ESD-1000 Series - Speed Control Unit

INSTALLATION

The speed control unit is hard-potted and rugged enough to be placed in a control cabinet or engine mounted enclosure with other dedicated control equipment. Extreme heat should be avoided.

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!

WIRING

Basic electrical connections are illustrated in Diagram 1. Battery and actuator connections to the RED, BLACK, WHITE, and BLUE wires should be at least #16 AWG (1.3mm. sq.) or larger. Long cable runs require an increase in the wire size to minimize voltage drops. The battery positive input, RED wire, must be fused for 15A as shown in Diagram 1. Connect the battery and actuator leads to the speed control unit.

The magnetic speed sensor connection to the GREEN and ORANGE wires **MUST BE TWISTED AND/OR SHIELDED** for their entire length. The speed sensor cable shield should only be connected to the GREEN wire. The shield should be insulated to insure no other part of the shield comes into contact with engine ground, otherwise stray signals may be introduced into the speed control unit. With the engine stopped, adjust the gap between the magnetic speed sensor and the ring gear teeth. This gap should not be any smaller than 0.020in (0.45mm). Usually, backing out the speed sensor 3/4 turn after touching the ring gear tooth will achieve a satisfactory air gap. The magnetic speed sensor output voltage should be at least 1 VRMS during cranking.

ADJUSTMENTS

Before Starting Engine

Check to insure the **GAIN** adjustment, and if applied, the external **SPEED TRIM CONTROL** are set to mid position.

Start Engine

The controller is factory set to operate at approximately engine idle speed (1000Hz speed signal sensor)

Crank the engine with DC power applied to the governor system. The actuator will energize to the maximum fuel position until the engine starts. The SPEED adjust pot is a 25-turn pot and you may have to turn it clockwise several turns before the engine starts. Once the engine starts, the governor system should be controlling the engine at a *low idle* speed. If the engine is unstable after starting, turn the **GAIN** adjustment counterclockwise until the engine stabilizes.

Governor Speed Setting

The governed speed setpoint is increased by clockwise rotation of the **SPEED** adjustment control. Remote speed adjustment can be obtained with an optional Speed Trim Control (See Diagram 1).

Governor Performance

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

1. Rotate the **GAIN** adjustment clockwise until instability develops. Gradually move this adjustment counterclockwise until stability returns. Move this adjustment 1/8 of a turn further counter-clockwise to insure stable performance (270° pot).
2. Gain 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 optimize the adjustments further.

If instability cannot be corrected or further performance improvements are required, refer to the troubleshooting section.

SPECIFICATIONS

Performance

Isochronous Operation / Steady State Stability ..... ±0.25% or Better
Speed Range Governor ..... 1kHz – 7.5kHz Continuous
Speed Trim Range ..... ±250 Hz. Typical
Speed Drift w/Temperature ..... ±1% Maximum
YELLOW Wire Sensitivity .....130 Hz. ± 15 Hz./Volt @ 5.1K Impedance

Environmental

Ambient Operating Temperature Range .....-40ºF to +180ºF (-40ºC to 85ºC)
Relative Humidity (Non-condensing) ..... Up to 100%
All Surface Finishes ..... Fungus Proof and Corrosion Resistant

Input Power

Supply .....(Transient and Reverse Voltage Protected)*
..... 12 Volt unit; 8VDC - 20VDC;
..... 24 Volt unit; 16VDC - 32VDC
Polarity .....Negative Ground (Case Isolated)
Power Consumption ..... 60mA Continuous Plus Actuator Current
Maximum Actuator Current @ 25°C (77°F) ..... 10A Continuous
Speed Sensor Signal ..... 0.5-50V RMS

**Reverse voltage is protected against by a parallel diode on the 12V unit or a series diode on the 24V unit. A 15A fuse must be installed in the positive battery lead. See Diagram 1.*

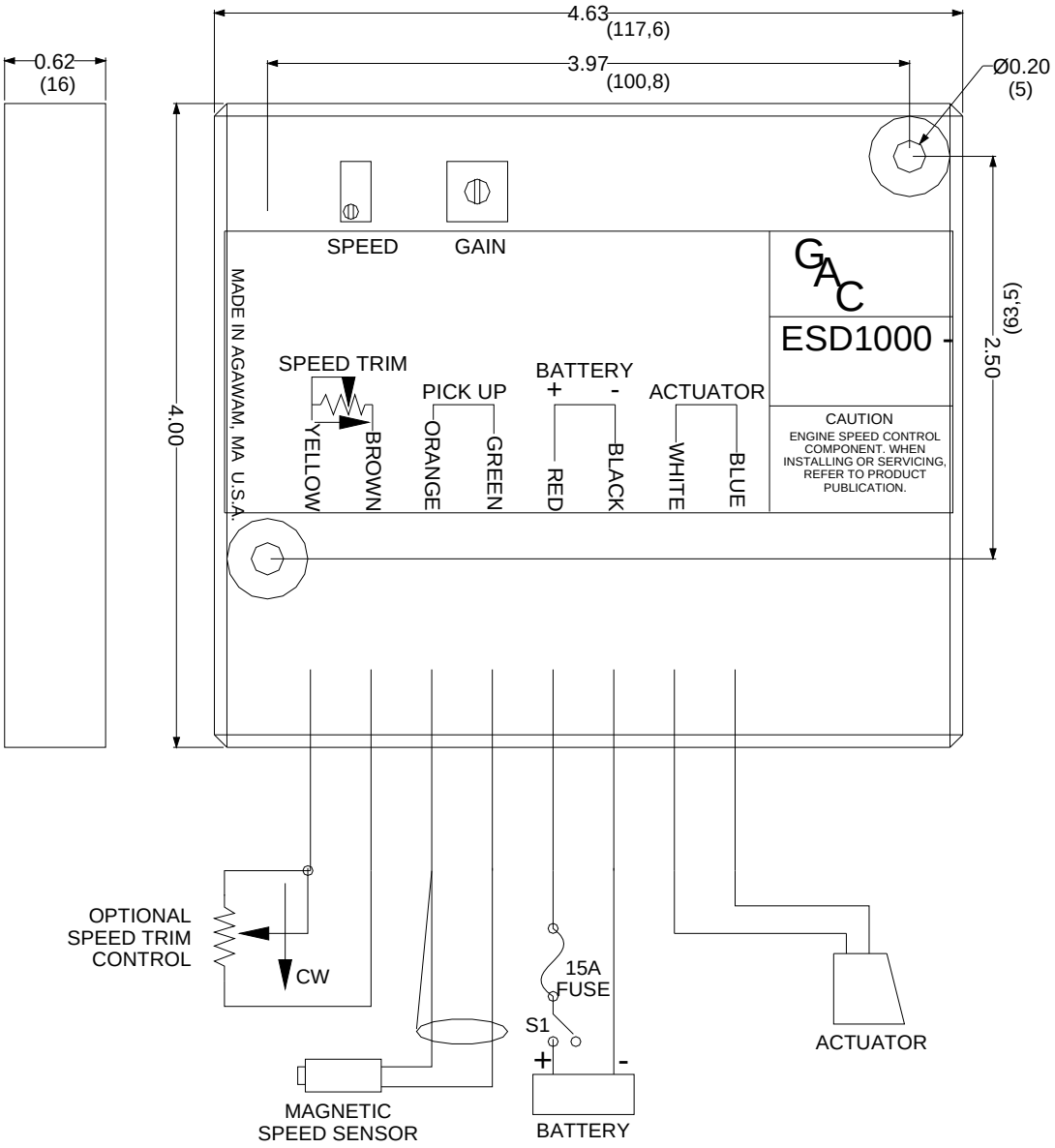
Reliability

Vibration ..... 5G @ 20Hz-500Hz
Testing ..... Functionally Tested

Physical

Dimensions ..... See Outline (Diagram 1)
Weight 12oz (347g)
Mounting ..... Any Position, Vertical Preferred

Diagram 1. SYSTEM WIRING/OUTLINE



SYSTEM TROUBLESHOOTING

Insufficient Magnetic Speed Sensor Signal

A strong magnetic speed sensor signal will eliminate the possibility of missed or extra pulses. The speed control unit will govern well with a 0.5VAC RMS speed sensor signal. However, a speed sensor signal of 3VAC RMS or greater is recommended.

The amplitude of the speed sensor signal can be raised by reducing the gap between the tip of the speed sensor and the top land of a tooth on the engine's ring-gear. This gap should not be any smaller than 0.020 in. (0.45 mm). With the engine stopped, turn the magnetic speed sensor CW until it touches the top land of a ring-gear tooth, then turn it CCW 3/4 turn. This will provide an acceptable gap.

Electromagnetic Compatibility (EMC)

EMI SUSCEPTIBILITY – The governor system can be adversely affected by large, interfering signals that are conducted through the cabling or through direct radiation into the control circuits.

All GAC speed controls contain filters and shielding designed to protect the unit's sensitive circuits from moderate external interfering sources. Although it is difficult to predict levels of interference, applications that include magnetos, solid-state ignition systems, radio transmitters, voltage regulators or battery chargers, should be considered suspect as possible interfering sources.

If it is suspected that external fields, either those that are radiated or conducted, are or will affect the governor system's operation; Huegli Tech recommends the use of shielded cable for all external connections. Be sure that only one end of the shields, including the speed sensor's shield, is connected to a single point on the case of the control unit. Mount the control unit to a grounded metal back plate or place in a sealed metal box.

Radiation is when the interfering signal is radiated directly through space to the governing system. To isolate the governor system's electronics from this type of interference source, a metal shield or a solid metal container is usually effective.

Conduction is when the interfering signal is conducted through the interconnecting wiring to the governor system's electronics. Shielded cables and the installation of filters are common remedies.

In severe, high-energy interference locations such as when the governor system is directly in the field of a powerful transmitting source, the shielding may require a special EMI class shielding. For these conditions, contact Huegli Tech for specific recommendations.

Instability

Instability in a closed loop speed control system can be categorized into two general types. **Periodic** appears to be sinusoidal and has a regular rate. **Non-Periodic** is a random wandering or an occasional deviation from a steady band for no apparent reason.

The **Periodic** type can be further classified as a fast or slow instability. Fast instability is a 3Hz or faster irregularity of the speed and is usually a jitter. Slow periodic instability is below 3Hz, can be very slow, and is sometimes violent.

If fast instability occurs, this is typically the governor responding to engine firings. Raising the engine speed increases the frequency of instability and vice-versa.

Interference from powerful electrical signals can also be the cause of fast instability. Turn off any battery chargers or other electrical equipment in the vicinity to see if the symptoms disappear.

Slow instability can have many causes. **GAIN** adjustments will usually correct most situations by matching the speed control unit dynamics.

If slow instability is unaffected by this procedure, evaluate the fuel system and engine performance. Check the fuel system linkage for binding, high friction and/or poor linkage. Be sure to check linkage during engine operation. Also, look at the engine fuel system. Irregularities with carburetion of fuel injection systems can change engine power even with a constant throttle setting. This can result in speed deviations beyond the control of the governor system.

Non-Periodic instability will generally respond to **GAIN** control. If increasing the gain reduces the instability, then the problem is most likely with the engine. Higher gain allows the governor to respond faster and correct for the disturbance. Look for engine misfiring, an erratic fuel system or load changes on the engine generator set voltage regulator.

System Inoperative

If the engine governing system does not function, the fault may be determined by performing the voltage tests described in Steps 1 through 3. Positive (+) and negative (-) refer to meter polarity. Should normal values be indicated during troubleshooting steps, and then the fault may be with the actuator or the wiring to the actuator. Tests are performed with battery power on and the engine off, except where noted. See actuator publication for testing procedure on the actuator.

Step	Wires	Normal Reading	Probable Cause of Abnormal Reading
1	RED(+) & BLACK (-)	Battery Supply Voltage (12 or 24 VDC)	1. DC battery power not connected. Check for blown fuse 2. Low battery voltage. 3. Wiring error.
2	YELLOW(+) & BROWN(-)	0-2.5 with speed trim 4.7-5.4 without speed trim	1. Speed trim shorted or miswired. 2. Defective unit.
3	ORANGE(+) & GREEN(-)	1.0 VAC RMS min. while cranking	1. Gap between speed sensor and gear teeth too great. Check gap. 2. Improper or defective wiring to the speed sensor. 3. Resistance should be between 30 to 1200 ohms. 4. Defective speed sensor.
4	RED(+) & BLUE(-)	0.8-1.5 V while cranking	1. Wiring error to actuator. 2. Defective speed control unit. 3. Defective actuator.

Unsatisfactory Performance

If the governing system functions poorly, perform the following tests.

Symptom	Test	Probable Fault
Engine overspeed	1. Do Not Crank. Apply DC power to the governor system.	1. Actuator goes to full fuel. Then disconnect the speed sensor wires. If actuator still at full fuel speed control unit defective. If actuator at minimum fuel position erroneous speed signal. Check speed sensor cable.
	2. Manually hold the engine at the desired running speed. Measure the DC voltage between the Blue wire(-) and the RED wire(+) on the speed control unit.	1. If the voltage reading is 1.0 to 1.5 VDC, a) SPEED adjustment set above desired speed b) Defective speed control unit. 2. If the voltage reading is above 1.5 VDC, actuator or linkage binding. 3. Set point of overspeed shutdown device set too low. 4. If the voltage reading is below 0.8 VDC, defective speed control unit.
Actuator does not energize fully while cranking.	1. Measure the DC voltage between BLUE wire(-) and RED wire(+) on the speed control unit. Should be 0.8 to 1.5 volts. If not:	1. Replace the battery if weak or undersized. 2. Actuator wiring incorrect. 3. If voltage is less than 1.5V, SPEED set too low
	2. Momentarily connect BLUE wire to the RED wire. The actuator should move to the full fuel position.	1. Actuator or battery wiring in error. 2. Actuator or linkage binding. 3. Defective actuator.
Engine remains below desired governed speed	1. Measure the actuator output, WHITE and BLUE, while running under governor control.	1. If voltage measurement is with 1.5 volts or more of the battery supply voltage level, then fuel control restricted from reaching full fuel position. Possibly due to mechanical governor, carburetor spring, or linkage interference. 2. If not, increase speed setting.