Engine Speed Governors

CASHMAN Power Solutions CAT

Understanding Engine Governors

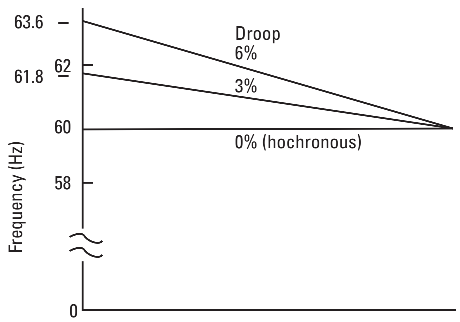
The engine governor controls engine speed, and in some generator applications, generator load. To select correct governors for particular applications, governor capabilities must be understood. The following terms are commonly encountered when describing governors:

Droop, Speed Droop or Regulation are terms used interchangeably to describe the relationship of engine speed change from no load (high idle) to full load (rated) in steady state operation. Expressed as a percentage age, droop is calculated as follows:

% Droop = (Speed at no load - Speed at full load) x 100 Speed at full load

The graph below illustrates various degrees of droop for both generator and industrial engine applications. Percentage droop remains constant and independent of operator speed change.

General Applications



Many applications easily accept some speed droop which means a less costly and complex governor can be used, even if the genset will be paralleled with other units.

Isochronous - These units offer 0% droop, i.e. constant engine speed from no load to full load. This capability is often required on gensets with certain loads demanding precise frequency control or automatic paralleling applications.

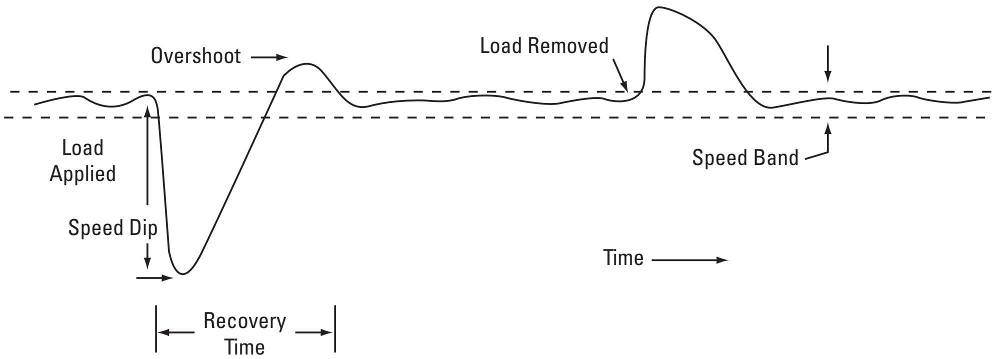
Compensation - Feedback allowing stable engine operation with minimum droop. This feature adds complexity and cost to the governor.

Speed Sensing - Using engine speed or generator frequency as control input. All engine governors are speed sensing in some form.

Transient Speed - Temporary excursions from steady state speed caused by sudden load changes.

Transient Response - This is the time interval required for engine speed to recover from a sudden load change. Overshoot is the maximum momentary increase in frequency on sudden load removal. The transient response graph below shows how an engine reacts to sudden load changes.

Transient Response



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Generator Set Stability and Response

The transient response and steady state stability of generator set engines can vary because of a number of factors: engine model, engine speed, aspiration, power factor, governor and the presence of an idle circuit.

Diesel engines have a short mechanical path between the governor actuator and the fuel delivery system to the combustion chamber. This system responds quickly to load change request from the governor.

ISO Class 1 and 2 are international standards for generator set response criteria. The two different ISO Classes refer to the performance level or specifications. Class 2 has more demanding performance specifications than Class 1. The following table reflects the current ISO standards for Class 1 and 2 diesel engines.

Transient Response

	Class 2	Class 1
Frequency recovery time	5 sec.	10 sec.
Frequency deviation	+20%	+25%
Tolerance for recovery	2.0%	3.5%
Voltage recovery time	6 sec.	10 sec.
Voltage deviation @ 0.8 power factor	+25%	+30%
Tolerance for recovery	+2.2%	+2.8%

Note: This criteria is based on adding load in three steps:

Step 1 116 psi bmep
Step 2 117 psi to 196 bmep
Step 3 197 psi to 261 bmep
Steady-State Stability

	Class 2	Class 1
Frequency	1.5%	2.5%
Voltage	2.5%	5.0%