

Portland State University
Electrical & Computer Engineering
EE 347 Power Systems I

-Homework #1-

Text Problems: 2-3, 2-6

Problem 1:

An industrial customer with a three-phase, 480 V service entrance is running the following set of loads:

- One 9 kW high-intensity discharge (HID) lighting system, unity PF
- One 5 ton heat pump¹ with a COP of 1.75 and a 0.95 lagging power factor
- Two 5 HP, 90% efficient lathes, 0.79 lagging power factor
- Three electric autoclaves, 10 kBTU/h, 98% efficient, 0.97 lagging PF

If the lighting system is replaced with a T8 fluorescent system with magnetic ballast that consumes 25% less than the previous system, but introduces a 0.91 leading power factor, by how much does the service entrance current change? Consider the case when all systems are fully loaded. Consider the AC load under the new lighting regime.

Use the NFPA 70 to determine the minimum allowed gauge of the service conductors. Feeder lines are copper, with a 60 °C temperature rating, contained within a raceway with an ambient temperature of 40 °C. Start with article 310.15; state the specific article(s)/tables used to determine your answer.

Problem 2:

A machine shop is fed by a 300 kV 480 V three-phase electrical service. On one of the branches leading away from the service, the shop runs several manufacturing machines, giving the branch a load profile of 210 kW with a 0.88 lagging PF.

Determine the minimum allowed gauge of the branch conductors. Branch conductors are aluminum, THW, contained within a raceway with an ambient temperature of 40 °C. State the specific article(s)/tables used to determine your answer.

The shop owner would like to add two new 12 HP lathes (90% efficient, PF = 0.87 lagging) to the branch. If the lathes are added, will the current in the branch exceed the rating of the branch conductors? Explain and show all calculations.

¹ 1 ton of refrigeration = 3.517kW. COP = $\eta/100$

Fundamentals of Engineering Exam Problem 1 (NCEES):

If the complex power is 2100 VA with a power factor of 0.85 lagging, the reactive power (VAR) is most nearly

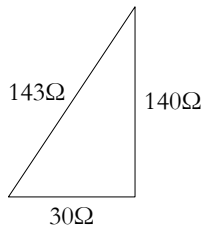
- (A) 1100
- (B) -1800
- (C) -1100
- (D) 1800

Fundamentals of Engineering Exam Problem 2 (NCEES):

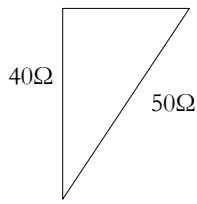
Series-connected circuit elements are shown in the figure below.



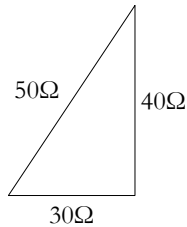
Which of the following impedance diagrams is correct according to conventional notation?



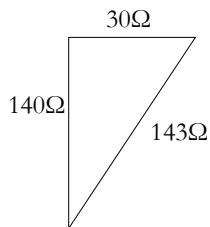
(A)



(B)



(C)



(D)