

36.74 A three-phase AC generator supplies 700A at 480V with a power factor of 0.8 and an efficiency of 90%. The engine speed is 3600rpm. What is the torque needed to drive the generator?

- A. 610ft · lb_f
- B. 750ft · lb_f
- C. 820ft · lb_f
- D. 1010ft · lb_f

Adapt the last formula in the table **Power for Different Motor Phases** for a generator. Normally the formula is used to calculate the output horsepower from a motor that receives a certain input of electricity, hence the efficiency is placed in the numerator to account for the motor's losses. However, in this case the generator receives horsepower as its input and produces electricity as its output, therefore it is appropriate to *divide* by the efficiency to account for the generator's losses.

$$P_{[hp]} = \frac{\sqrt{3}IV (pf)}{746\eta}$$
$$P = \frac{\sqrt{3} (700A) (480V) (0.8)}{(746) (0.9)} = 693.4hp$$

On the same page in reference handbook under **Torques**, use the formula relating the torque to the horsepower and rotational speed. Provided the speed is in rpm, the torque will be in ft · lb_f. No additional unit conversion is needed. Calculate the torque.

$$T = 5250 \left(\frac{hp}{rpm} \right)$$
$$T = 5250 \left(\frac{693.4}{3600} \right) = 1011ft \cdot lb_f$$

Answer D