

Voltage Regulation

A convenient way to compare the voltage behaviour of two generators is by their *voltage regulation (VR)*. The *VR* of a synchronous generator at a given load, power factor, and at rated speed is defined as

$$VR = \frac{E_{nl} - V_{fl}}{V_{fl}} \times 100\%$$

Where V_{fl} is the full-load terminal voltage, and E_{nl} (equal to E_f) is the no-load terminal voltage (internal voltage) at rated speed when the load is removed without changing the field current. For lagging power factor (*PF*), *VR* is fairly positive, for unity *PF*, *VR* is small positive and for leading *PF*, *VR* is negative.

Voltage regulation of an alternator

$$\% \text{ Regulation} = \frac{E - V}{V} * 100$$

Where E is the no load terminal voltage

V is the full load terminal voltage

Voltage regulation of an alternator

- Generally the alternator working at upf has 10% regulation maximum and at lagging power factor has 30% regulation .
- Voltage difference ($E-V$) depends on effective armature resistance (R_{eff}) and synchronous reactance (X_s)
- Less amount of % regulation indicates the good performance of the alternator
- % Regulation is +ve value for unity and lagging power factor load
- % Regulation is -ve value for leading power factor load.

Determination of Regulation

By Direct method :

- In this method no load voltage of an alternator is taken as induced emf ' E' .
- Then alternator is loaded step by step directly
- Each load condition terminal voltage (V) is noted down
- % Regulation = $(E - V / V) * 100$
- In this method power is wasted hence it is used for small ratings .

Predetermination of Regulation

- EMF Method (Synchronous –impedance method)
- MMF Method (Ampere turn method)
- ZPF Method (Zero power factor method) or potier method