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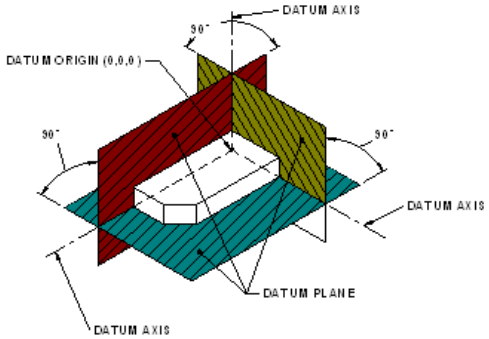

Department of Energy
Fundamentals Handbook

MECHANICAL SCIENCE
Module 3
Pumps

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TERMINAL OBJECTIVE

1.0 Without references, **DESCRIBE** the purpose, construction, and principles of operation for centrifugal pumps.

ENABLING OBJECTIVES

1.1 **STATE** the purposes of the following centrifugal pump components:

a. Impeller
b. Volute
c. Diffuser
d. Packing
e. Lantern Ring
f. Wearing ring

1.2 Given a drawing of a centrifugal pump, **IDENTIFY** the following major components:

a. Pump casing
b. Pump shaft
c. Impeller
d. Volute
e. Stuffing box
f. Stuffing box gland
g. Packing
h. Lantern Ring
i. Impeller wearing ring
j. Pump casing wearing ring

1.3 **DEFINE** the following terms:

a. Net Positive Suction Head Available
b. Cavitation
c. Gas binding
d. Shutoff head
e. Pump runout

1.4 **STATE** the relationship between net positive suction head available and net positive suction head required that is necessary to avoid cavitation.

1.5 **LIST** three indications that a centrifugal pump may be cavitating.

1.6 **LIST** five changes that can be made in a pump or its surrounding system that can reduce cavitation.

1.7 **LIST** three effects of cavitation.

1.8 **DESCRIBE** the shape of the characteristic curve for a centrifugal pump.

1.9 **DESCRIBE** how centrifugal pumps are protected from the conditions of dead heading and pump runout.

TERMINAL OBJECTIVE

2.0 Without references, **DESCRIBE** the purpose, construction, and principle of operation for positive displacement pumps.

ENABLING OBJECTIVES

2.1 **STATE** the difference between the flow characteristics of centrifugal and positive displacement pumps.

2.2 Given a simplified drawing of a positive displacement pump, **CLASSIFY** the pump as one of the following:

a. Reciprocating piston pump
b. Gear-type rotary pump
c. Screw-type rotary pump
d. Lobe-type rotary pump
e. Moving vane pump
f. Diaphragm pump

2.3 **EXPLAIN** the importance of viscosity as it relates to the operation of a reciprocating positive displacement pump.

2.4 **DESCRIBE** the characteristic curve for a positive displacement pump.

2.5 **DEFINE** the term slippage.

2.6 **STATE** how positive displacement pumps are protected against overpressurization.

CENTRIFUGAL PUMPS

Centrifugal pumps are the most common type of pumps found in DOE facilities. Centrifugal pumps enjoy widespread application partly due to their ability to operate over a wide range of flow rates and pump heads.

EO 1.1 STATE the purposes of the following centrifugal pump components:

a. Impeller
b. Volute
c. Diffuser
d. Packing
e. Lantern Ring
f. Wearing ring

EO 1.2 Given a drawing of a centrifugal pump, IDENTIFY the following major components:

a. Pump casing
b. Pump shaft
c. Impeller
d. Volute
e. Stuffing box
f. Stuffing box gland
g. Packing
h. Lantern Ring
i. Impeller wearing ring
j. Pump casing wearing ring

Introduction

Centrifugal pumps basically consist of a stationary pump casing and an impeller mounted on a rotating shaft. The pump casing provides a pressure boundary for the pump and contains channels to properly direct the suction and discharge flow. The pump casing has suction and discharge penetrations for the main flow path of the pump and normally has small drain and vent fittings to remove gases trapped in the pump casing or to drain the pump casing for maintenance.

Figure 1 is a simplified diagram of a typical centrifugal pump that shows the relative locations of the pump suction, impeller, volute, and discharge. The pump casing guides the liquid from the suction connection to the center, or eye, of the impeller. The vanes of the rotating *impeller* impart a radial and rotary motion to the liquid, forcing it to the outer periphery of the pump casing where it is collected in the outer part of the pump casing called the volute. The *volute* is a region that expands in cross-sectional area as it wraps around the pump casing. The purpose of the volute is to collect the liquid discharged from the periphery of the impeller at high velocity and gradually cause a reduction in fluid velocity by increasing the flow area. This converts the velocity head to static pressure. The fluid is then discharged from the pump through the discharge connection.

Centri nct volutes, each receiv any given time. Pumps to a split volute pumps d to the shaft and bearin on of single and double

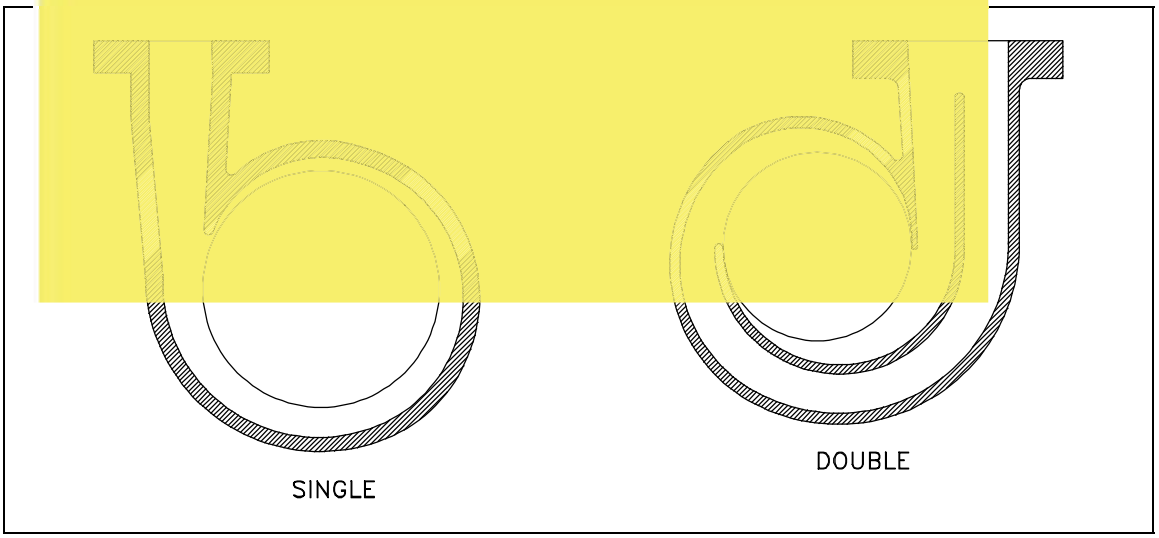

Figure 2 Single and Double Volutes