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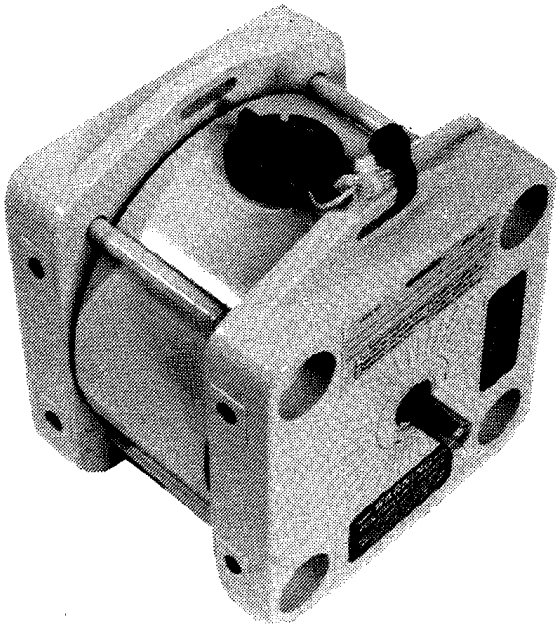

Installation of EPGs (Electrically Powered Governors) to Control Engine Speed through Existing Mechanical Governor Speed Setting Devices

Application Note 50528 (Revision A)

WARNING—DANGER OF DEATH OR PERSONAL INJURY

WARNING—FOLLOW INSTRUCTIONS

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

WARNING—OUT-OF-DATE PUBLICATION

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WARNING—OVERSPEED PROTECTION

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

WARNING—PROPER USE

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

CAUTION—POSSIBLE DAMAGE TO EQUIPMENT OR PROPERTY

CAUTION—BATTERY CHARGING

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

CAUTION—ELECTROSTATIC DISCHARGE

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

IMPORTANT DEFINITIONS

- **A WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
- **A CAUTION indicates a potentially hazardous situation which, if not avoided, could result in damage to equipment or property.**
- **A NOTE provides other helpful information that does not fall under the warning or caution categories.**

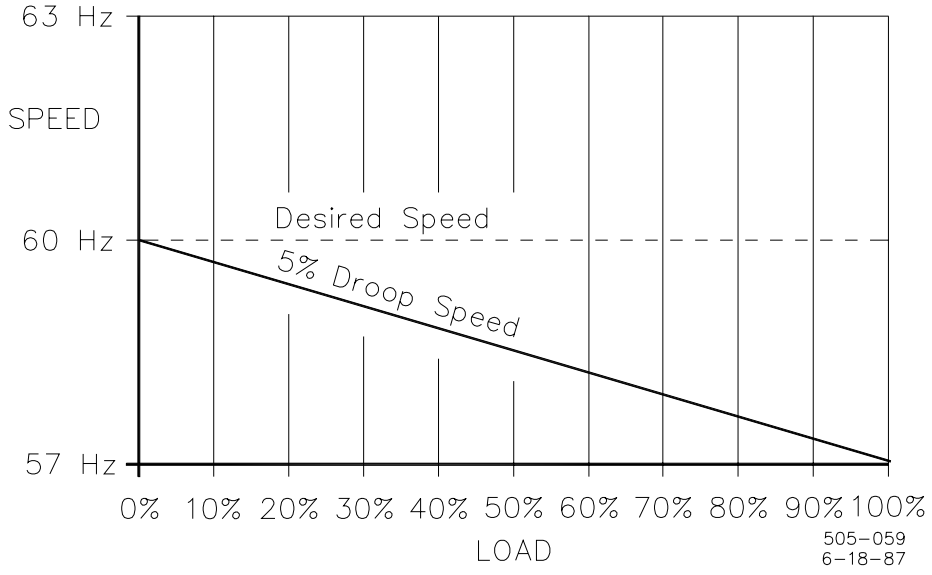
Installation of EPGs (Electrically Powered Governors) to Control Engine Speed through Existing Mechanical Governor Speed Setting Devices

Introduction

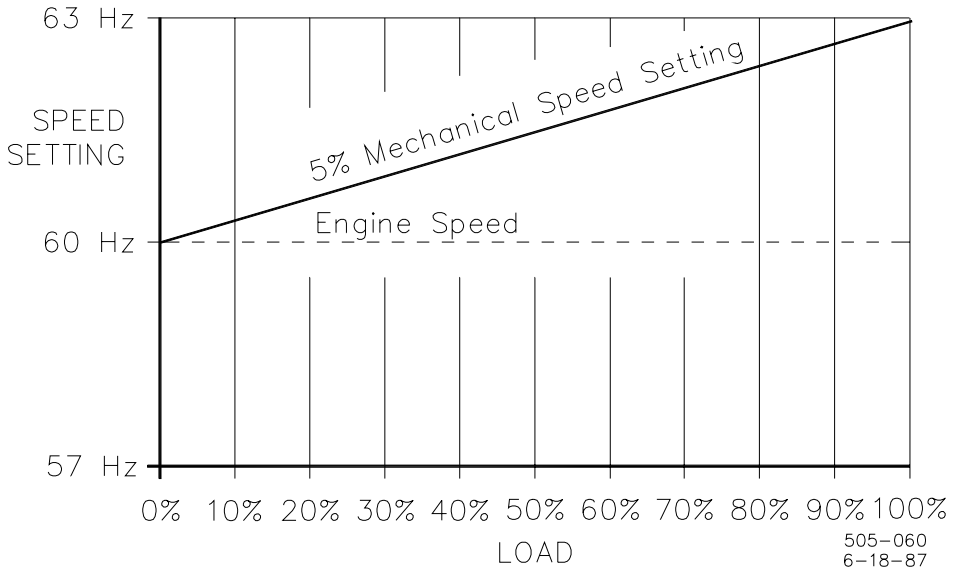
In some instances the Woodward Electrically Powered Governor (EPG) controls engine speed by operating the speed-setting lever of a mechanical governor. These instructions are for use where this is the most feasible way to control engine speed.

These instructions apply only when attaching the electric actuator output to the mechanical governor speed-setting shaft. Excellent control can also be obtained by attaching the electric actuator to the shutdown lever or directly to the injector rack. Connecting in series with the mechanical governor should only be used when it is inconvenient to connect to the rack or the shutdown lever. It is easier to set up the electronic control system on a 10% droop governor than it is on a 5% droop governor. At least 5% droop is recommended for good stability.

Many diesel engines used in generator-set applications come equipped with mechanical governors which control at a lower speed at full load than at no load. The speed-control difference, typically between 5 and 10% of no-load speed, is called droop. (The speed “droops” off as load increases.) A 5% droop governor will control an engine between 60 Hz at no load and 57 Hz at full load. A 10-percent droop governor will provide control at 60 Hz at no load and 54 Hz at full load. Both examples provide unacceptable frequency control for many generator-set applications.



The Woodward EPG will provide acceptable generator-set-speed control when linked to the speed-setting lever of a droop governor by moving the speed-setting lever enough to compensate for the droop which is built into the mechanical governor. In this system the mechanical governor provides the fuel setting for the engine and the electronic control provides the speed setting of the mechanical governor.



NOTE

Obtaining stable operation linking the Woodward actuator to a mechanical droop governor is easier the greater the droop in the mechanical governor. If convenient, the governor should be adjusted to provide the maximum droop. Good control is possible through mechanical governors with as little a 5% droop, but care must be taken to obtain maximum rotation of the Woodward actuator shaft while moving the mechanical governor speed-setting shaft only the amount of the droop. This can require an extension on the mechanical governor speed-setting lever.

Droop is built into the mechanical governor to provide stability of control and/or to allow engines to be paired on a common load. When an EPG system is controlling the speed setting through a governor, mechanical droop is overcome by the EPG. An EPG load sensor must be added to the control system if isochronous load sharing between units is desired.
When the mechanical governor and the EPG are connected in series, the mechanical governor will continue to control the speed of response while the EPG will control the accuracy of response.

Installation to Control through a Mechanical Governor

The following steps are provided as a guide for installation of an Electrically Powered Governor on an engine with a droop governor.

1. Establish the amount of droop in the existing mechanical governor by setting the speed at 60 Hz (50 Hz for some units) at no load.

   Increase to full load and observe the steady-state speed. Divide the difference between the full-load and no-load speeds by the desired frequency to obtain the percent of droop.

   Example: The speed at no load is 60 Hz. The speed at full load is 54 Hz. The difference is 6 Hz. 6 divided by 60 is 0.10 (10% droop).

   Droop is normally a straight-line function of governor speed, and the amount of droop can be found with less than full load, if the result is adjusted by the ratio of load to full load.

   In many cases the engine specifications will call out the amount of droop in the mechanical governor, or the engine manufacturer can supply the droop factor upon request.

2. With the percent of droop established, set the speed-setting lever on the mechanical governor to almost provide the desired frequency at no load (59 Hz on a 10% droop governor, 59.5 Hz on a 5% droop governor). Mark this position.

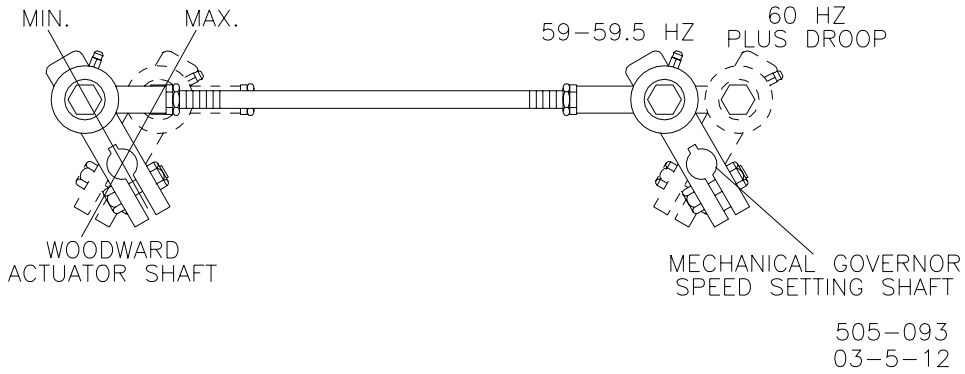
3. Multiply the desired frequency by the percent of droop and add the product to the desired frequency. Set the speed-setting lever at a position to give no-load speed at the percent of droop above the desired frequency. (5% droop governor speed will be 63 Hz. 10% droop speed will be 66 Hz. Better response will be obtained if these top settings are slightly high, about 63.5 Hz for a 5% droop governor and 67 Hz for a 10% droop governor.) Mark this position.

4. Install the electric actuator and EPG control unit. Adjust the linkage from the electric actuator to the speed-setting lever to provide the desired frequency at no load when the Woodward actuator is just above the minimum position and the desired frequency plus the droop percentage when the Woodward actuator is just below the maximum position.

The electric actuator should move the speed-setting lever between only the desired frequency (actuator at minimum position) and the desired frequency plus the percentage of droop (actuator at maximum position). If the linkage is set exactly as outlined, the unit will be provided with maximum response and maximum stability.

Mechanical speed-setting shafts will require relatively little movement, particularly on 5% droop governors. It is important that the lever on the actuator and the lever on the mechanical speed-setting shaft be about parallel at mid-position. In many cases it will be necessary to locate the rod end as close as possible to the electric-actuator shaft and as far as possible away from the mechanical governor's speed-setting shaft in order to get the required rotation of the actuator shaft between no load and full load.

If adjusted as outlined, the electric actuator will not provide either shutdown or overspeed protection, but will allow continuous engine operation at the desired frequency within the ability of the engine to maintain the frequency at full load. Other means must be established to provide overspeed protection and to provide shutdown of the engine-generator set.



Typical Actuator-to-Speed-Setting-Shaft Linkage

When an engine is set up to operate the speed setting lever, all of the actuator travel is used to overcome droop in the mechanical governor. The electronic control cannot provide an idle or other alternate speed setting. The only speed that can be controlled is the operating frequency.

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