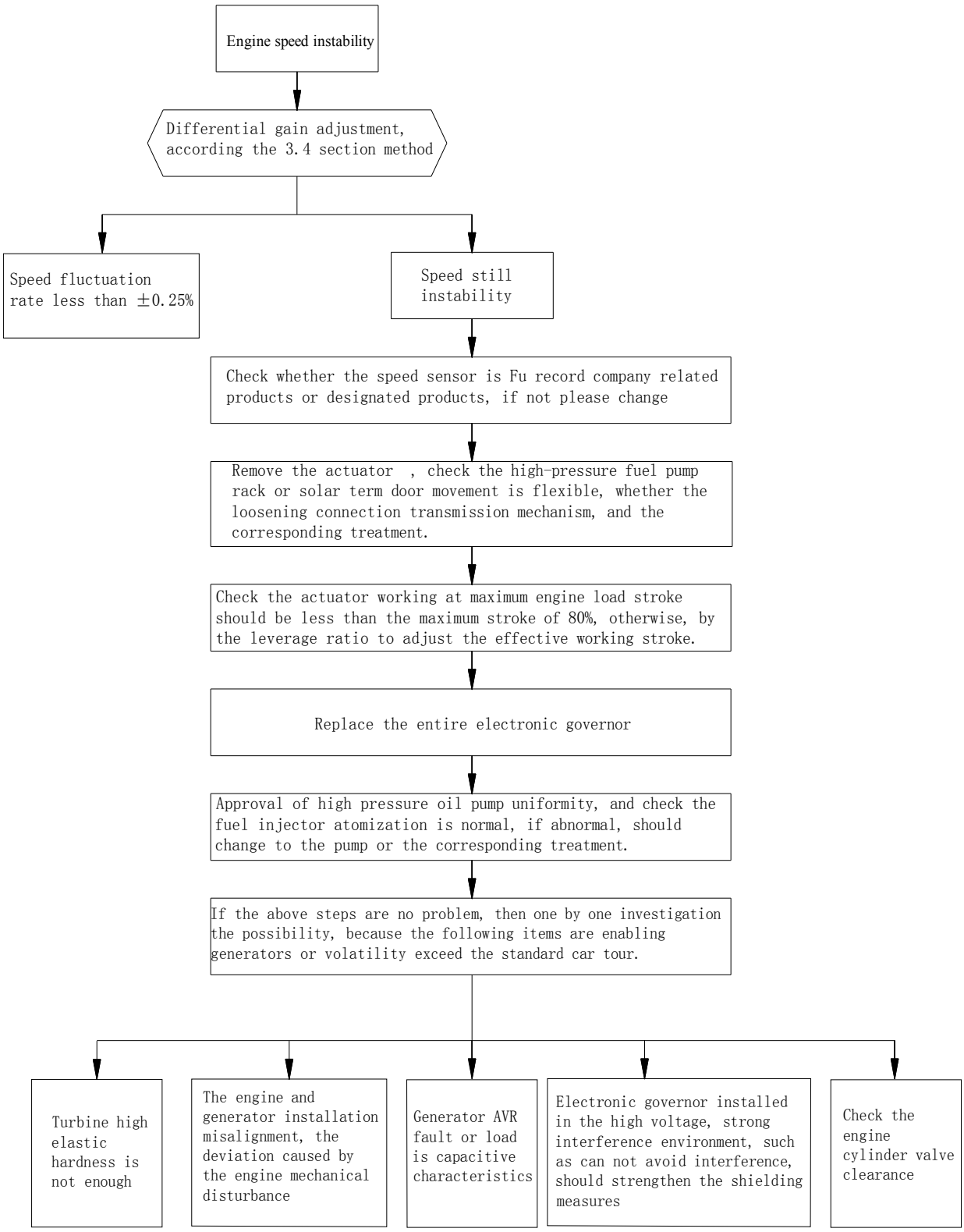


Figure 4.1.2 Engine speed instability

4.1.3 Engine shut down during the running period

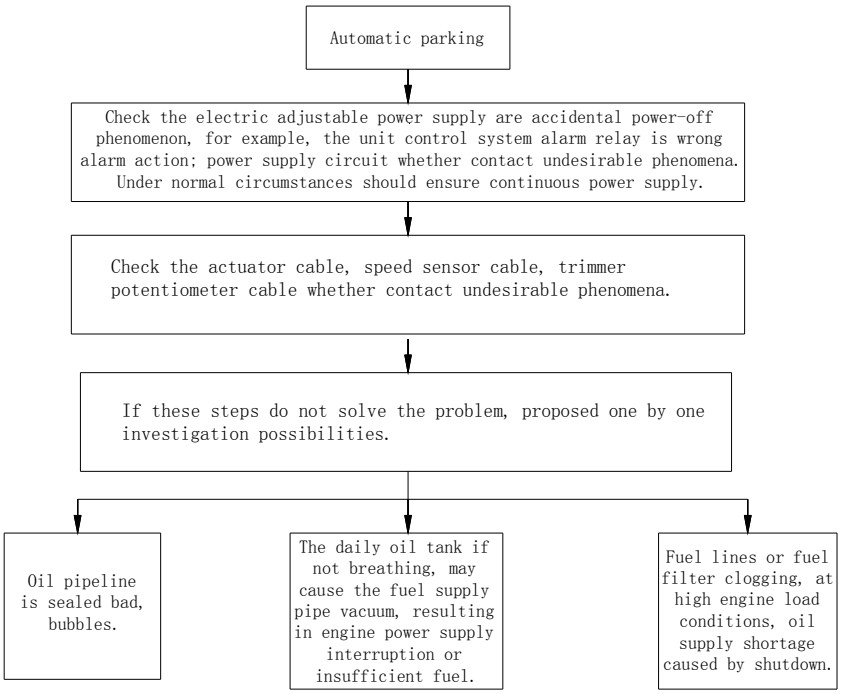
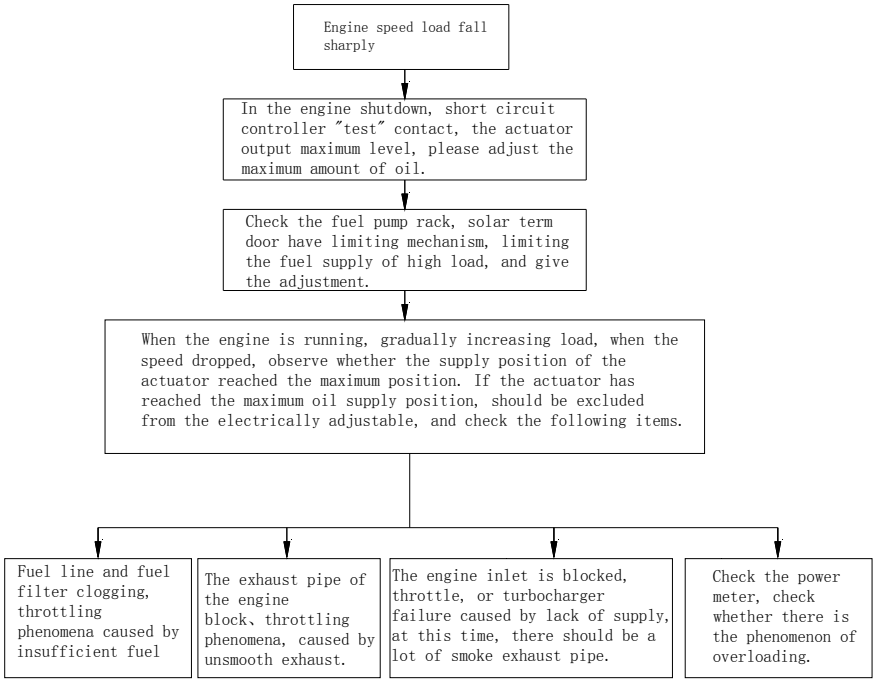


Figure 4.1.3 Engine shut down during the running period

4.1.4 Engine speed fell sharply after loading



- **Figure 4.1.4** Engine speed fell sharply after loading

4.1.5 Engine over speed

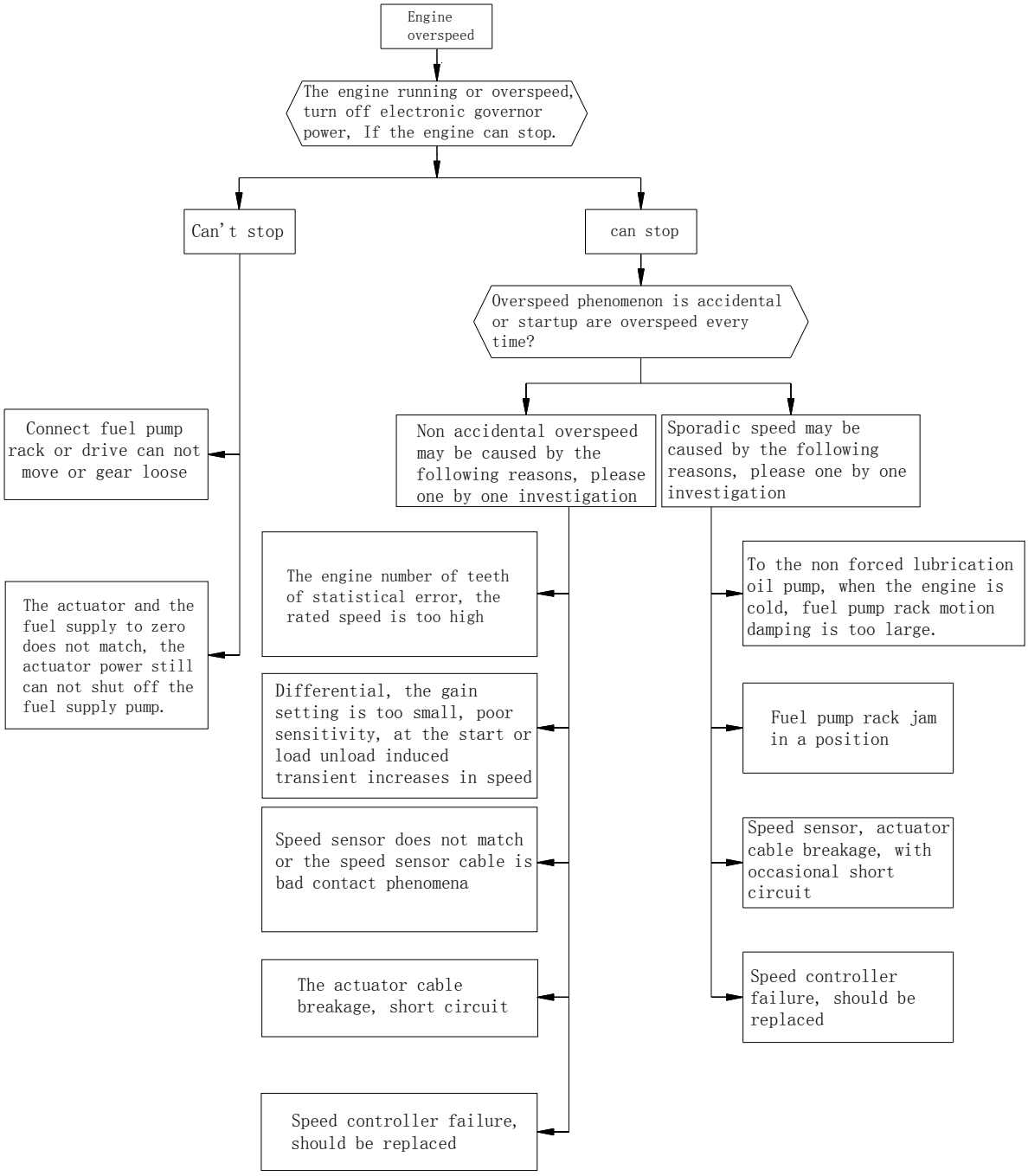


Figure 4.1.5 Engine over speed

Remark:

If the trouble not be solved after you deal with the mentioned ways while there is no trouble with the engine system, maybe it is the internal fault of the governor, please send to the repair. If you can't repair it by yourself please don't overhaul in case of expanding the fault.

4.2 Insufficient Magnetic Speed Sensor Signal

When the speed sensor signal is stronger, it can resist the external pulses , the speed sensor can measure the outputted signal which is more than 3volts .When the voltage is less than 3volts, you shall reduce the tooth gap between the speed actuator and engine ,which can improve the amplitude of the signal. The gap shall less than 0.45mm. If the voltage is still less than 3 volts, you shall check the whether the magnetism of the speed actuator is too weak.

4.3 Electromagnetic interference (EMI)

The electronic governor system can be adversely affected by large interfering signals that are introduced through the cabling or through direct radiation into the control circuits. To avoid the medium interference, all the speed controller produced by Fortrust include the filter unit and shielding designs that can protect the sensitive circuits from the external interference.

It is difficult to predict the value of the interference. You shall consider all the possible range of the interference such as the radio communications of the space field, wireless walkie-talkie, and wireless radio transmitter and also including the use of magneto, solid-state ignition systems, and voltage adjuster or battery chargers.

When you doubt that space field or other systems will affect the speed governor system operation by conduction or direct radiation during the using period, we suggest that you shall use the double shielded cables as the external cables of the controller. Also ensure that one terminal of the shielded cable which includes the 360 degree of the speed actuator shall connect to the shell of the controller. And mount the speed control unit on a grounded metal back plate or place it in a sealed metal box to avoid the electronic interference. There will be a good effect when using the metal cover or the metal container. The most common anti-interference measure is to use the shielding wire. If using the generator with brush, you can't ignore the electronic spark interference, so you shall use the special shielding measure to the huge interference environment. If you can't solve this kind of problems, please contact with our engineers. They will give you some more suggestions.

⚠ 5 Maintenance and precautions

5.1 Maintenance of electronic speed governor

5.1.1 Routine maintenance

- Check cables whether there is any trouble and handle timely. Cables arranged along the route shall be tied tightly to avoid cable shaking which may lead to the body friction. As layout of the cables, you shall avoid cable near the high temperature parts (such as turbocharger, exhaust pipes etc.).
- Check whether the actuator fastener is loose, if loosing, you shall handle timely.
- Check whether the actuator connector, sensor connector and cable fastening screws have oil or loose, and make the corresponding treatment.
- Check whether the battery power is enough and the charging device is working smoothly.
- For the non-enforcement lubrication oil pump, you shall check the high-pressure oil pump level and replace

the lubricating oil timely

- In a low temperature environment, you shall push the actuator arm by your hands several times, feeling running smoothly and no blocking, and then you can start the engine.
- Observing whether there is oil leakage phenomenon of the actuator, if there is any oil leakage phenomenon, you shall replace the oil seal of the high pressure oil pump camshaft promptly

5.1.2 Maintenance after running 2000 hours

- There is some dust in the probe site of the speed sensor, you shall remove and clean it up.
- Open the observation shell of the middle connect, check whether the connection fasteners of the actuator and the pump rack ,the pins are loosening or fall off . If loosening, you shall handle timely.

5.1.3 Maintenance after running 6000 hours

- Remove the actuator from high-pressure oil pump , check whether the fuel pump rack is flexible
- Check whether the high-pressure pump uniformity of the oil tank and injector atomization situation is normal on the oil pump check table.
- Change the speed sensor.
- For the forced lubrication oil pump, you shall replace the seal of high pressure oil pump camshaft to ensure the lubricating oil won't leak to the actuator.

5.2 Application Notice

- The speed sensor is sole used by electronic governor produced by Fortrust , which can't be used with other speed detection devices

- To ensure the safety of engine system, the speed-control function cannot replace the over-speed protection function of the electronic governor; you shall install the over-speed protection device independently.
- Before you start the engine, you shall check to ensure that the idle/rated conversion switch is in the idle position.
- All the adjusting potentiometers of the governor have been pre-stetted; non-professional personals shall not adjust it freely.
- You cannot adjust the rated speed potentiometer setting and the speed trimming potentiometer when the engine shuts down (especially increase) to avoid the over speed caused by the high speed setting when the engine starts.
- When you restart the engine after a long time of rest or under a low temperature environment, you shall push the actuator arms (or the tail shaft) by your hands several times firstly, feeling running smoothly with no clamping phenomenon. If there is the clamping phenomenon, you can't start the engine.

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