

Vacuum Pump

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Type: Design problem
Time: Two weeks
Location: Laboratory

Summary

Project goals are to introduce engineering students to the component design for fluid mechanic problems. The students must categorize each component of a vacuum pump for reverse engineering design. Then the students are asked to iterate a component design for the vacuum pump. The design should be given within the week that pumps are discussed in a typical introductory to fluid mechanics course. The students working in small groups will produce drawings and component specification for all parts of a vacuum pump. Follow-on activities may include the incorporation of this component design in an electrical system class.

ABET Descriptors

Engrg. Sci. Content: Fluid Mechanics
Type: Component
Elements: Design specifications, evaluation, synthesis
Features: Design, creativity, communication
Constraints: Time
Effort: Team

Vacuum Pump

Problem Statement:

Students shall work in small groups.

Each student group is asked to first sketch a pump and describe their sketch to the class.

Each student group is then asked to disassemble into individual component parts a vacuum pump. Each component of the pump is to be given a name related to its function. These names are to be listed on a component list along with the quantity and material. Each component is to be sketched to scale with dimensions (assuming that the students have already taken a graphic or mechanical drawing class which is a prerequisite for most fluid mechanics courses).

Design requirements:

Re-design the vacuum pump so it will be half the original size without compromising operation efficiency. The reverse engineering of the vacuum pump should be completed in one week and a component design discussion will follow. Concurrently, each group should re-design the pump and prepare a design report for peer review in two weeks.

Product:

Design report including component bill of material and schematics.

Vacuum Pump

Engineering Notes:

This group project is intended for students to obtain hands on experience of pump configuration and design. The students should be able to dismantle and re-assemble the pump. Many students have very little concept of vacuum as well as compression pump configuration.

The reverse engineering project is set up for a vacuum pump, but could also be changed for a compression pump. The pumps can be easily obtained through individual school surplus, departmental surplus, state surplus as well as federal surplus. The pumps do not need to be operational to demonstrate the component design.

The re-design of a pump helps students better understand the specific operational requirements for each of the components. The instructor should emphasis that the re-design need not meet the same pump configuration as the one that was used for dismantling.

Discussion/follow-on activities:

A short discussion of the different pump configurations could be used at the mid-point of the dismantle portion of the design to aid the students in creatively designing another pump.

A short discussion of dual vacuum/compression pump.

If the pump is operational before disassembling, then the students could measure before and after disassembly the operation curve of the pump.