AN INTRO TO

Pump Dynamics

An introductory guide to Pump Dynamics and how to succeed at it

A Publication of

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1

Pump Fluid Basics

Pump Fluid Basics

Hydraulics

The two types of pumps are centrifugal pumps and positive displacement pumps. In this chapter we will talk about the differences between the two pump types.

Centrifugal Pumps:

- **86% of all pumps are Centrifugal Pumps:** Made universally by many brands
- **Pressure-creating device:** only puts out a given amount of pressure
- **Converts velocity energy into pressure energy:** the faster you turn it, the more pressure you are going to get - the flow is only dependent upon the system characteristics

Positive Displacement Pumps:

- **Flow-creating device**
- **Fixed volume of fluid delivered per rotation**
- **Pressure developed dependent upon system characteristics**

Pump Fluid Basics

Hydraulics

ANSI Process Pump:

- **American National Standard Institute (ANSI):** These pumps are dimensionally interchangeable
- **ANSI Process Pumps make up 50% of all Centrifugal Pumps**
- **Many different brands of ANSI pumps:** Gould, DURCO, Summit, etc.

In order to view our Pump Fluid Basics video on our YouTube channel, please visit candb.equipment

CHAPTER

2

Fluid Hydraulics

Fluid Hydraulics

Properties of the Sealed Liquid

Industrial pumps are used to pump countless types of materials from oils, fertilizers, fats, etc to their respective destinations. This chapter discusses the build up and break down points of pumping these materials.

Specific Gravity:

- **Specific gravity is a dimensionless number**.
- **The ratio of a fluid's density to that of water:** Water has a specific gravity of 1. A fluid with a specific gravity of 0.5 weighs half as much as the same volume of water. Oil, fat, crude oil, etc. are all examples of fluid with specific gravity values less than that of water – if it floats, it's lighter.

Vapor Pressure:

- **Vapor Pressure is also known as the boiling point:** this is different for different fluids
- **Vapor Pressure is the pressure below which liquid at a given temperature will become a gas:** 212 degrees F at 14.7 psi at sea level for water
- **It is the pressure above which a liquid will become a liquid:** to keep something in liquid state, you can't have it in an open atmosphere

Fluid Hydraulics

Properties of the Sealed Liquid

Industrial pumps are used to pump countless types of materials from oils, fertilizers, fats, etc. in to and out of industrial systems. This chapter discusses the build up and break down points of pumping these materials.

Pressure:

- **Pressure is the force exerted per unit area**: psi
- **When pressure is exerted on a liquid, that pressure is transmitted equally and undiminished in all directions:** Liquids cannot be compressed
- **Atmospheric Pressure:** Force exerted by the atmosphere (Pressure at sea level is 14.7 psi)
  - **Atmosphere=Absolute – Gage**
- **Gage Pressure:** The pressure contained in a vessel not acted upon by the atmosphere (units/psig)
  - **Gage=Absolute – Atmospheric**
- **Absolute Pressure:** the sum of gage and atmospheric pressure (units/psia)
  - **Absolute=Gage + Atmospheric**

Fluid Hydraulics

Properties of the Sealed Liquid

Industrial Pumps are used to pump countless types of materials from oils, fertilizers, fats, etc. in to and out of industrial systems. This chapter discusses the build up and break down points of pumping these materials.

Head:

- **Head is used as a standard measure of pressure, indicated by the height and weight of a column of liquid being discharged by a centrifugal pump**
- **Measured in “Feet of Liquid”**
- **When dealing with centrifugal pumps, we must think in terms of “feet of liquid” rather than “pressure”**
- **A given pump with a given impeller diameter and speed will raise a liquid to a certain height regardless of the weight of the liquid.**

In order to view our Fluid Hydraulics video on our YouTube channel, please visit candb.equipment

CHAPTER

3

Effects of Misapplied Applications

Effects of Misapplied Applications

In this chapter we will explain shaft dynamics and the effects of misapplied applications to industrial pumps.

Shaft Dynamics:

- **whip:** cone-shaped motion caused by imbalance (usually in impeller)
- **Run-out:** bent shaft or eccentricity between shaft sleeve and shaft
- **deflection**: under constant radial load in one direction
  - It is possible to have all three events occurring simultaneously

.

- **Shaft Whip:**
  - **Shaft changes 180 degrees from its centerline in every rotation**
  - **Usually caused by unbalanced impeller on some side of shaft**
  - **Whip and deflection can occur at the same time – moved to one side by the amount the shaft deflects**
- **Shaft Deflection:** Deflection is a function of four factors:
  - **Radial force in the impeller**
  - **Length from impeller to radial bearing**
  - **Shaft diameter (the smaller the diameter, the more deflection)**
  - **Material properties (young modulus) – different materials have a different flex**

Effects of Misapplied Applications

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Causes of Pump and Seal Failures:

- **Pump operation off its best efficiency point (B.E.P)**
- **Insufficient NPSHA –** (Net Positive Suction Head Available)
  - This can lead to cavitation
- **Pipe Strain**
- **Foundation/Baseplate**
  - Need to have the pump properly supported
- **Impeller Clearance**
  - This effects pump efficiency
- **Poor suction/Discharge piping**
- **Coupling Misalignment**
- **Thermal Expansion**

In order to view our Effects of Misapplied Applications video on our YouTube channel, please visit candb.equipment

CHAPTER

4

Reading Pump Curves

Reading Pump Curves

When figuring out how to measure pump curves, you must first know how to find the suction, discharge and impeller diameter. To get an in-depth demonstration of how to read pump curves, please view our classroom session on our YouTube channel by visiting candb.equipment

CHAPTER

5

Hands-On Class

Hands-On Class

Sometimes it's easier to learn and apply by watching examples. Please feel free to view this in order to put all of the textbook work into perspective on our YouTube channel by visiting candb.equipment

CHAPTER

6

Trouble-Shooting Pumps

Trouble-Shooting Pumps

Session 6

Several things can go wrong when pumping fluids. In this chapter we'll examine some of the scenarios that might need trouble-shooting and talk address why these problems are occurring.

Problem Scenarios:

- **No liquid coming from the pump:** If the plate is full of "green oil", pitch or tar, no fluid can get in and it won't pump anything; it plugs the impeller completely off.
- **Suction pipe not opening:** It's not submerged enough or the suction lift is too high. 25 feet is the maximum lift for water before it starts to boil.
- **Pump is not producing rated flow:** This creates an air leak. When this happens, spray it down with soapy water and see if the water goes into the stuffing box. It will go in if there is a pulling vacuum.
- **Pump starts then STOPS pumping:** It's improperly primed and it won't suck any air
- **Bearings run hot:** caused by improper alignment, improper lubrication, lube cooling, etc.
- **The motor requires excessive power:** the liquid is too heavy, requiring more horse-power to pump
- **The pump is noisy/vibrates:** caused by improper alignment or cavitation

In order to view our Trouble-Shooting Pumps video, please go to candb.equipment

“If you ever have a suction issue while running packed boxes, spray soapy water on it and see if it physically goes into the stuffing box; it will go into the stuffing box if there is a pulling a vacuum”

- Jeff Shinkle, Territory Manager - Pumps & Blowers

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