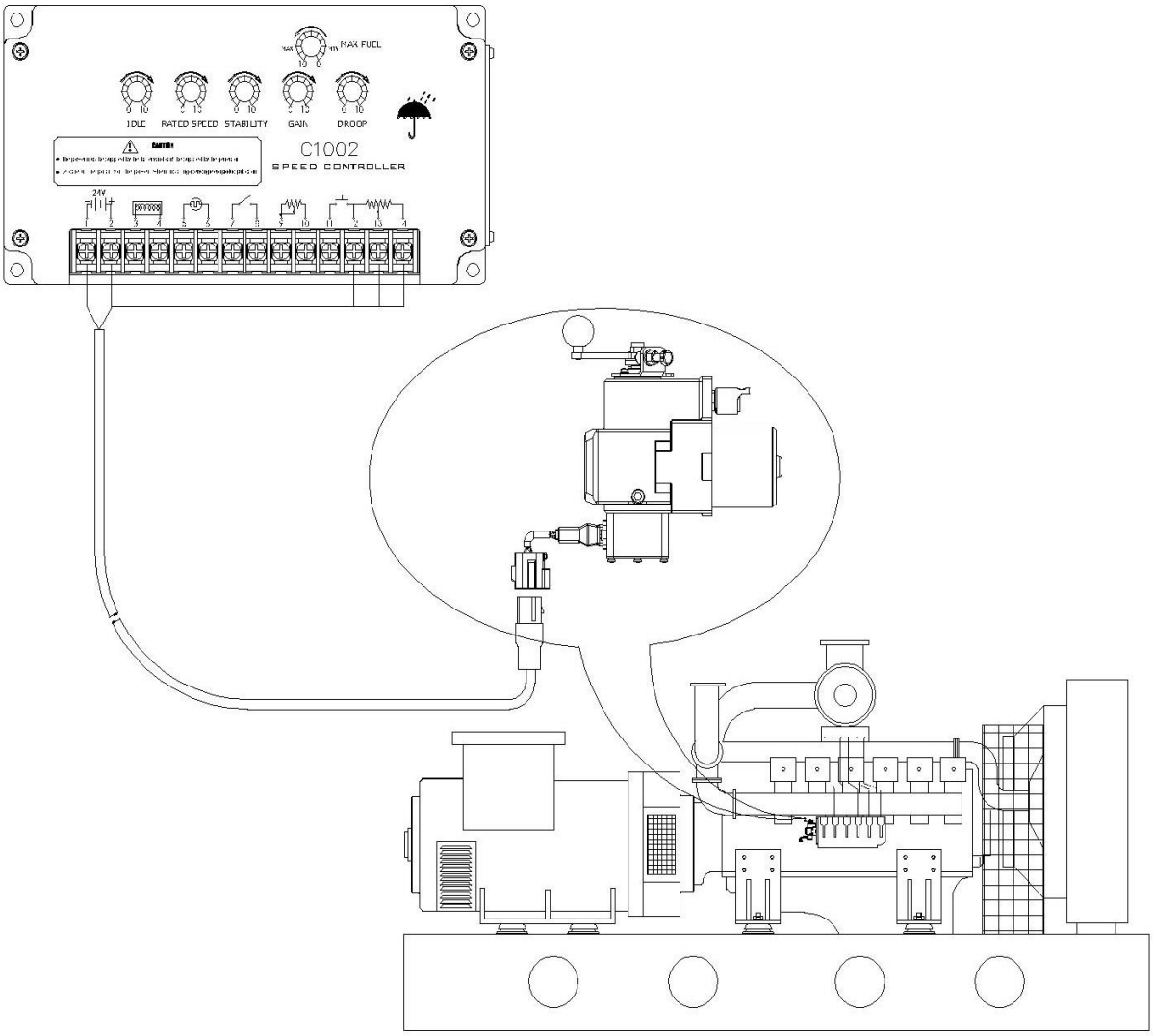
ESG1002 Series
Electronic Governor Instruction



Preface

This manual mainly introduced the working principle, composition, adjustment, operation, maintenance and some simple fault elimination methods of the electronic speed control system. It is applicable to the staff who have knowledge of the engines and electronic speed control units and those who do some daily installment, connecting wires, using and maintenance. We suggest you shall put the manual in the workplace and strictly follow the methods provided here.

Warning

- The speed sensor of the electronic speed control system cannot be used with other systems, otherwise it will lead to serious consequences.
- You cannot completely depend on the electronic speed control system to prevent overspeed, and you shall install the independent and effective overspeed protection device on the engine system.
- You shall confirm that the oil injection rod of the pump in the cut-off position while the push-pull oil gear shall be flexible without jamming.

Contents

1 Working Principle of the Electronic Governor System

The electronic governor is the precision control device that can make the engine run in a set speed under the stable operation. The electronic governor, with its reliable performance, complete function, easy installation and maintenance and perfect speed control performance which is the unique advantages distinguished from other types of speed governors, is widely used in the fields of engine speed regulation system, monitor system of the generating set. It is becoming a development trend of the industry applications.

The electronic governor has components in respect of speed setting, speed measurement, comparison, calculation, output, executive component, parameter adjusting setting, overspeed protection or restriction. All the components form to a closed-loop control system by effective combination. (As shown in figure 1.1)

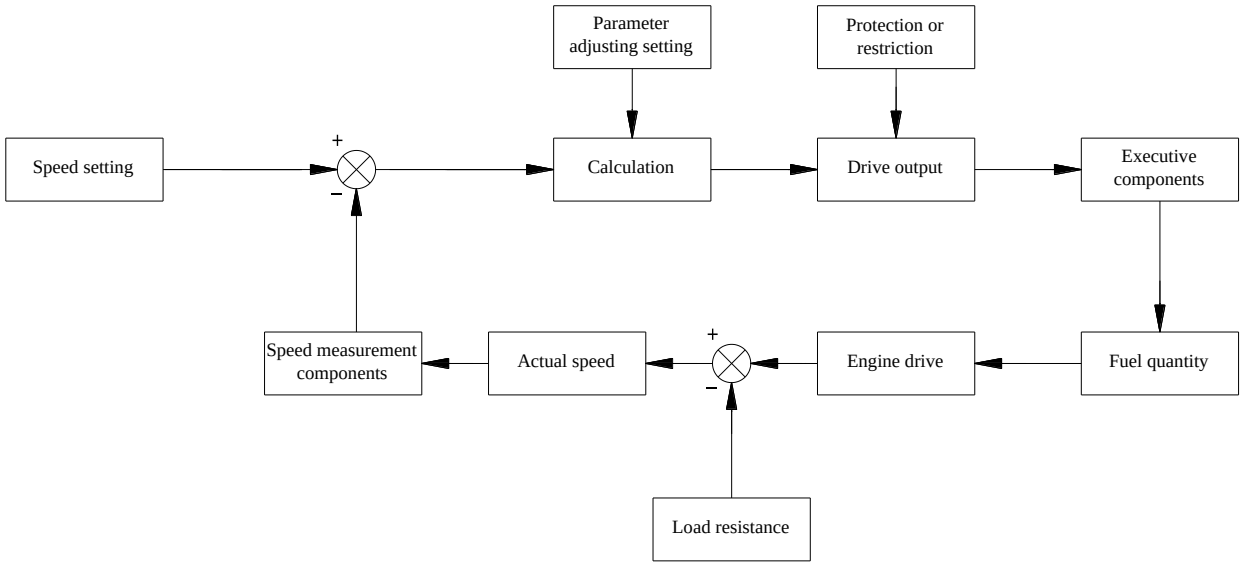


Figure 1.1 Working principle diagram of the electronic governor system

The closed-loop control mode of the electronic governor can make a quick and accurate response to the instantaneous load change, which can control the engine speed to the stable trend

Manually adjust the potentiometers such as GAIN, STABILITY and DROOP to meet the requirements of different engines on the transient adjustable rate, time stability and steady-state rate.

The electromagnetic actuator is the executive component of the governor. The speed controller can be used to control the coil current, and then it is available to control the displacement of the output.

The electromagnetic actuator directly drives the rack of the high pressure oil pump, the throttle of the gas machine, thus to control the fuel supply of the engine.

Through the thermal conversion, the engine converts the chemical energy into motion energy, output

torque, then dynamic torque and load torque interact to form the speed output of the engine.

Therefore, you can control the engine speed by controlling the current of the actuator.

The ideal speed of the engine is set by speed setting potentiometer and external trimmer potentiometer. The actual speed of the engine felt by the magnetic speed sensor installed at the tooth ring of the flywheel, the output signal is the AC voltage signal caused by frequency and engine speed.

The signal is converted into DC voltage through F/V circuit, after comparison with the speed set point, you can get the deviation value.

After calculated and amplified by PID1 regulator, the deviation value can get the engine fuel supply location value, that is the position for the steady-state output instruction of executive components; compared with the actual output of the electromagnetic actuator position, the signal can get the position deviation, after calculated and amplified by PID2 regulator, the position deviation can convert into PWM current control mode, output the drive current to the actuator to change the output displacement of the actuator, then drive the engine fuel injection pump rack or fuel control valves, throttle to reduce speed deviation in the direction of the movement so as control the speed of the engine set up under a stable operation.

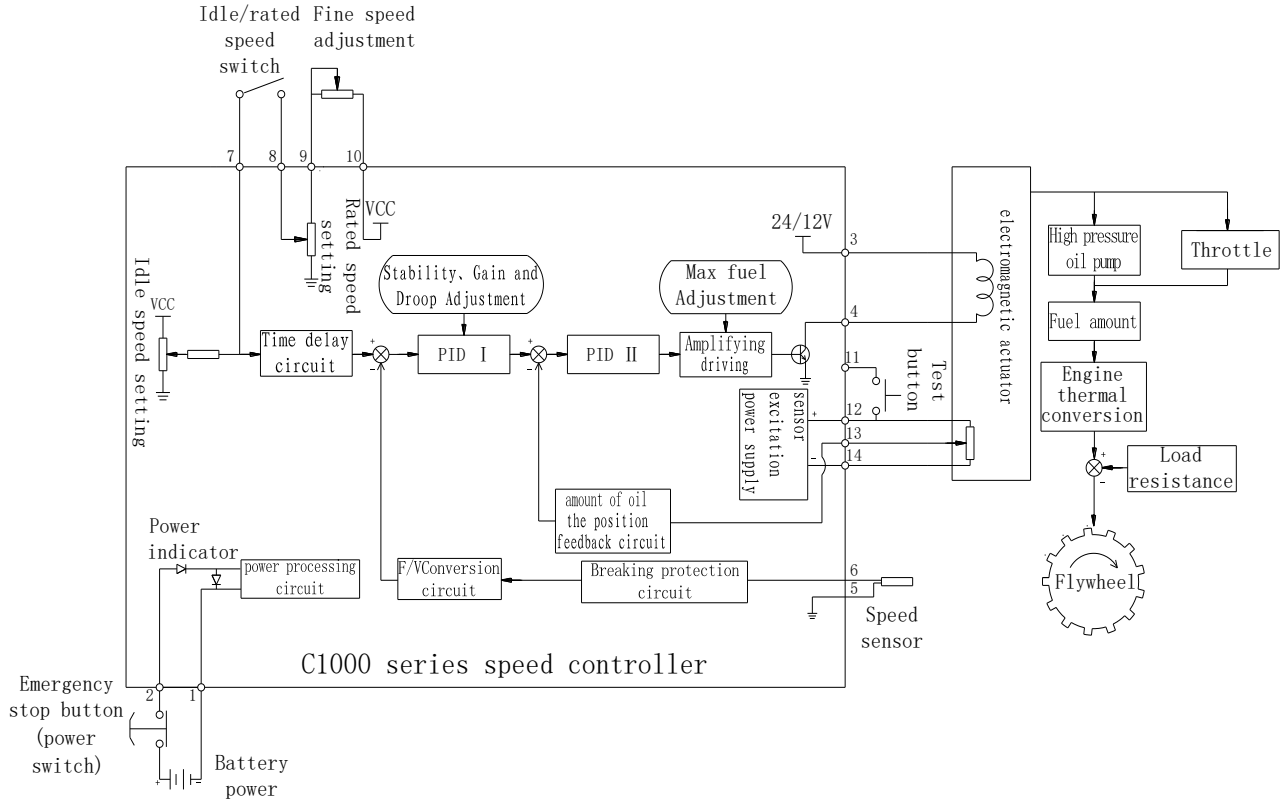


Figure 1.2 Schematic diagram for the control system of ESG1002 series electronic governor

2 Composition of the Electronic Speed Control System

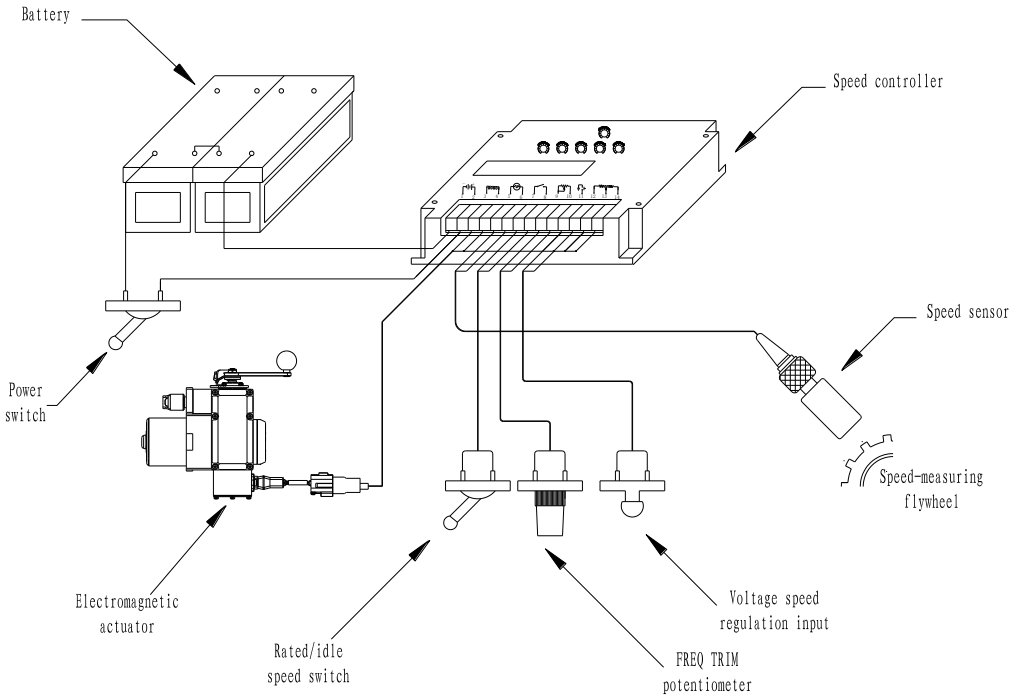


Figure 2.1 Constitutional diagram for the basic system of the ESG1002 series electronic governor

2.1 Speed controller C1002

2.1.1 The basic electronic characteristics

☑ SUPPLY VOLTAGE: DC 24V (Scope 18V～32V)

☑ SUPPLLY CONSUMPTION: < 0.1A (excluding actuator)

☑ Control frequency: 1000～13000Hz

☑ SPEED FLUCTUATION RATIO: ≤ ±0.25%

☑ STEADY- STATE SPEED DROOP: 0~5% Adjustable

☑ Transient adjustable rate: ≤ 10 %

☑ The environment temperature : -40℃～ +80℃

☑ Environmental humidity: < 95%

☑ Protection grade: IP44

2.1.2 The basic function of the speed controller C1002

- Max fuel: limiting the max fuel injection qty. of the pump to prevent excess use of the engine;
- Speed control and fine adjustment: adopting the double closed-loop method to realize accurate speed

adjustment and remote control;

- High and low speed conversion: can convert between idle status and rated status
- Droop adjustable: can adjust the speed range
- Parallel machine function: can realize parallel machine function by manual way
- The whole speed adjusting: can adjust speed in a continuous and smooth condition within a certain range
- Automatic shutdown protection: when the speed signal disappears or the controller is power off, the engine will shutdown automatically.

Please refer to the parameter setting in the subsequent chapters in details for the realization of all the above mentioned functions. According to the different requirements of different users, the whole speed adjusting function shall install different external accessories. If the user has any need, please contact with us.

2.1.3 Extending function of the speed controller C1002

In addition to the above mentioned functions, the speed controller C1002 also has some inner functions such as speed range, A/B plate and gas machine, other functions. These functions can be set by changing different jumped line positions inside the controller. The prominent characteristics of the speed controller is using the double closed-loop control circuit and speed filter capacitance redundancy design, which make it have a perfect performance and more functions, easy to install and high in reliability .

- TP1: Voltage monitoring point for speed setting: the collecting voltage is V1 which shall be equal to V2;
- TP2: Feedback speed voltage monitoring point, the collecting voltage is V2;
- J1: Control the setting of jumper wire in frequency range

  N1(1M): ≤ 1700Hz; N2(2M): ≤ 3400Hz

  N3(4M): ≤ 6800Hz; N4(8M): ≤ 13400Hz
- J2: Suitable for the A/B plate setting of feedback device in different positions
  - **a.** speed controller C1002-A
  - **b.** speed controller C1002-B
- J3: suitable for the gas machine control
  - **c.** C1000-A of C1002-B speed controller
  - **d.** special for the gas machine----speed controller C1002-Q
- J4: High speed switching time selection jumper
  - **e.** Delay increases about 3 seconds

f.Delay increases about 10seconds

Note: For the setting of jumper wire in above optional jumper wire terminal, every jumper wire terminal is only allowed for one jumper wire instead of several ones. Otherwise it will cause serious consequences. Non-professionals cannot operate.

2.1.4 The outline and installing size of the speed controller C1002 (as shown in figure 2.2)

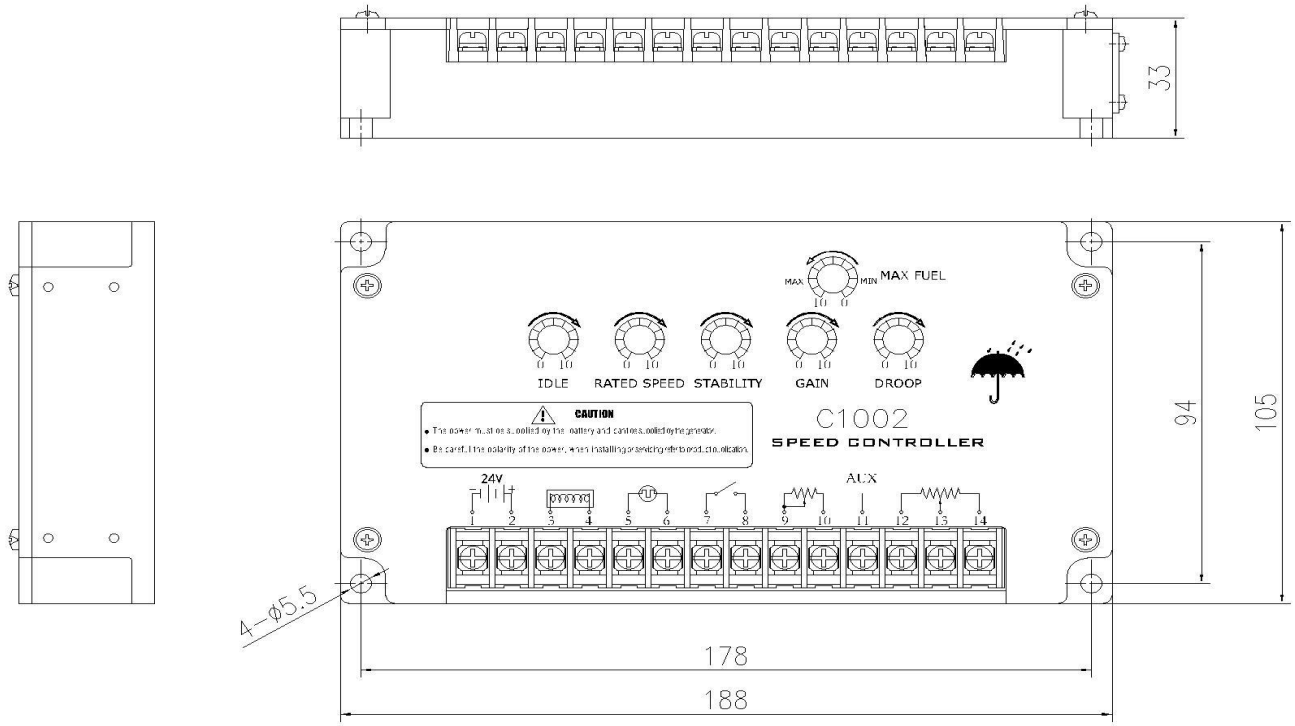


Figure 2.2.1 The outline and installing size of the speed controller C1002

2.1.5 Connecting diagram of the speed controller C1002 (as shown in figure 2.3)

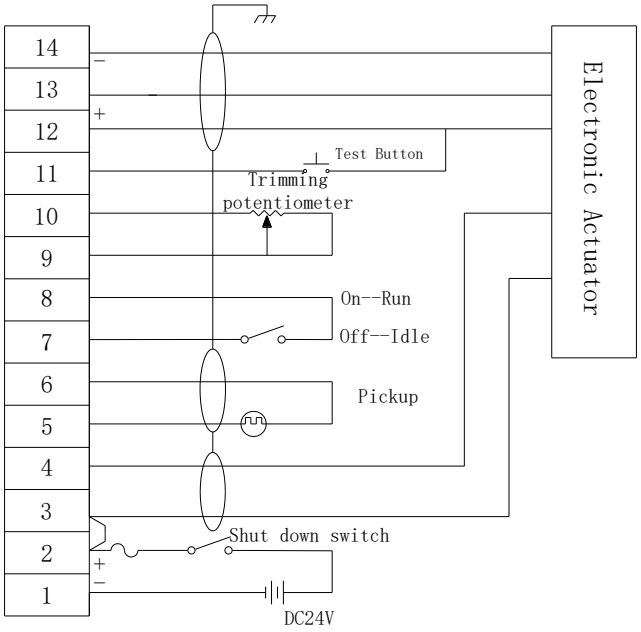


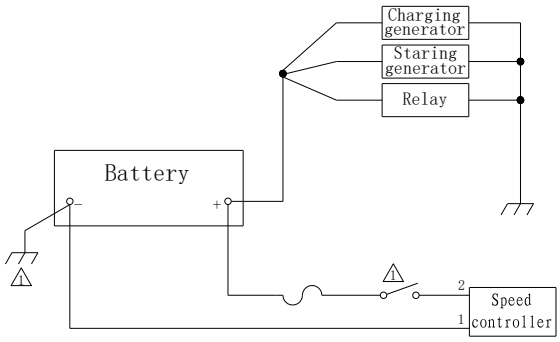
Figure 2.3 The connecting diagram of the speed controller C1002

2.1.5.1 Definition of the connecting port and requirement to the external wire harness

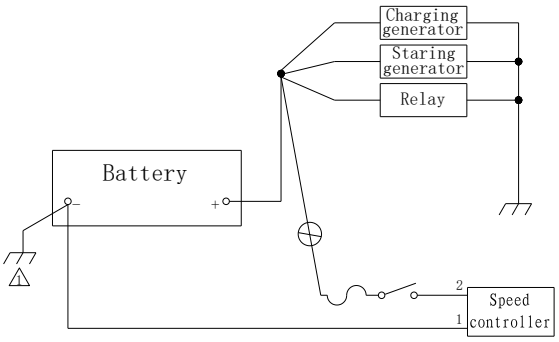
Terminal	Wire harness	
	Less than 6 meters	More than 6 meters
Terminal 1 and 2 shall connect with battery (refer to the voltage value of the controller)	1 mm^2	2.5 mm^2
Terminal 3 and 4 shall connect with the winding end of the actuator	1 mm^2	2.5 mm^2
Terminal 5 and 6 shall connect with speed sensor (the minimum signal of the both ends is AC 3V)	0.5 mm^2	1 mm^2
Terminal 7 and 8 shall connect with the idle speed rated switch	The signal points are milliampere level current, so 0.5 mm2 ~ 1 mm2 wire harness can be used for connection. In a strong magnetic field environment, you shall use the shield lines to for connection and shielding net shall connect the nearest grounded end of the controller effectively.	
Terminal 9 and 10 shall connect with FREQ TRIM potentiometer		
Terminal 11 and 12 shall Test Button		
Terminal 12, 13 and 14 shall connect with the position feedback device (12 is the positive terminal , 13 is the input signal terminal , 14 is the negative terminal)		

2.1.5.2 Several problems required to be paid attention to in the connection of electronic governor

- Terminal 1 and 2 connect with battery for electricity, Terminal 3 and 4 connect with the winding end of the actuator, requiring the two groups of line sections to be thick enough, and the longer the cables, the thicker the wire diameters shall be. It is necessary that there is a fuse of 10A serially connected on the cable between positive battery electrode and positive speed controller electrode (terminal 2); if the negative electrode of battery needs to be grounded, the grounding shall be done in the negative electrode terminal, instead of the speed controller terminal (terminal 1). The power line of the controller shall be taken out from the positive and negative electrode of the battery separately and directly, instead of bypassing other interfaces. The correct connections are as below:



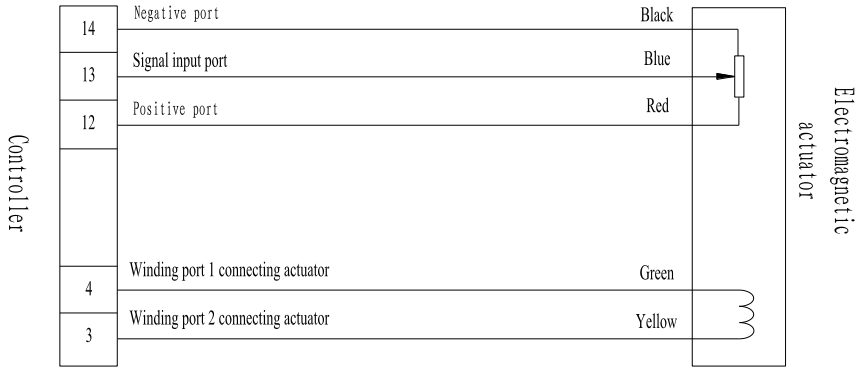
☑ The correct wiring diagram



■ The wrong wiring diagram

- Terminal 5 and 6 shall connect with the speed sensor (pick-up), it shall use the whole braided shielding net cable to connect ,the shielding net part of the cable shall be 360-degree connected to the fulcrum (terminal 5) and cannot be connected to anywhere else of the engine, otherwise the interference signal may enter into the speed controller and lead to unpredictable consequence; The speed sensor used in the electronic speed control system produced by Our company must be used by the speed control system separately and cannot be used with other speed measuring systems ,otherwise it may lead to serious consequences.
- Terminal 9 and 10 shall connect with trimmer potentiometer (FREQ TRIM) for adjustment of the speed. If the length of cable exceeds the required limited value, you must use the braid shielding network cable for connection, the shielding net ring shall be 360-degree connected to the enclosure ground; When there is no need to use the FREQ TRIM or the FREQ TRIM is out-of work, you must use the terminals 9 and 10 for short connection, otherwise the engine can't realize the high speed.
- Terminal 11 and 12 shall Test Button， for the detection of actuator is normal

- The relationship between wire harness of the actuator and various ports



2.2 Actuator

The speed controller in this manual can be used with the double closed-loop electromagnetic actuator produced by Our company. Users can select the double closed-loop actuator and intermediates produced by Our company according to the different requirements, or our professionals can match the products on the scene to provide the best solutions; the actuator in this manual is listed according to your matching requirements, If there is any enquiry to our other actuators or any further information, please contact us by the mentioned contact info：We will try our best to serve you and provide the professional solutions!

2.2.1 A1000C-F Actuator

☑ The power supply voltage： DC24V、DC12V can choose（Specify when ordering）

☑ Working ability： 1N•m

☑ Working stroke： 22mm

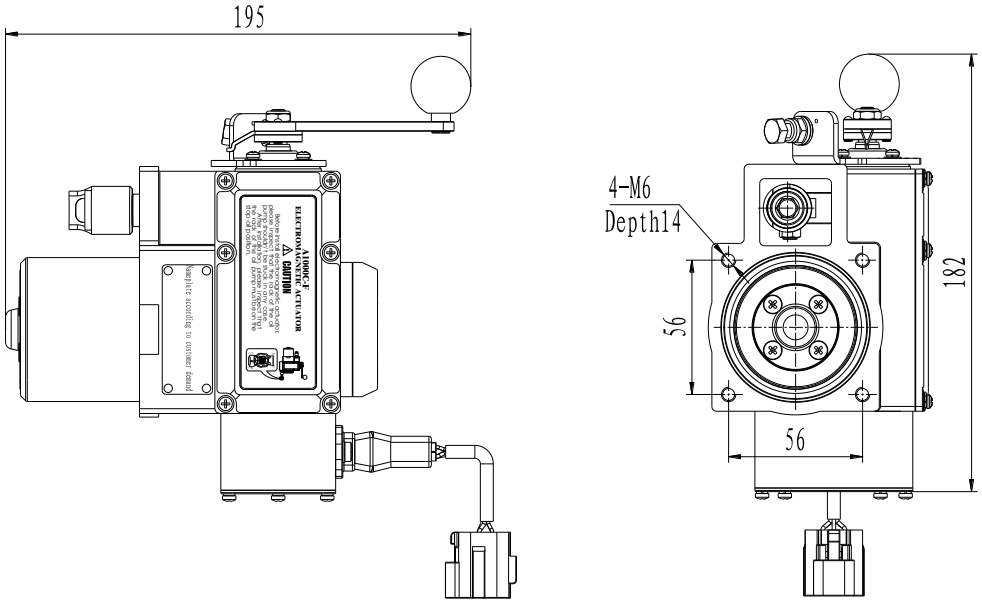


Figure 2.4 A1000C-F Actuator Shape and size of installation

2.2.2 A2000C-F Actuator

☑ The power supply voltage: DC24V

☑ Working ability: 2N•m

☑ Working stroke: 22mm

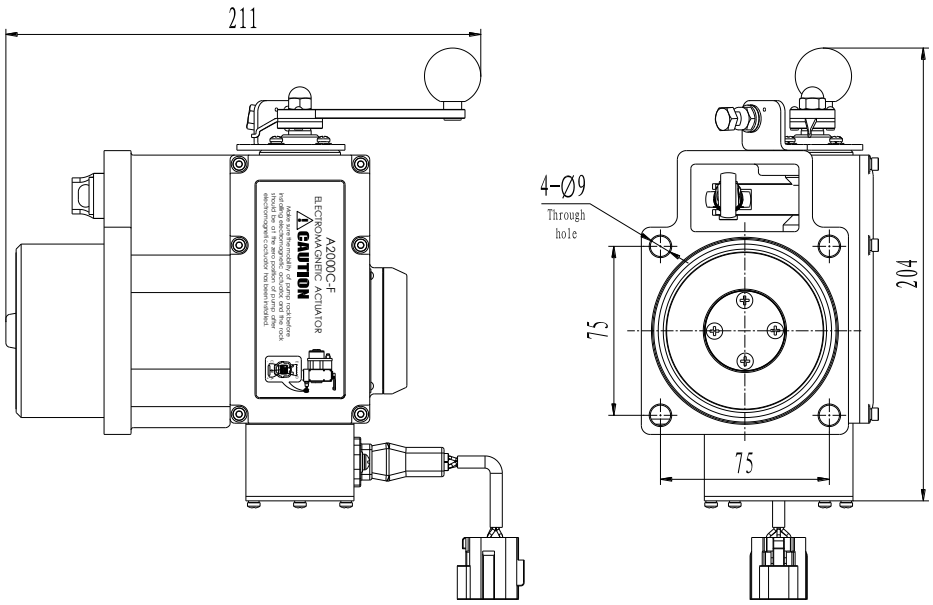


Figure 2.5 A2000C-F Actuator Shape and size of installation

2.3 Speed sensor (PICK-UP)

The speed sensor (PICK-UP) of this electronic speed control system uses the passive magnetoelectric speed sensor that changes according to magnetic gap caused by the rotation of speed measuring gear, outputing speed signal which caused by the inductive electromotive force produced by the pick-up.

The corresponding relation between the frequency and speed of the output signal is as below:

f=nz/60

In which, f is frequency (Hz), n is RPM (revolutions per minute), z is number of flywheel gears (piece).

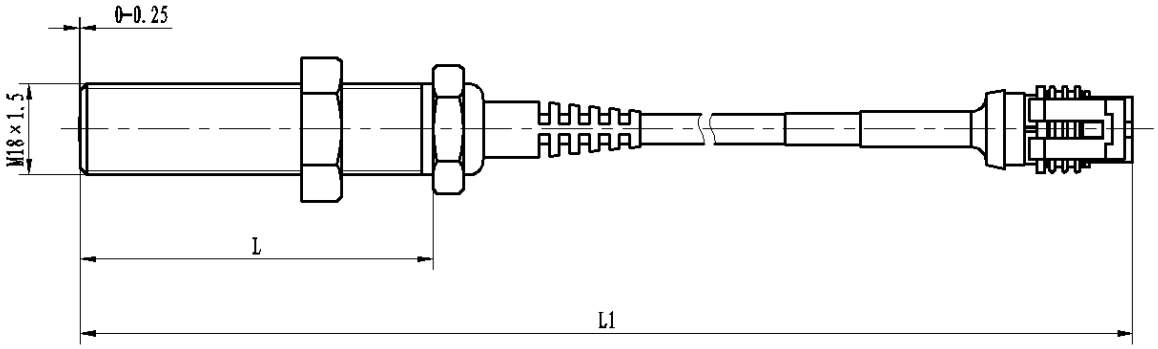


Figure 2.6 The outline and installing size of the PICK-UP (M16, M18 series can choose, this chart is M18)

TM18X1.5-(L)A series 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 different installation sizes, so you can select according to your different requirements.

Warning: the speed sensor of the electronic speed control system shall not be used with other systems, otherwise it may cause very serious consequences!

3 Installation and Adjustment

3.1 Connection diagram of ESG1002 series electronic governor

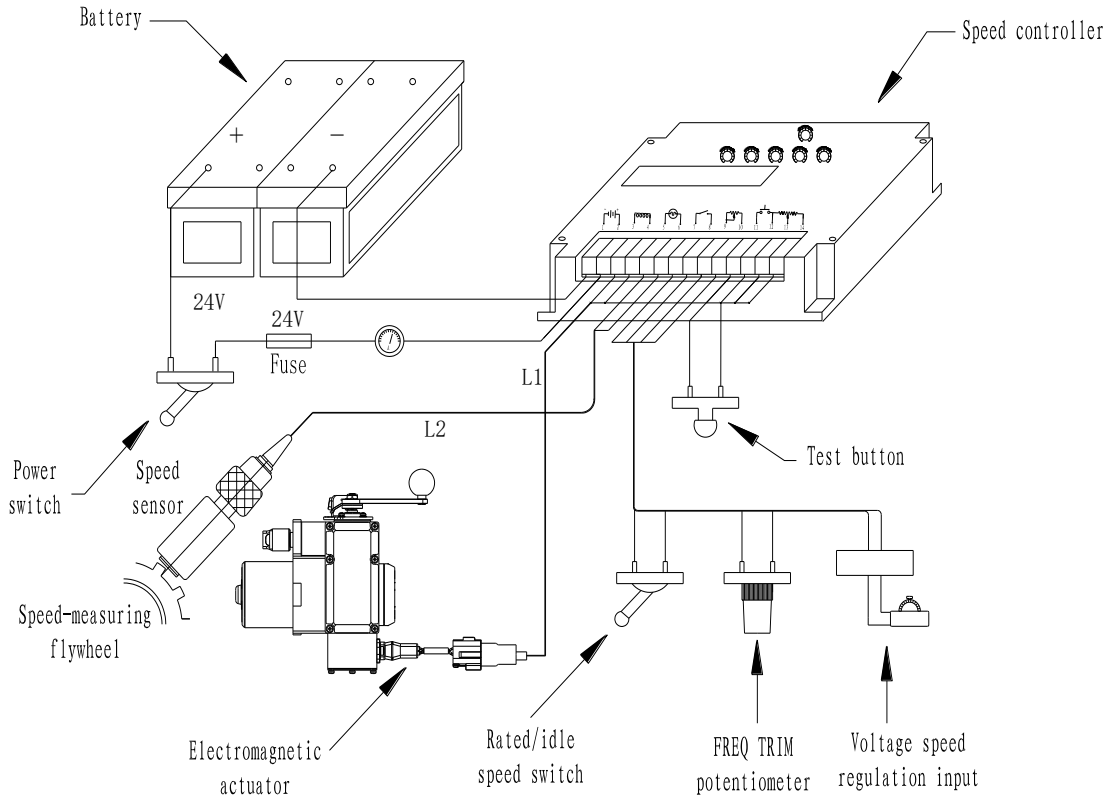


Figure 3.1 The connection diagram of ESG1002 series electronic governor

Warning: the engine shall have independent over-speed protection device, and cannot depend on this electronic speed control system to prevent overspeed.

3.2 Installation of the speed controller

The speed controller C1002 is usually installed in the control cabinet where there is no strong impact vibration and electromagnetic interference, or fixed on the outer equipments in other similar places of the engine; you shall choose the location with dry air and appropriate temperature to install; the speed controller has the moistureproof processing, but still have to prevent from water, fog or coagulation; when installation , it shall be far away from the high temperature and thermal radiation to avoid the damage of high temperature; it shall be installed vertically under the moisture condition; special shielding device shall be used under the condition with huge electromagnetic field .

3.3 Installation of the speed sensor (PICK-UP)

The speed sensor(PICK-UP) shall be installed on the gear plate of the engine to determine the engine speed

by induction to the number of flywheel gears; during installing, when reaching the top of the gear, the speed sensor shall exit 1/2---3/4 circle, then fasten the nut , which is a more ideal gap. If there is no flywheel ring gears, you can also use other sensing gears which must be made of magnetic material, and ensure in the working range of the engine, the output frequency of the sensor is not less than 1000Hz.

3.4 Installation of the electromagnetic actuator

The actuator is installed in the engine, its installation location and method depend on specific circumstance, we recommend installing the actuator produced by Our company with the pump in an integration installation way, but under some special circumstances or some specific requirements, you can also use the way of external installation.

The output shaft of the actuator and the injection pump rack of the engine joint directly, with output in a straight line and the output displacement of 10-30mm.After installation, the initial position shall guarantee that the pump can have fuel cut reliably and the pump rack stroke and the actuator stroke shall cooperate well. Generally, it is required to ensure the stroke from fuel cut to fuel full to be about 75% of the actuator's working stroke.

There are several connecting ways between output connecting rod of the actuator and the pump rack, which must ensure there is no jam or slippage after installation. The installation shall realize the purpose of no clearance transmission between the output connecting rod and pump rack.

If you are not sure, please consult us, we will provide you with solutions; If the connection way made by yourself fails to meet the requirements, serious consequences may be caused.

Several problems shall be paid attention to in integration installation

- You shall install closed protective enclosure -- intermediate between output terminal of the electromagnetic actuator and the fuel injection pump of the engine, so that you can avoid the dirt's entrance which will make the actuator bearing jammed or premature worn. The first problem for the integration installation you shall pay attention to is that the zero position of the actuator shall match with the zero position(shutdown and fuel cut position) of the pump, that is when the output stroke of the actuator is zero, the oil pump rack can have fuel cut reliably.
- For the forced lubrication of high pressure oil pump, the camshaft of the oil pump shall have oil seal. During operation, the leakage of the lubricating oil shall go through the tube to the oil pan, there can't have trapped oil in the internal of intermediate; otherwise it will affect the normal work of the electronic governor seriously.
- For the high pressure oil pump of unforced lubrication, there shall be trapped oil in the intermediate, the

designed oil level shall not exceed the rack position.

- For the work environment with high temperature, the electromagnetic actuator and intermediate shall be coated with a suitable amount of sealant instead of seal packing, and then installed directly to improve its thermal performance.
- There shall be an observation hole in the intermediate, you can observe the movement situation of the rack during the period of testing and debugging, and after debugging, you shall cover the observation hole with the cover plate.
- After the rack is connected with the connecting mechanism of the actuator, the operation shall be smooth with no jam phenomenon.

3.5 Adjusting of the speed control system before the engine starts

If this is the first time to start the engine, please check the following points strictly when installation.

▲ **Check the related electrical connections**

According to the figure 3.1 or the requirements of the electronic governor system diagram, check whether the electrical connection is correct, the battery voltage shall conform to the using requirements (in the situation of no-load, the battery shall be slightly large than 24V (12V); in the situation of the starting moment, the battery shall not be less than 18V (9V);

▲ **Check whether actions of the actuator are flexible**

It is required that there is no space between the connecting rod and oil rod of the actuator, the action of the actuator shall be flexible. In the natural state, the actuator shall be able to break the fuel / gas in the minimum position; the actuator shall be able to achieve the maximum the oil / gas in the maximum limited position.

▲ **Check the flexibility of the oil rod**

It is required that the whole pump delivery stroke is free from binding and the oil rod works smoothly. This examination is very important .If the oil rod is not flexible, the control system maybe out-of work, which may lead to some serious consequences such as engine speed instability, over-speeding, or even engine racing.

▲ **Check the parameter setting**

In general, the governors produce by Our company are set parameters according to the requirements before delivery, so you just need to check. Under special circumstances if you can’t get these information, it is necessary to check and set according to the following points;

1) please check whether the max fuel potentiometer is in the larger position, usually set at 12 o'clock position; please check the position of the GAIN potentiometer and STABILITY potentiometer, in the uncertain case, please set them at 12 o'clock position.
2) Please set the high/low speed switch in the low speed (the Toggle Switch is OFF).
3) The speed of the controller has been preset according to the user's data before delivery. In general, you needn't to adjust the speed potentiometer before the engine starts. Users just need to do some more precise adjustments after the engine starts; if you can't ensure the set value of speed, please set the rated speed potentiometer counterclockwise to the 9 o'clock position, in the meanwhile, you shall observe the position of the IDLE potentiometer, in the uncertain case, please set the IDLE potentiometer at 12 o'clock position, and then adjust according to the different requirements after the engine starts up.

3.6 Adjustment of the speed controller parameters when the engine starts

Note: before set the parameters, you shall pay attention to the following matters.
All the potentiometers on the controller are single-loop potentiometer which revolve less than one loop, the maximum effective adjusting angle is 270 degree (see figure 3.2). When adjusting parameters, remember not to make the forced rotation exceeding the scope from 7 am to 4pm in the clockwise direction, otherwise it will lead to serious consequences such as damage of the potentiometer, engine shutoff, unstability or even over-speed. All the above potentiometers are all precise electronic device; you shall use special tools to adjust them slowly so as to avoid man-made damage.

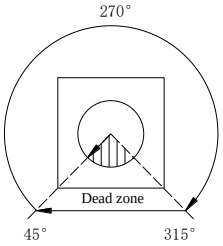


Figure 3.2 The adjusting position of the potentiometer

3.6.1 The max fuel limit

The max fuel potentiometer is used to limit the maximum output displacement of the actuator and prevent users' excess use of the engine for avoidance of unexpected hidden dangers. When adjusting the potentiometer, you shall make the engine load reach the maximum power load, then slowly rotate the max fuel potentiometer counterclockwise until the engine; speed begins to decrease. On this basis, please rotate a small angle clockwise to complete the set of the max fuel potentiometer.

3.6.2 Adjusting the high and low speed

After the engine starts, the speed controller shall in the IDLE position (OFF position of the Toggle switch), the IDLE potentiometer is used to set the speed value when the engine in the idle condition. The clockwise direction is for speed increasing and the counterclockwise direction is for speed reducing; according to the speed value when the engine starts, you shall slowly rotate the IDLE potentiometer until it reaches the required idle value.

Switch-over the high / low speed switch to the high speed (ON position of the Toggle switch), the engine starts from the idle value to the rated speed value according to the certain speed ACC slope gradually; the SPEED potentiometer is used to adjust the rated value of the engine; the clockwise direction is for speed increasing and the counterclockwise direction is for speed reducing. You can adjust the rated SPEED potentiometer until it reaches the required rated speed value.

You can use the FERQ TRIM potentiometer of the speed controller for remote control of speed and more precise adjustment of rated speed value, with the clockwise direction as speed increasing direction.

3.6.3 Adjusting the stability

The closed-loop speed control system consists of the electronic governor and the engine. The stability depends on the moment of the inertia of the engine, system time constant, the engine link gain, the governor gain, disturbance factors and etc. The effect of adjusting the electronic governor is same as adjusting the speed governor gain. Any closed-loop control system has the stability domain and will become unstable beyond the stability domain.

In the stability domain diagram (figure 3.3), when the Stability and Gain are in the shaded area, the system is stable, when they are lower than the low gain stable line, the system will have low frequency block. When they are higher than the high gain stable line, the system will have high frequency block. While the system is guaranteed certain redundancy of stability, the Stability and Gain shall be close to the high gain stable line to ensure the governor working in the stability domain and has excellent dynamic speed indicator.

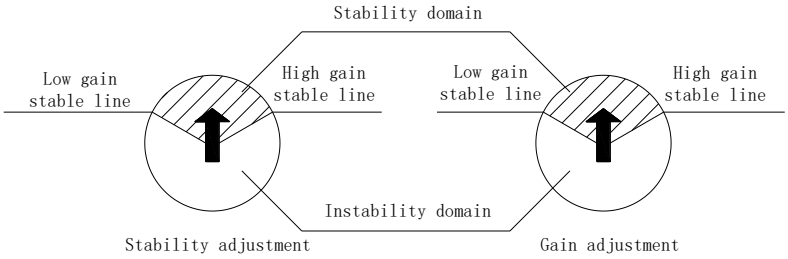


Figure 3.3 stability domain diagram

If the speed is unstable after the engine starting, you can read the following content and then adjust according the following steps; the adjusting order of the stability shall be successively idle, high speed, full-load, and make the engine achieve stability under these three statuses.

Note: the stability of the engine under idle status, high speed status and full-load status is interlinked. You shall consider the three statuses when you adjust and make the system achieve the best effect under these three statuses. When the above requirements are met, the GAIN potentiometer shall be adjusted in the larger direction to ensure that the engine has the best dynamic index.

The periodic instability can be divided into fast instability and slow instability. The fast instability generally refers to the instability in 3Hz or higher frequency and the slow instability refers to the instability in frequency less than 3Hz; the slow instability maybe strongly instable, you shall pay special attention to it; if the special instability occurs, you shall adjust the potentiometer as soon as possible to change it into the faster instability and then make a careful adjustment to avoid the damage of the machine or even the accident.

The stability adjustment of the engine is mainly done by adjusting the GAIN potentiometer and the STABILITY potentiometer. The GAIN potentiometer is used to adjust the sensitivity of the speed control system, the clockwise adjustment is to increase the sensitivity or reduce the sensitivity on the contrary; the GAIN potentiometer is used to adjust the response time of the speed control system, the clockwise adjustment is to increase the rate of the response time or reduce the rate of the response time on the contrary; through the interaction of the GAIN and STABILITY potentiometers, in general, you can make the engine achieve the perfect status.

In general, when the engine starts, you can adjust according the following steps if the instable status occurs

1. **Adjust the GAIN potentiometer** If instability has an increasing tendency when you rotate the GAIN potentiometer in the clockwise direction, you shall rotate it in the counterclockwise direction until the GAIN potentiometer in a stable status; if there is no stable point, you shall rotate the GAIN potentiometer to the relative point; based on this adjustment, you shall callback a little in the counterclockwise direction to ensure its stability;
2. **Adjust the STABILITY potentiometer** If instability has an increasing tendency when you rotate the

STABILITY potentiometer in the clockwise direction, you shall rotate it in the counterclockwise direction until the STABILITY potentiometer in a stable status; if there is no stable point, you shall rotate the STABILITY potentiometer to the relative point; based on this adjustment, you shall callback a little in the counterclockwise direction to ensure its stability;

In general, when you repeat the above mentioned steps, the engine can achieve the required stability.

Due to the control object has a various characters, you can refer to the following methods to adjust the stability of the electronic governor.

1) For the small single cylinder diesel engine with number of cylinders <= 4, you shall set the STABILITY potentiometer at the direction from 9 o'clock to 11 o'clock and set the GAIN potentiometer at the direction from 10 o'clock to 2 o'clock to search the stable working point within the scope.
2) For the diesel engine with number of cylinders >= 6, you shall set the STABILITY potentiometer at the direction from11 o'clock to 1 o'clock and set the GAIN potentiometer at the direction from 11 o'clock to 3 o'clock to search the stable working point within the scope.
3) For the gas engine and multi-cylinder diesel engine with a large moment of inertia or when the load moment of inertia is larger, you shall set the STABILITY potentiometer at the direction from 12 o'clock to 2 o'clock and set the GAIN potentiometer at the direction from 10 o'clock to 3 o'clock to search the stable working point within the scope.

To test whether the above adjustment achieves the stable working point of the system, you shall exert disturbance to the system to check whether it can quickly restore stability. The simple solution is to appropriately touch the output connector of the electromagnetic actuator and the engine speed shall be quickly stable after the sharp fluctuation, otherwise, you shall decrease the GAIN.

After adjusting the rated speed of the engine, please set the engine in the IDLE status. The adjusting method in the IDLE status is same as that in rated speed. The stability adjusting shall consider both IDLE and Rated speed. If not, you shall ensure the rated speed performance in priority. If the idle speed is too low and causes the traveling block, you shall raise the idle speed of the engine.

It is important to note that the above setting and classification are based on a large number of matching tests and conclusions from daily use experience. The inherent characteristics based on the engine design, manufacturing and system integration are not classified precisely according to above classifications, even with the state cross phenomenon, thus the above classification does not have a definite corresponding relationship.

If you can't solve the problem through the above adjustment, it maybe the engine problem. You shall check the stability of the fuel system, intake system and the overload, and evaluate the performance of the engine, also

you shall check whether the stability of the power supply and the amplitude of the speed signal can meet the requirement (>1.5Vpp when in idle status, >3Vpp when in normal speed) and whether the shielding effect of the rotational speed signal and the external control signal are in good condition, etc.

3.6.4 Adjusting the DROOP

The adjustment of the DROOP potentiometer is used in many sets of the parallel operation; the steady-state adjustable rate of the generator can be adjusted through the DROOP potentiometer, the clockwise direction is for increase. You can preset the potentiometer to a certain position, and then observe the speed change when the engine in the no-load status and over-load status, calculate the steady-state adjustable rate according to the calculation formula as shown; if it doesn't meet the requirement, you shall adjust the DROOP potentiometer according to its trendency, repeat the above loading test for several times until meeting the requirements.

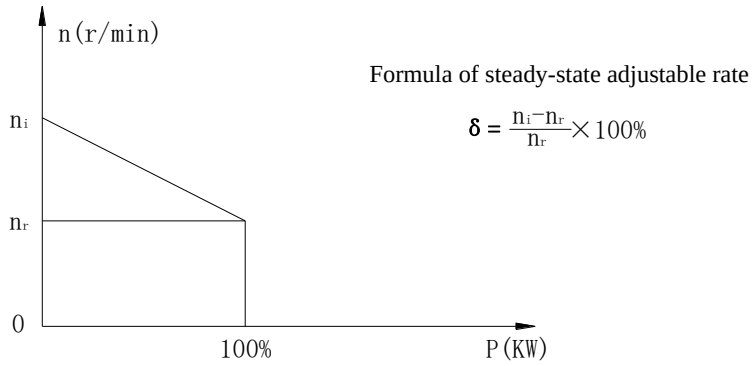


Figure 3.4 Curve of steady-state adjustable rate

When you adjust the DROOP potentiometer, the speed of the engine will have a tiny change and you shall revise the speed of the engine.

The following example will explain the process of adjusting the steady-state adjustable rate.

For example, a engine of 1500RMP needs 3% steady-state adjustable rate, this is to say, when in the no-load status, it is 1545 RMP; when in the full-load status, it is 1500 RMP.

a. After the engine starts , in the no-load status, you shall adjust the DROOP potentiometer to about the 12 o'clock direction, then adjust the SPEED potentiometer or the FREQ TRIM potentiometer, adjust the speed of the engine to 1545 RMP;

b. After the adjustment, slowly increase load to full-load status, at this time, the speed of the engine will slowly decrease with the load adding

c. Record the speed value in the full-load status. When the speed value >1500RMP in the full –load status, the steady-state adjustable rate is smaller, and you shall adjust the SPEED potentiometer in the clockwise direction; on the other hand, the steady-state adjustable rate is larger, and you shall adjust the SPEED potentiometer in the counterclockwise direction;

d. Note: you can't adjust the SPEED potentiometer or the FREQ TRIM potentiometer in the full-load status! After the step C, unload the engine to no-load.

e. In no-load status, the rotate speed won't be 1545 RMP as set before. You shall continue to adjust the SPEED potentiometer or the FREQ TRIM potentiometer to make the speed to be 1545RMP (You can't adjust the DROOP potentiometer during this period.)

f. Continuously repeat step b to step e until the speed of the engine achieve 1545 RMP in the no-load status and 1500 RMP in the full-load status. That is to say you finish the adjustment of the required 3% steady-state adjustable rate.

4 Fault Judgment and Processing

4.1 Judgment and Processing

The fault of the electronic governor will cause the engine performance degradation which may lead the engine to shut down. If the speed regulation system is out of work and you can judge the fault of the electronic governor, you just shall change the electronic governor; Faults of engine and the auxiliary system may be indicated by that the engine speed fails to reach the using requirements, and can't be solved even if you change the electronic governor. Thus, you shall judge the caused through comprehensive analysis on system.

This chapter provides the program flows of typical fault judgment and processing:

- Engine can not start
- Engine speed instability
- Engine shuts down automatically during the running period
- Engine speed decreases sharply after loading
- Engine overspeed

4.1.1 Engine can not start

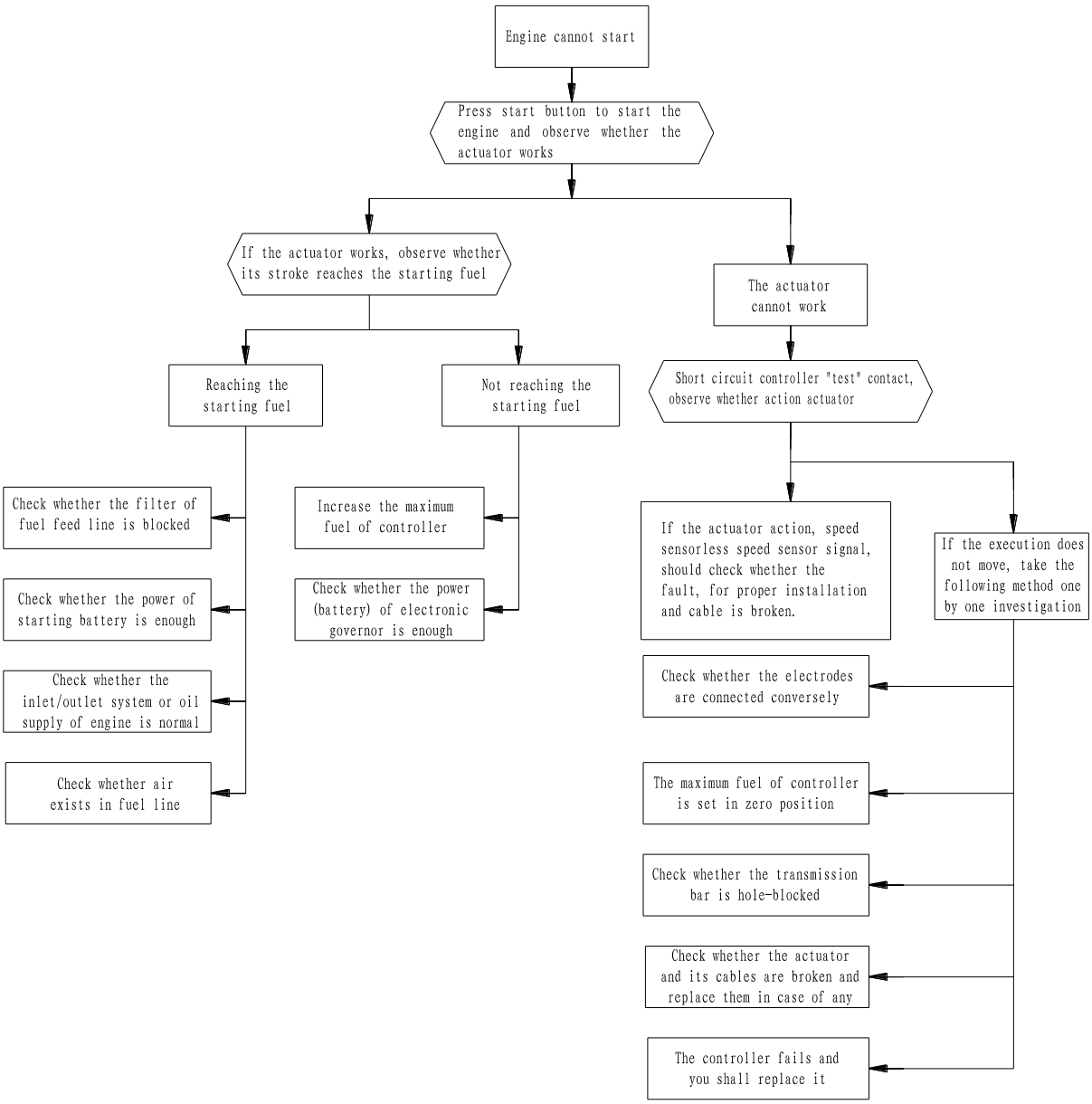


Figure 4.1 Engine cannot start

4.1.2 Engine speed instability

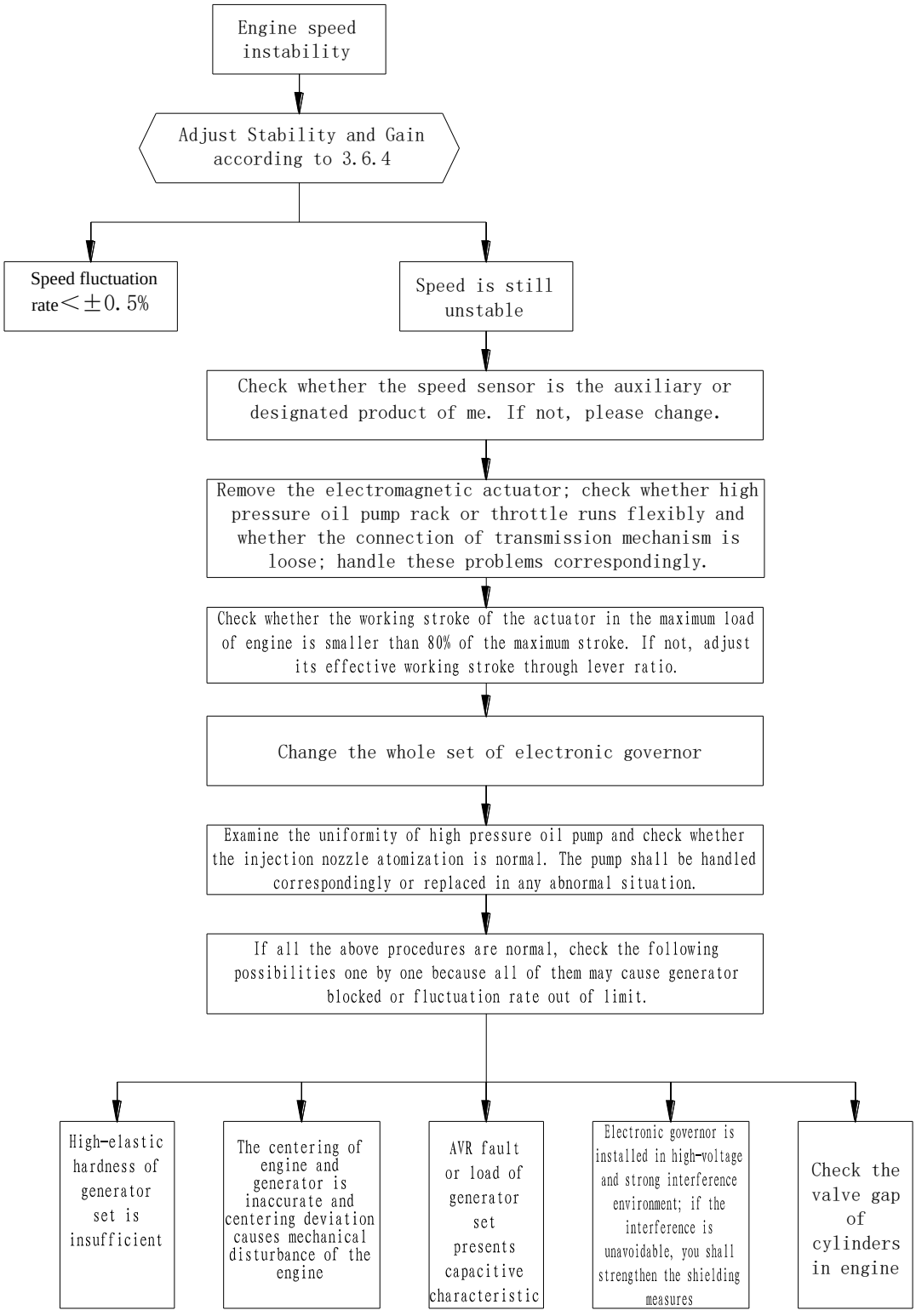


Figure 4.2 Engine speed instability

4.1.3 Engine shuts down automatically during the running period

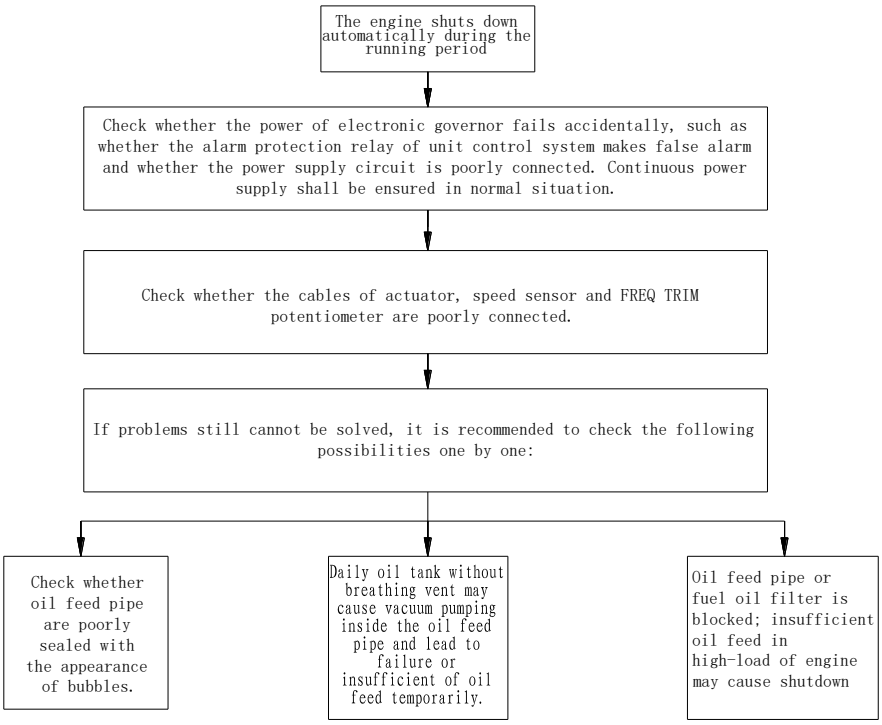


Figure 4.3 Engine shuts down during the running period

4.1.4 Engine speed fell sharply after loading

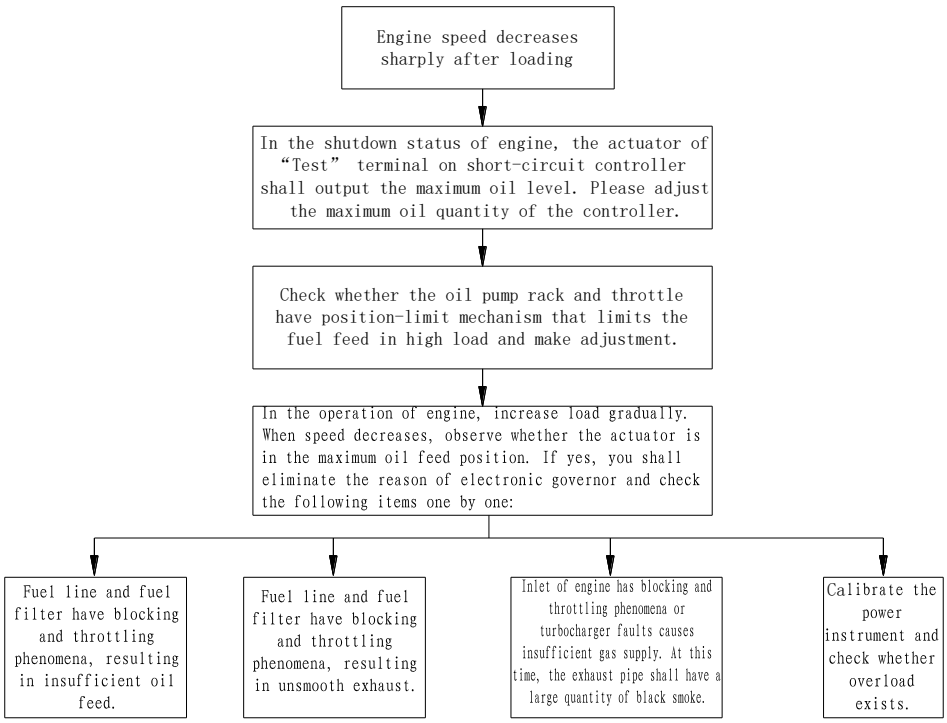


Figure 4.4 Engine speed decreases sharply after loading

4.1.5 Engine overspeed

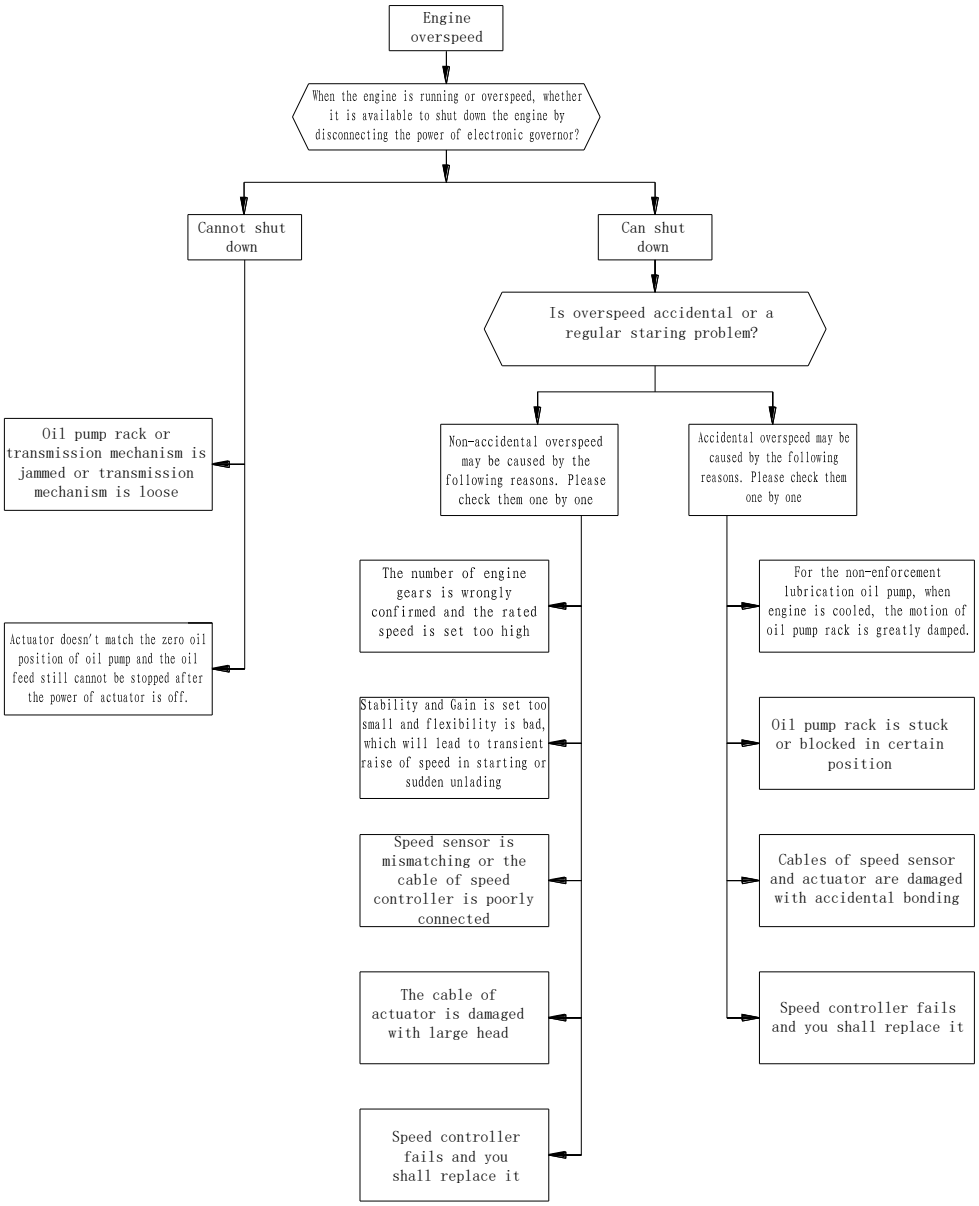


Figure 4.5 Engine overspeed

Note: If the trouble can't be solved after processed through the above mentioned ways and meanwhile, there is no trouble with the engine system, maybe it is the internal fault of the governor .Then you can send it to the maintenance department to repair .For the users who have no ability to maintenance, please don't dismantle blindly in case of expanding the fault.

4.2 Insufficient magnetic signal of the speed sensor

When the signal of the speed sensor is stronger, it can resist the external pulse interference; the speed sensor can measure the outputted signal which is more than 3V. When the signal of the speed sensor is less than

3V, you shall reduce the tooth gap between the speed sensor and the engine to improve the amplitude of the signal. The gap shall between 0.45~0.8mm. If the voltage is still less than 3V, you shall check whether the magnetism of the speed sensor is too weak.

4.3 Electromagnetic interference (EMI)

The electronic governor system can be adversely affected by large interfering signal that are introduced through the cabling or direct radiation into the control circuits. In order to avoid the medium interference, all the speed controllers produced include the filter unit and shielding designs that can protect the sensitive circuits against the external interference.

It is difficult and complicated to predict the value of the interference, you shall consider all the possible interference within the range such as radio communications of the space field, wireless walkie-talkie, wireless radio transmitter and the use of magneto, solid-state ignition system, voltage adjuster and battery chargers. When you doubt that the space field or the other systems will affect the operation of the governor 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. And also ensure that one terminal of the shielded cable, including the shielded cable of speed sensor, 360 degree loop-connected to one supporting point on the enclosure of the speed governor, and then ground the metal plate of the governor or install it in a sealed metal box to avoid the electronic interference; There will be a better effect when using the metal cover or the metal container; It is the most common anti-interference measure to use the shielding wires. If using the generator with brush, you can’t ignore the electronic spark interference, so you shall use the special shielding measure in huge interference environment; If you can’t solve this kind of problems, please contact with our engineers who will give you some more suggestions.

5 Maintenance and Precautions

5.1 Maintenance of the electronic governor

5.1.1 Daily maintenance

- Please check whether there is something wrong with the cables and handle it timely. Cables arranged along the route shall be tied tightly to avoid cable shaking which may lead to the body friction; when laying out the cables, you shall keep the cables away from the high temperature parts (such as turbocharger, exhaust pipes etc.)
- Check whether the fasteners of the actuator are loose. If loose, you shall handle it timely.
- Check whether the actuator connector, sensor connector and the cable fastening screws have oil or become loose, and you shall make the corresponding treatment.
- Check whether the battery power is enough and the charging device is working smoothly.
- As to the non-enforcement lubrication oil pump, you shall check the high-pressure oil pump level and replace the lubricating oil timely.
- In the low temperature environment, you shall push the actuator arm by your hands several times; when you feel it running smoothly, you can start the engine.
- Observe whether there is oil leakage phenomenon on the actuator, if any, you shall replace the camshaft seal of the high pressure oil pump timely.

5.1.2 Maintenance for running 2000 hours

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

5.1.3 Maintenance for running 6000 hours

- Remove the actuator from the high-pressure oil pump and check whether the pump rack is flexible.
- Check whether the high-pressure pump uniformity in the oil supply of each tank and injector atomization situation are 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 notes

- The speed sensor is solely used for the electronic governor produced by Our company and can't be used with other speed detection devices.
- To ensure the safety of the engine system, the speed-control function cannot replace the over-speed protection function of the electronic governor. You shall install the independent over-speed protection device.
- Every time before starting the engine, it is necessary to confirm whether the "IDLE/RATED" conversion switch is in the idle position.
- All the adjusting potentiometers of the controller have been preset. The non-professional people shall not adjust them arbitrarily
- You can't adjust (especially increase) the rated speed potentiometer setting and the speed trimming potentiometer when the engine shuts down 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 to make it run smoothly with no clamping phenomenon. If there is any clamping phenomenon, you can't start the enginee.