

Tuesday, May 19, 2020

8:00 am - 10:00 am

CWEA Mechanical Technologist - Grade 1 Certification Training Webinar

Learning Objective(s):

After participating in this session, attendees will be able to:

- List the Knowledge, Skills and Abilities (KSAs) included in the Mechanical Technologist Grade 1 exam.
- Practice basic math formulas needed for the Mechanical Technologist Grade 1 exam.
- Describe the material they will need to study for the Mechanical Technologist Grade 1 exam.

CWEA Contact Hours: 2.4 towards Mechanical Technologist certification



Introducer and Moderator: Roy Reynolds, Mechanical Maintenance Supervisor, Orange County Sanitation District

Roy Reynolds has 28 years of experience in the wastewater field. The last 18 years he has been a Maintenance Supervisor at Orange County Sanitation District in Southern California. He served in the U.S. Navy, assigned to the SeaBees stationed in San Diego, before the Battalion moved to Port Hueneme California. He has been active in the CWEA sitting on many of the Local and State committees related to Maintenance and Certification. Currently serving the CWEA as the SARBS TCP Committee Chair.



Speaker: Robert Delgado, Manager of Operations and Maintenance, Inland Empire Utilities Agency

Robert Delgado is a Manager of Operations and Maintenance with Inland Empire Utilities Agency in Chino, California. He has over 15 years of combined experience in Maintenance, Operations, Reliability and Asset Management. He holds a Bachelor's Degree in Business Administration from Pepperdine University. After serving in the U.S. Navy, Robert transition his career to the civilian sector where he gained experience in Aviation, Petrochemical, and Utilities. Robert is a Director for Santa Ana River Basin Section (SARBS), a local section for CWEA. He holds a Mechanical Technologist Grade 4 certification among other industry recognized certifications.

CWEA Mechanical Technologist - Grade 1 Certification Training

May 19, 2020

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Road Map for this Training Section

- Understanding the KSA's
 - Knowledge, Skills, and Abilities (KSA)
- Knowing the basic math formulas
- Knowing what to study

2

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Mechanical Tech. 1 KSA's

Knowledge, Skills and Abilities

KSA 101: Welding	4%
KSA 102: Engine Maintenance	6%
KSA 103: Pump Principles	8%
KSA 104: Wet Well Cleaning and Maintenance	3%
KSA 105: Pipelines and Valves	5%
KSA 106: Compressor and Blowers	5%
KSA 107: Safely and Effective Repair of Process Equipment	8%
KSA 108: Shop Mathematics	5%
KSA 109: Basic Electrical	5%
KSA 110: Industrial Safety Standards	12%
KSA 111: Lifting and Moving Heavy Equipment	5%
KSA 112: Proper use of Tools	11%
KSA 113: Construction Methods and Materials	5%
KSA 114: Using Manuals and Blueprints	6%
KSA 115: Working Relationships	5%
KSA 116: Communications both Verbal and in Writing	5%

Suggested Reading for Grade 1

- Audel Millwrights & Mechanics Guide
- Audel Mechanical Trades – Pocket Manual
- Operation of Wastewater Treatment Plants Vol. II
- National Electrical Code
- U.S. Bolts – Head and Wrench Sizes
- Pocket Guide to Flanges, Fittings and Piping Data
- USA North's California Excavation Manual
- Industrial Maintenance, 3rd edition

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KSA 101 – Welding, Cutting, Brazing

What you might see on the test!

- Hazards Involved with Welding, Cutting, and Brazing:
 - High temperatures
 - Use of explosive gases
 - Possible exposure to harmful light
 - Toxic fumes
 - Molten metal spatter, and
 - Flying particles
- Basic protective clothing must be worn by the welder to shield skin from exposure, a helmet is required to protect the face and eyes, fire-resistant clothing, shoes, leather gloves, jacket or apron and ventilation.
- The word “shielding” is used to describe the creation of an environment of controlled gas or gases around the weld zone to protect the molten weld metal from contamination by the oxygen and nitrogen in the atmosphere.

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KSA 101 – Welding, Cutting, Brazing

- Oxy Acetylene Gas – Best used for small pipe maintenance welding
 - Store bottles upright
 - Make sure caps are installed tightly when not in use
 - Check conditions of hoses, tanks, regulating valves and torch prior to using
 - Cal-OSHA – Where combustible materials such as paper clippings, wood shavings, or textile fibers are on the floor, the floor shall be swept clean for a radius of 35 feet. (that also means levels below your work)
 - At least one 10lb dry chemical extinguisher must be present
 - Fire Watch - If a fire watch is used, that individual must be only assigned to that task and will remain onsite for at least 30 minutes after the work is completed.
 - Strike the torch with a spark lighter not a cigarette lighter
 - After the welding work is finished, close the valves and empty the system of all gases from cylinders to torch tip
- Arc-welding
 - Electric welding machine that consists of an electric circuit that produces high current/low voltage output
 - The electrode is a rod of filler metal which is consistence with the metal being welded. The electrode is coated with chemicals that partial turn into gas and partially melt into the arc. The melting chemicals are called slag which forms a protective blanket and keeps the atmosphere out.
 - The temperature of the arc is roughly 5500 *C
 - The most common form of arc welding is manual shielded metal arc welding.

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KSA 101 – Welding, Cutting, Brazing

Some of the Best Known Arc Welding Methods

- Shielded metal arc welding (SMAW) - also known as "stick welding", uses an electrode that has flux, the protectant for the puddle, around it.
- Gas tungsten arc welding (GTAW) - also known as TIG (tungsten, inert gas), uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas such as Argon or Helium.
- Gas metal arc welding (GMAW) - commonly termed MIG (metal, inert gas), uses a wire feeding gun that feeds wire at an adjustable speed and flows an argon-based shielding gas or a mix of argon and carbon dioxide (CO₂) over the weld puddle to protect it from atmospheric contamination.
- Flux-cored arc welding (FCAW) - almost identical to MIG welding except it uses a special tubular wire filled with flux; it can be used with or without shielding gas, depending on the filler.
- Submerged arc welding (SAW) - uses an automatically fed consumable electrode and a blanket of granular fusible flux. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under the flux blanket.

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KSA 102 – Engine Maintenance

Basic Maintenance

- LOTO is required by the California Code of Regulations, Title 8, Section 3314.
- Remember that communications are vital with Plant Operators, coordinate any and all lock-out / tag-out operations with Plant Operations
- **Locked out** machinery or equipment cannot be restarted unless the lockout device is removed. Once the machinery or equipment is locked, you can then safely do your work. This could mean the difference between life and death for you
- **Tagged out** means to place a tag out device on the machine or equipment to show that it is prohibited to restart or operate the machine or equipment.
- Receive training and understand your employer's LOTO Program.
- Knowing all hazardous energy sources AND Controlling all hazardous energy sources
- Applying personal locks and tags. Testing and checking that the hazardous energy has been controlled.
- Regularly read and log instrument readings to detect trouble. Any leaks or abnormal noise must be addressed quickly to prevent increased downtime
- Read the equipment manuals for all equipment to familiarize yourself with the operation, maintenance and troubleshooting of the unit.

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KSA 102 – Engine Maintenance

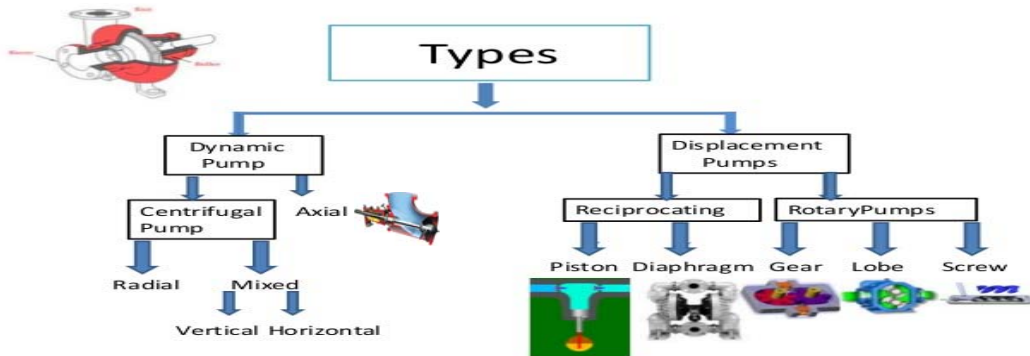
- An engine is defined as a machine designed to convert energy into useful mechanical motion.
- Engine oil pumps are positive displacement which makes a fluid move by trapping a fixed amount and forcing (displacing) that trapped volume into the discharge pipe.
- Heat Exchanger are devices that transfer heat from on fluid to another.
- A maintenance program consists of two major parts scheduling tasks and performing tasks.
- A battery should never get below 12.45 volts (75%) before recharging and a charging voltage of 1 ½ to 2 volts greater than the battery voltage should be used. Once fully charged and rested a battery should read 12.7 to be considered fully charged.
- Practice Questions
 - Is a Radiator a heat exchanger? Why or Why Not?
 - If I use the word atomization, what part of the diesel or gasoline engine am I talking about?
 - If you use a hydrometer to measure the specific gravity of a battery and the reading is 1.060 the battery is in what operational condition?

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KSA 103 – Pump Principles

All pumps use basic forces of nature to move a liquid. As the moving pump part (impeller, vane, piston diaphragm, etc.) begins to move, air is pushed out of the way. The movement of air creates a partial vacuum (low pressure) which can be filled up by more air, or in the case of water pumps, water.



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KSA 103 – Pump Principles



Centrifugal Pump

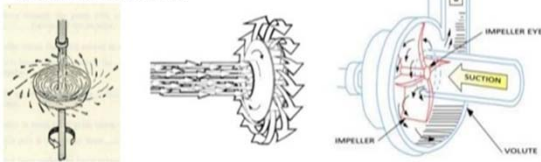
- Working Principle:**

Works on the principle of centrifugal force. This is the force that pushes the liquid away from the centre (in tangential direction).

Converting Prime Mover energy into Mechanical energy through shaft.

Converting Mechanical energy into fluid energy impeller.

Converting kinetic Energy into pressure energy through the volute casing.



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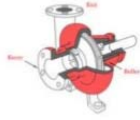
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KSA 103 – Pump Principles



Centrifugal Pump

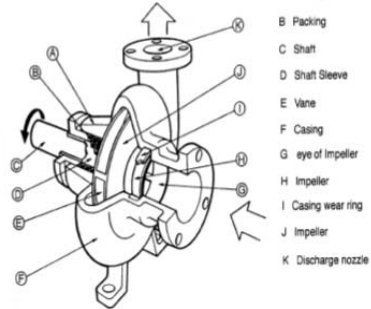
- **Major Parts:**
- **Shaft:** It transmit the torque/Power, and supporting the impeller and other rotating parts. Shaft is protected from erosion, corrosion and wear at the seal chamber through renewable sleeve.
- **Impeller:** An Impeller has vanes that pushes the liquid through the impeller. Transmit energy into the fluid (hydraulic energy).
- **Volute/Casing:** Impeller are fitted inside the casing. Volute casing is a curved shaped, increasing in cross sectional area. Volute reduces the velocity of the liquid and increases the pressure.



Major Parts

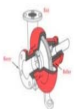


ANSI Back Pull-Out Design
Most common



- A Stuffing Box
- B Packing
- C Shaft
- D Shaft Sleeve
- E Vane
- F Casing
- G eye of Impeller
- H Impeller
- I Casing wear ring
- J Impeller
- K Discharge nozzle

KSA 103 – Pump Principles

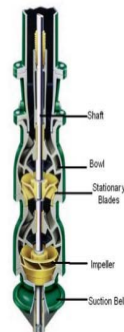


Why Centrifugal Pumps Need Priming?

Centrifugal pumps does not create suction at the start without impeller filled with water. Hence Priming required. Priming is the process in which the impeller of a centrifugal pump will get fully sub merged in liquid without any air trap inside. This is especially required when there is a first start up. But it is advisable to start the pump only after priming.

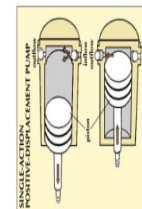
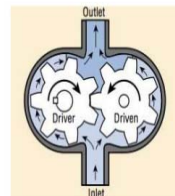


Vertical Pumps



Positive Displacement Pumps

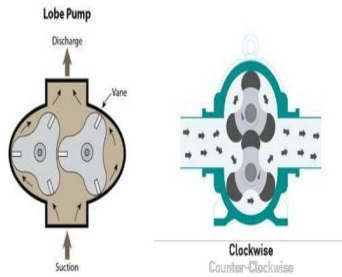
- **Working Principle:** Positive Displacement Pump has an expanding cavity on the suction side of the pump and a decreasing cavity on the discharge side. Liquid is allowed to flow into the pump as the cavity on the suction side expands and the liquid is forced out of the discharge as the cavity collapses.



KSA 103 – Pump Principles

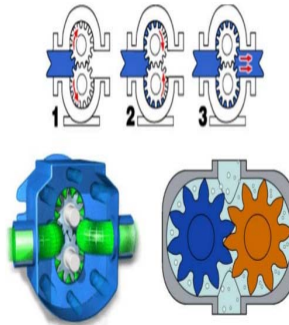
Lobe Pump

• Working Principle



Gear Pumps

Working Principle:



Displacement Vs Centrifugal

- Centrifugal pumps are suitable for low head and high flow rate.
- PD pumps produce high head and low flow rate.
- PD are suitable for High Viscosity application.
- Centrifugal Pumps are not recommended for high viscosity application because as viscosity increases its flow decreases.
- Usually a relieve valve is attached with the displacement pumps.

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KSA 103 – Pump Principles

Centrifugal Pump Troubleshooting Chart

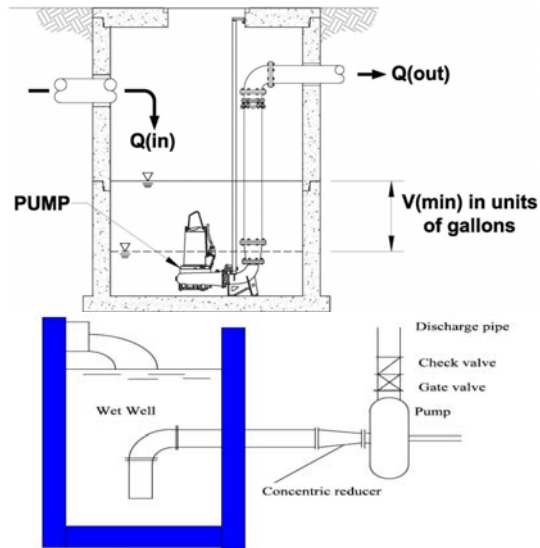
<u>Problem</u>	<u>Cause</u>
1. No Liquid being pumped	Suction closed, pump not primed, Impeller clogged, incorrect rotation.
2. Pump not producing rate flow or pressure	Air leak at stuffing box, air leak at suction flange/gasket, impeller partial clogged.
3. Hot Bearings	Improper Lubrication and or alignment
4. Pump vibrates	Poor alignment, worn bearings, pump is cavitating, unbalanced impeller, broken parts

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KSA 104 – Wet Well Cleaning and Maintenance

- Wet Wells are used in a sewer collection system.
- Typically known as Pump Stations.
- Wet Wells can have fully submersible pumps or dry submersible.
- Pump Stations of today require redundancy with additional pumps or bypass pumping capabilities and emergency power generator.
- Level controllers can be either float activated, submersible elements, non-contact Ultrasonic or radar level transmitters.
- The Air Quality Management District (AQMD) is the regulatory agency that permits odor control systems.



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KSA 105 – Pipelines and Valves

Know the different names of fittings by look and description.



Flux: A paste used to assist melting when soldering or brazing.
Solvent Weld: A chemical process used to join two PVC connections.

TYPES OF VALVES

1. GATE VALVES o/c
2. GLOBE VALVES throttling
3. PLUG VALVES o/c
4. DIAPHRAGM VALVES throttling
5. BALL VALVES o/c
6. BUTTERFLY VALVES throttling
7. NEEDLE VALVES throttling
8. CHECK VALVES o/c
9. PRESSURE RELIEF VALVES o/c
10. CONTROL VALVES o/c or throttling

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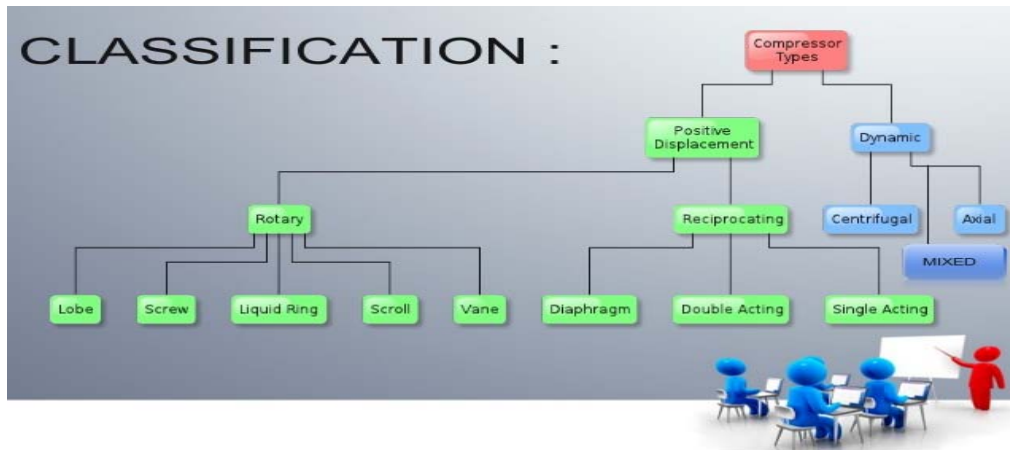
Mohd. Hanif Dewani, Senior Lecturer,
International Maritime Academy,
Bangladesh.

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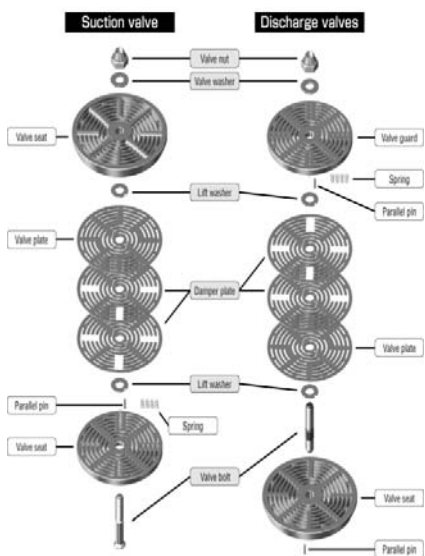
KSA 106 – Compressors and Blowers



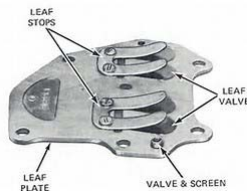
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KSA 106 – Compressors and Blowers



Four basic types of valves are in general use in various types of air compressors: Finger, Leaf, channel and annular ring

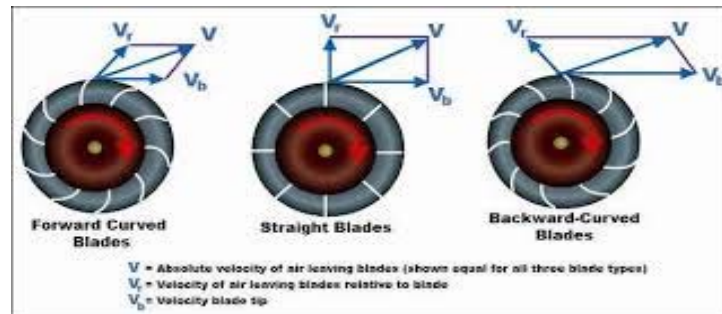


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KSA 106 – Compressors and Blowers

Any type of device that moves air or gas is called a fan or blower. The shop name for a centrifugal fan is a “squirrel cage” fan. A fan is considered for low pressure applications below 1 psi, whereas blowers are in use for pressures up to 10 psi.

Fans and centrifugal blowers offer a number of blade orientations, including backward curved, forward curved, and radial.



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KSA 106 – Compressors and Blowers

- Bearings rely on a thin film of lubricant between the balls and rollers, races and retainers to prevent actual surface to surface contact. This lubricant also dissipates heat, prevents corrosion, restricts the entry of contaminants and flushes out any particles that result from wear. Check the equipment maintenance manual to determine proper lubricant to be used.
- Grease lubrication is suitable for most low and medium speeds but not normally recommended for higher speeds. Oil is used for these applications. Grease is a combination of oil and a thickening agent, sometimes called soap.
- Intercoolers and Aftercoolers are seldom used on compressors to lower air temperature and reduce moisture content to assist with better compression on the second or third stage of compression.
- V-Belts (more than one) should be installed and their tension adjusted as recommended by the equipment manufacturer.

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KSA 107 – Safely and effectively Repair and Maintain Process Equipment

- Safety, Safety and Safety is the most critical responsibility that must be practiced each and every moment of your work day.
- When performing maintenance, remember that communication with the Operational Department is vital. You are not allowed to make operational changes (i.e. turn off a pump, closing a valve, etc.). This must be done by a certified Operator, so that permit requirements are not violated.
- Prior to commencing any maintenance work, always assess the area to identify potential safety hazards.
- Slips, trips and falls are the highest injuries that occur in Treatment Facilities. Polymers which are used to facilitate removal of water in other treatment processes are a huge slipping hazard and dry polymer can cause irritation of the skin, eyes or lungs, so PPE of chemical gloves, splash-proof goggles and an apron should be worn.
- DO NOT start any work (pulling off machinery guards, opening an electrical bucket, etc.) until the requirements of LOTO established by your facility is completed and tested to verify the system is isolated.
- Do you have the proper tools to perform the task, work order or testing that you will be doing. Some work orders may call out specific tools or instruments that are needed to perform the work correctly.

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KSA 108 – Shop Mathematics

Grade 1 math problems are simply perimeter, temp. conversion, area, square feet/yards and maybe a volume question.

What is the conversion of 100° Celsius into Fahrenheit?

- A. 212°
- B. 200°
- C. 100°
- D. 112°

$$\begin{aligned}^{\circ}\text{C} \times 9/5 + 32 &= ^{\circ}\text{F} \\ (^{\circ}\text{F} - 32) \times 5/9 &= ^{\circ}\text{C}\end{aligned}$$

$$\begin{aligned}^{\circ}\text{C} \times 9/5 + 32 &= ^{\circ}\text{F} \\ 100^{\circ} \times 9/5 + 32 &= ^{\circ}\text{F} \\ 100^{\circ} \times 1.8 + 32 &= ^{\circ}\text{F} \\ 180 + 32 &= ^{\circ}\text{F} \\ 212^{\circ} &= ^{\circ}\text{F}\end{aligned}$$

$$\begin{aligned} (^{\circ}\text{F} - 32) \times 5/9 &= ^{\circ}\text{C} \\ (212 - 32) \times 5/9 &= ^{\circ}\text{C} \\ (180) \times 5/9 &= ^{\circ}\text{C} \\ 180 \times 0.555 &= ^{\circ}\text{C} \\ 99.9 &= ^{\circ}\text{C}\end{aligned}$$

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KSA 108 – Shop Mathematics

If 17.32 v are applied across a resistance of 50 ohms, how much power is expended in the resistor?

- A. 0.34 watts
- B. 2.08 watts
- C. 6.0 watts
- D. 866 watts

$$I = V / R$$

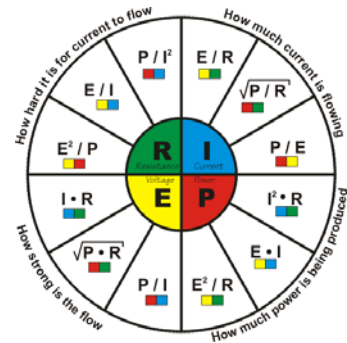
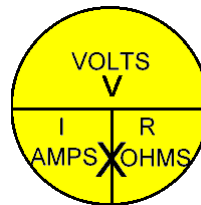
$$I = 17.32 / 50$$

$$I = 0.3464$$

$$P = 17.32 \times 0.3464$$

$$P = 5.99 (6.0)$$

$V = I \times R$ (Voltage = Current multiplied by Resistance)
 $R = V / I$ (Resistance = Voltage divided by Current)
 $I = V / R$ (Current = Voltage Divided by Resistance)
 $P = \text{Power, } E =$



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KSA 108 – Shop Mathematics

Which of the following is 12/16 of one inch equal to?

- A. 3/4 inch
- B. 1/2 inch
- C. 3/8 inch
- D. 16/32 inch

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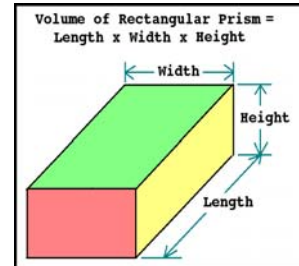
KSA 108 – Shop Mathematics

A standard steel plate is 4' wide, 8' long, and 1" thick. If steel weighs 490 lbs/ft³, what is the total weight of this plate?

- A. 1,306 lbs
- B. 1,881 lbs
- C. 15,860 lbs
- D. 18,816 lbs

$$V = L \times W \times H$$
$$V = 8 \times 4 \times 0.0833 \text{ (1" / 12")}$$
$$V = 2.6656 \text{ cubic feet}$$

$$490 \times 2.6656 = 1306.144 \text{ lbs}$$



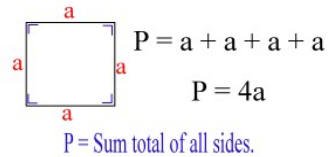
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KSA 108 – Shop Mathematics

A fence is to be installed on the perimeter of a sewer lift station. The sides of the pump station measure 235 feet, 366 feet, 266 feet and 298 feet. If a 20 foot gate is to be installed in the 266 foot section, how many linear feet of fence will be required?

- A. 1185 feet
- B. 1145 feet
- C. 1235 feet
- D. 1085 feet



$$\text{Perimeter} = 235 + 366 + (266 - 20) + 298$$
$$\text{Perimeter} = 235 + 366 + 246 + 298$$
$$\text{Perimeter} = 1145 \text{ feet}$$

or

$$\text{Perimeter} = 235 + 366 + 266 + 298$$
$$\text{Perimeter} = 1165 \text{ feet} - 20 \text{ feet} = 1145 \text{ feet}$$

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KSA 108 – Shop Mathematics

A sodium hypochlorite tank's full working capacity is 23,000 gallons. Its current level is at 1,200 gallons. How many gallons does the delivery driver need to add to bring it to 70% capacity?

- A. 14,900 gal.
- B. 16,100 gal.
- C. 17,300 gal.
- D. 21,800 gal.

23,000 / 100% capacity = 230 gallons in 1%
230 gallons x 70 % = 16,100 gallons
16,100 gallons – 1200 gallons = 14,900 gallons

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KSA 108 – Shop Mathematics

Jaime must paint a 16" wide, red stripe completely around a water tank at a centered height of 18 feet. The tank's dimensions are 25 feet high and 150 feet in diameter. How long, in linear feet, will the stripe be?

- A. 56.52 feet
- B. 471 feet
- C. 78.5 feet
- D. 706.5 feet

The linear foot is a length measurement equal to 12 inches

Circumference of circle = 3.14×150

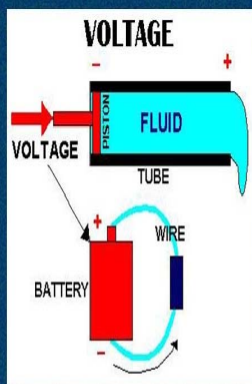
Circumference of a circle = $\pi \times \text{Diameter}$

Circumference of circle = 471 feet

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KSA 109 – Basic Electrical



The force that causes electricity to move in a conductor is called **voltage (V)** or **electromagnetic force (E)**.

Current

A flow of electric charge; also, the rate of such flow



The symbol for current flow is I.



Direct Current



Alternating Current

There are two general types of electrical current: direct and alternating currents.



Resistance is measured in **ohms** (symbol: Ω , the Greek letter omega).

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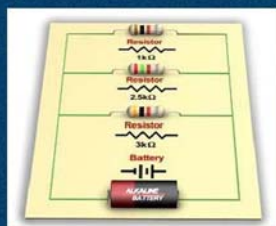
KSA 109 – Basic Electrical

Ohm

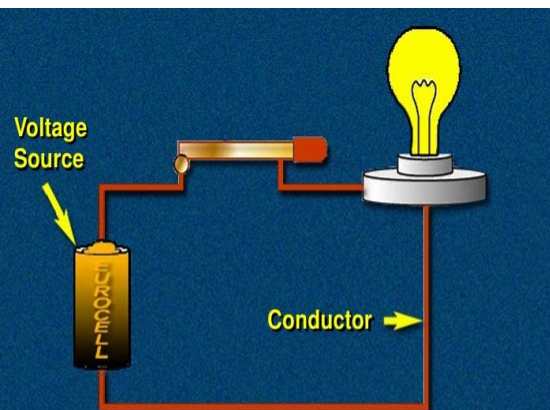
The resistance of a circuit element (or circuit) that permits a steady current of one ampere to flow when a constant potential difference of one volt is applied to that circuit

Resistance

The opposition offered by a body or substance to the passage through it of a steady electric current



One ohm is the **resistance** of a circuit that permits one ampere to flow when a potential difference of one volt is applied to the circuit.



An *electric circuit* is a conducting pathway consisting of the conductor and a path through the voltage source.

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KSA 109 – Basic Electrical

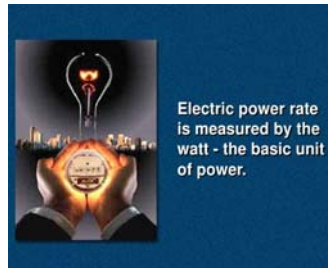
Resistance

The opposition offered by a body or substance to the passage through it of a steady electric current



A wire's resistance depends on:

- Length
- Diameter
- Composition
- Temperature



Electric power rate is measured by the watt - the basic unit of power.

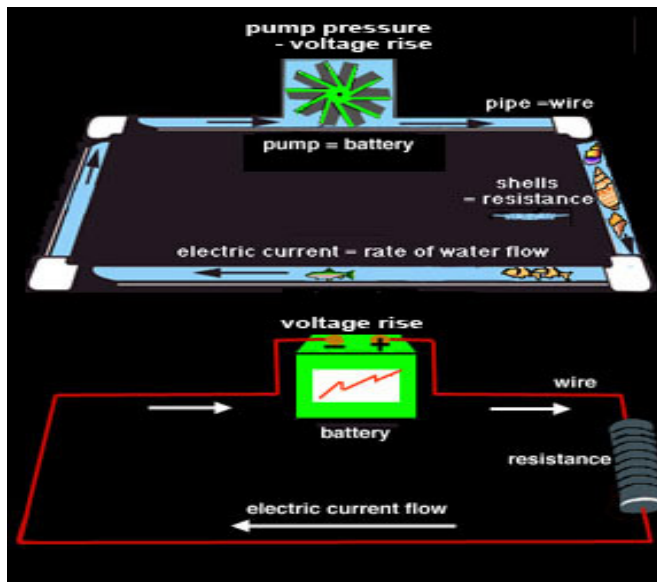


A battery consists of one or more cells assembled in a common container to act as a source of electrical power.

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KSA 109 – Basic Electrical



This mechanical system consists of a pump pushing water through a closed pipe. Imagine that the electrical current is similar to the water flowing through the pipe. The following parts of the two systems are related:

The pipe is like the wire in the electric circuit
The pump is like the battery.

The pressure generated by the pump drives water through the pipe; that pressure is like the voltage generated by the battery which drives electrons through the circuit.

The seashells plug up the pipe and slow the flow of water, creating a pressure difference from one end to the other. In a similar way the resistance in the electric circuit resists the flow of electricity and creates a voltage drop from one end to the other. Energy is lost across the resistor and shows up as heat.

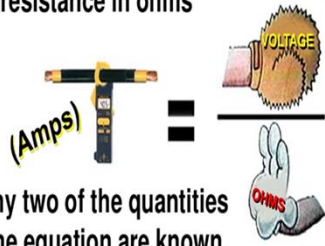
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KSA 109 – Basic Electrical

I = current in amperes
 E = voltage in volts
 R = resistance in ohms

$$I = \frac{E}{R}$$



If any two of the quantities
 In the equation are known,
 The third may be easily found.



OHMS LAW

Ohms Law Pie Chart



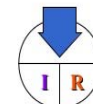
Current = Voltage over Resistance



Resistance = Voltage over Current



voltage = Current times Resistance

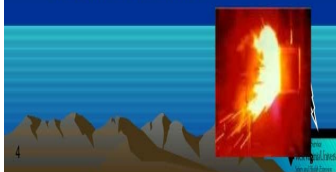


KSA 109 – Basic Electrical

Introduction

• What is Arc Flash?

- Arc flash results from an arcing fault, where the electric arcs and resulting radiation and shrapnel cause severe skin burns, hearing damage, and eye injuries.



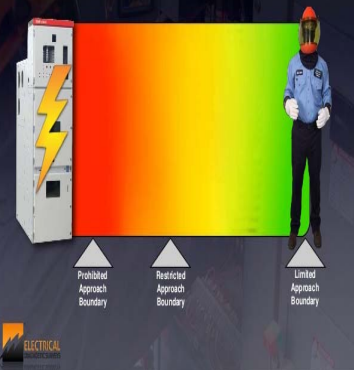
Introduction

Important Temperatures

Skin temperature for curable burn	176°F
Skin temperature causing cell death	205°F
Ignition of clothing	752°-1472°F
Burning clothing	1472°F
Metal droplets from arcing	1832°F
Surface of sun	9000°F
Arc terminals	35,000°F



Shock Protection Boundaries



KSA 109 – Basic Electrical

NFPA 70E 2015

□ Electrical hazards cause...

□ 300 deaths

□ 4,600 injuries

in the workplace each year



- National Fire Protection Association 70 E (code/standard) is the standard for Electrical Safety in the Workplace.
- Originally developed at OSHA's request
- NFPA 70E helps companies and employees avoid injuries and fatalities due to shock, electrocution, arc flash and arc blast
- Assists in meeting compliance with Cal-OSHA Title 8 CCR Chapter 4, subchapter 5 in the Electrical Safety Orders, sections 2299-2599 low voltage (0-600 v) and sections 2700-2989 high voltage (above 600 v).

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KSA 109 – Basic Electrical

What does NEC stand for?

- A.** National Electrical Code
- B. National Engineering Code
- C. Natural Electronic Computers
- D. National Electronics Code

What does EMT stand for?

- A.** Electrical Metal Tubing
- B. Electrical Measurement Timing
- C. Electrical Meter Timing
- D. Electrical Metal Transmitting

What device would be used to measure AC current flow in a large diameter conductor?

- A. A solenoid type tester
- B.** A clamp-on type ammeter
- C. An ohmmeter
- D. A potentiometer

Which of the following can burn the insulation on the supply connections at the motor starter?

- A. Having the incorrect insulation
- B. The voltage running through the connections is too high
- C. The connections are loose or have poor contacts
- D. The voltage through the connections is too low

What does GFCI stand for?

- A. Ground Fault Circuit Indicator
- B. Great Failure Circuit Indicator
- C.** Ground Fault Circuit Interrupter
- D. Great Fault Circuit Interrupter

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KSA 110 – Industrial Safety Standards

LOTO Verification:

Ensure that the isolation and de-energization of the equipment has been accomplished prior to starting any work. Test all lock-outs by following the normal startup procedure. After testing, place controls in the neutral, off or stop position.

Inspect the lock-out devices, valves, disconnected switches, blades, piping systems, etc. to verify that all energy sources have been isolated.

Confined Space:

- a. Is large enough and so configured that an employee can bodily enter and perform assigned work;
- b. Has limited or restricted means for entry or exit; and
- c. Is not designed for continuous occupancy.
- d. Confined Spaces are particularly susceptible to containing oxygen-deficient, toxic or explosive atmospheres
- e. Hydrogen Sulfide (H₂S) is a toxic gas that produces the rotten-egg smell.
- f. Four gas that must be tested and monitored prior to any confined space entry are Oxygen- 19.5 low to 23.5 high, carbon monoxide, Hydrogen Sulfide – 10 ppm and Low Explosive Limit (LEL) – 10 ppm.

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KSA 110 – Industrial Safety Standards

Frequency of STFs

- Slips, trips & falls make up majority of general industry accidents (USDOL)
 - 15% of all accidental deaths; 2nd leading cause behind motor vehicles
 - ~12,000/year
 - One of most frequently-reported injuries
 - ~25% of reported claims/year
 - Over 17% of all disabling occupational injuries result from falls
- Most could have been prevented

Typical Injury Sites

- Knee, ankle and/or foot
- Wrist &/or elbow
- Back &/or shoulder
- Hip
- Head



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KSA 110 – Industrial Safety Standards

Definitions

- Fall
 - Occurs when too far off center of balance
- Two types
 - Fall at same level
 - Fall at same walking or working surface, or fall into or against objects above same surface
 - Fall to lower level
 - Fall to level below walking or working surface

Causes of Trips



- Uncovered hoses, cables, wires or extension cords across aisles or walkways
- Clutter, obstacles in aisles, walkway & work areas
- Open cabinet, file or desk drawers & doors



Human Factors Increasing Risk of Trips & Slips - Behavior

- Carrying or moving cumbersome objects or simply too many objects at one time
- Not paying attention to surroundings or walking distracted
- Taking unapproved shortcuts
- Being in a hurry and rushing



KSA 110 – Industrial Safety Standards



Electrical Safety on the Job Site 11 Ways to Build it Safe.

Everyone on the job site is at risk.

Electrical currents can cause shocks, fires, explosions, burns, falls which can be fatal or cause serious injury.

Most electrical accidents result from one of the following three factors:

- unsafe equipment or installation,
- unsafe environment, or
- unsafe work practices.

Electrocution is the 3rd leading cause of worker-related death for construction workers.

Controlling Top Hazards

Check your extension cords and plugs—a torn jacket, exposed wire at the plug or missing a "ground" pin are quick checks to ensure that the cord is in good working condition.

Check your tools for damaged cord, missing ground pin or exposed wires.

Stay clear of overhead wires.

Do not overload circuits.

Extension cords should be placed where they will not get damaged.

De-energize circuits. Use effective lockout—tagout procedures.

Close electrical panels—never leave an open panel so that unqualified persons have access.

Test your Ground Fault Circuit Interrupter (GFCI) outlet to ensure its proper operation with an approved tester.



Test all circuits to ensure the absence of voltage with the proper meter.

Temporary lighting should be elevated and include protective cages around the bulbs.

Stay dry. Wet conditions—standing in water, wearing wet clothing, working in high humidity, and perspiring can increase electrocution risk.



OSHA 3092
© 2014 International Brotherhood of Electrical Workers, Local 1000
National Institute of Occupational Safety and Health
http://www.niosh.gov/publications/OSHA-3092-100.pdf

www.electricalalliance.org

THE ELECTRICAL ALLIANCE
National Electrical Contractors Association
200 Contractors and 8,000 Electricians United for Quality.

FIRE SAFETY TIPS

1 Put the phone numbers of the fire department near the phone.

2 Eliminate fire hazards through good house-keeping. Dispose waste paper, rubbish, and other flammable materials regularly.

3 Keep flammable materials inside proper containers and store them properly.

4 Regularly check your electrical installations, and have all frayed wires and electrical fixtures changed or repaired by a licensed electrician.

5 Do not overload electrical circuits by putting additional lights and appliances.

6 Blown fuses should not be replaced with coins, wires, or any metal.

7 Unplug all electrical appliances after every use.

8 Never leave lighted candles unattended.

9 Strictly obey the no smoking signs.

10 Do not throw lighted cigar or cigarette butts on dried leaves and garbage.

11 Never leave a lit cigarette/cigar/pipe unattended – it may fall on flammable materials which could start a fire.

12 Ensure that you have a pre-fire plan at your office.

13 Check fire protection gadgets or devices of appliances and equipment regularly.

14 Be fire-safety conscious.

EMERGENCY PHONE NUMBERS

FIRE	_____
POLICE	_____
AMBULANCE	_____
POISON CENTER	_____
PROFESSION	_____

UNPLUG WHEN NOT IN USE

NO SMOKING


















DANGER FLAMMABLE LIQUIDS

ASSEMBLY POINT

KSA 110 – Industrial Safety Standards

(g) Safety Data Sheet Format

1. Identification of the substance or mixture and of the supplier
2. Hazards identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information (non-mandatory)
13. Disposal considerations (non-mandatory)
14. Transport information (non-mandatory)
15. Regulatory information (non-mandatory)
16. Other information, including date of preparation or last revision

OLD		NEW		
Symbols	Description	GHS-Symbols	Description	Hazard statement examples
	E Explosive		GHS01 Exploding bomb	Explodes due to fire, shock, friction or heat; danger due to fire, blast and projectiles.
	F+ Extremely flammable F Highly flammable		GHS02 Flame	Flammable; catches fire spontaneously if exposed to air; in contact with water releases flammable gases which may ignite spontaneously.
	O Oxidizing		GHS03 Flame over circle	May cause fire or explosion; strong oxidizer.
	No equivalent		GHS04 Gas cylinder	Contains gas under pressure; may explode if heated; contains refrigerated gas; may cause cryogenic burns or injury.
	C Corrosive		GHS05 Corrosion	May be corrosive to metals; causes severe skin burns and eye damage.
	T+ Very toxic T Toxic		GHS06 Skull and crossbones	Small quantities are harmful or fatal.
	Xn Harmful			No direct equivalent
	Xi Irritant			No direct equivalent
	No equivalent		GHS07 Exclamation mark	Harmful, irritates eyes, skin or respiratory system, large quantities are fatal.
	No direct equivalent		GHS08 Health hazard	Causes allergic reactions; may cause cancer, may cause genetic defects; may damage fertility or the unborn child; causes damage to organs.
	N Dangerous for the environment		GHS09 Environment	Harmful, toxic or very toxic to aquatic life with long lasting effects.

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KSA 110 – Industrial Safety Standards

Why do we need fire and gas detection system?????.....

- ❖ Fire & Gas detection is mainly used to monitor areas where hazardous levels of gas or flammable substance that are not present at normal operation.
- ❖ They are designed to give early warning of the build up of gas or fire before it becomes a hazard to people, infrastructure and environment.
- ❖ Various national and international laws exist that demand the use of gas or fire detection to protect people and plant
- ❖ Many local codes of practice also exist that ensure health and safety policies are employed
- ❖ Insurance companies may not provide cover to businesses that cannot prove that they have taken appropriate safety measures to detect hazardous gases and detection of flame, smoke, heat, or fire

Gas Detection

- ❖ In general, gas detection is divided into **combustible gas detection** and **toxic gas detection**. This is a broad separation that breaks down in some cases, e.g. some gases are both toxic and combustible in the concentrations expected. Historically there has also been a separation in technology between combustible and toxic detection.

Below are some of the issues you need to consider when choosing gas detectors.

- ❖ Most devices used in the oil and gas industry are set to detect methane (CH₄) or hydrogen sulphide (H₂S).
- ❖ Many detectors show **cross-sensitivity**; i.e. a detector for detecting one gas will also detect another, at different readings. So at the time of purchase it is important to specify the gas that is to be detected and consider other gases that may be present that may affect the readings.
- ❖ The nature of the gas should be considered – e.g. **H₂S is heavier** than air, **methane rises**, propane sinks. However they may not behave like that under a high pressure discharge.
- ❖ **Altitude affects** the readings of some detectors.


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KSA 110 – Industrial Safety Standards

What is PPE?

- PPE is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemicals, radiological, physical, electrical, mechanical or other workplace hazards.
- Occupational Safety Health Administration –OSHA- regulates the use of PPE



8/27/2011

Examples of PPE


- Eye - safety glasses, goggles
- Face - face shields
- Head - hard hats
- Feet - safety shoes
- Hands and arms - gloves
- Bodies - vests
- Hearing - earplugs, earmuffs

OSHA Office of Training and Education


POWER AND CHESTER INSTITUTE

KSA 111 – Lifting and Moving Heavy Equipment

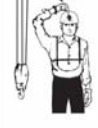
STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS



HOIST. Forearm vertical, forefinger pointing up, move hand in small horizontal circles.




LOWER. Arm extended downward, forefinger pointing down, move hand in small horizontal circles.




USE MAIN HOIST. Tap fist on head; then use regular signals.

EPC of JIC Cooling Plant 108-C08

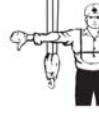
STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS (cont.)



USE WHIPLINE. Tap elbow with one hand; then use regular signals.




RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.




LOWER BOOM. Arm extended, fingers closed, thumb pointing down.

EPC of JIC Cooling Plant 108-C08


STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS (cont.)



MOVE SLOWLY. One hand gives motion signal, other hand motionless in front of hand giving the motion signal.



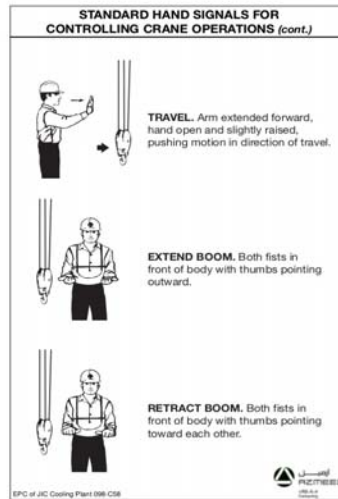
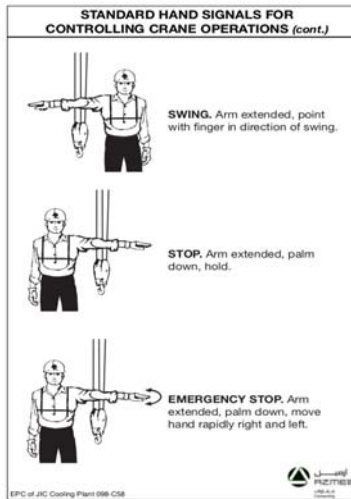
RAISE THE BOOM AND LOWER THE LOAD. Arm extended, thumb pointing up, flex fingers in and out.



LOWER THE BOOM AND RAISE THE LOAD. Arm extended, thumb pointing down, flex fingers in and out.

EPC of JIC Cooling Plant 108-C08

KSA 111 – Lifting and Moving Heavy Equipment

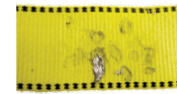


EXAMPLES OF WEB SLINGS TO BE REMOVED FROM SERVICE:

SLING KNOT



SLING WELD SPLATTERS



SLING CUTS



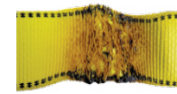
SLING ABRASION



SLING FRAYS AND PULLS



SLING ACID BURN



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KSA 112 – Proper Use of Tools

Pipe Basics

Have you ever tried to order fittings, pipe, nipples, or valves and had difficulty determining the size? If so, you're not alone. Even experienced maintenance people are sometimes confused by the industry's terminology and method of sizing. Before joining a pipe with a fitting or valve, you need to know the pipe size, thread style, and thread type—the pipe sizes must be the same and the thread types must be compatible in order for two components to fit properly

There are two thread styles: tapered and straight.

Tapered threads, which are the most common type, have a slight taper toward the end of the fitting. When threads are mated and tightened together, they hold the fitting in place and seal the connection.

Straight (parallel) threads maintain the same diameter along their entire length. They're used for mechanical joining and serve one purpose—to hold a fitting in place. Straight threads require a seal to make a tight connection.

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KSA 112 – Proper Use of Tools

Ball and roller bearings operate with less friction than plain bearings, so they're often called antifriction bearings.

Ball bearings are primarily for high speeds and moderate radial loads, but they can also handle light thrust loads.

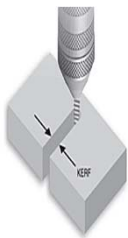
Roller bearings support higher loads than ball bearings but run at lower speeds. There are three types of roller bearings. Needle-roller bearings have a thin profile for use in tight spaces. They handle radial loads. Spherical-roller bearings generally have higher load capacities than needle and tapered roller bearings. They handle a combination of radial and thrust loads. Tapered-roller bearings handle shock loads as well as a combination of radial and thrust loads.

Open bearings dissipate heat more efficiently than double-shielded and double-sealed bearings. Double-shielded bearings resist dust and contaminants, but do not dissipate heat as efficiently as open bearings. Double-sealed bearings offer the best dust resistance, but retain the most heat.

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KSA 112 – Proper Use of Tools

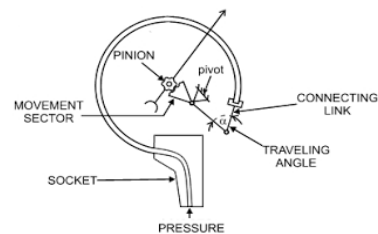


Kerf = Width

Kerf is defined as the width of material that is removed by a cutting process. It was originally used to describe how much wood was removed by a saw, because the teeth on a saw are bent to the side, so that they remove more material than the width of the saw blade itself, preventing the blade from getting stuck in the wood. When talking about CNC shape cutting with typical cutting processes, kerf is the width of material that the process removes as it cuts through the plate.

Bourdon-tube gauge

an instrument for measuring the pressure of gases or liquids, consisting of a semicircular or coiled, flexible metal tube attached to a gauge that records the degree to which the tube is straightened by the pressure of the gas or liquid inside



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KSA 112 – Proper Use of Tools



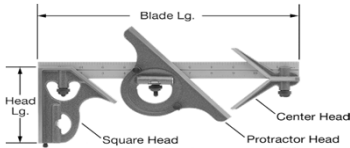
Electric Rotary Hammers



Electrical and Data Cable Cutters



Tube Benders



Combination Squares



Threads per Inch and Thread Pitch Identifiers



Micrometer

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KSA 113 – Construction Methods and Materials

Concrete Information:

Aggregate: The inert filler material that makes up the bulk of concrete. Usually sand, gravel, and rocks. Fibers and reinforcing bars are not considered aggregate

Cement: the dry unreacted powder that comes in a bag

Cement paste: Cement (see above) that has been mixed with water. Usually the term implies that it has already become hard.

Concrete: A mixture of sand, gravel, and rocks held together by cement paste. The world's most widely-used man-made material.

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KSA 113 – Construction Methods and Materials

Curing/Hardening: Essentially interchangeable terms that mean the process of continued strength gain after the cement paste has set due to chemical reactions between cement and water.

Fresh: Refers to cement paste or concrete that has been recently mixed and is still fluid.

Hardened: Refers to cement paste or concrete that has gained enough strength to bear some load.

Heat of hydration: Like most spontaneous chemical reactions, the hydration reactions between cement and water are exothermic, meaning that they release heat. Large volumes of concrete can warm up considerably during the first few days after mixing when hydration is rapid. This is generally a bad thing, for reasons that will be discussed.

Hydration: The chemical reactions between cement and water. Hydration is what causes cement paste to first set and then harden.

Mature: Refers to cement paste or concrete that has reached close to its full strength and is reacting very slowly, if at all. An age of 28 days is a very rough rule of thumb for reaching maturity.

Mortar: A mixture of cement paste and sand used in thin layers to hold together bricks or stones. Technically, mortar is just a specific type of concrete with a small maximum aggregate size.

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KSA 113 – Construction Methods and Materials

Steel trowels purpose: Used after floating to produce a smooth, hard, dense slab surface.



Floats purpose: To level ridges, fill voids, and smooth the surface in preparation for troweling. Unlike trowel finishing, floating won't close the surface, which is important at this stage to permit water to bleed out. A float also helps bring paste to the surface by pushing down the coarse aggregate

Tampers (sometimes called Jitterbugs) push the coarse aggregate in the concrete below the concrete surface and consolidate the concrete.



Groovers
Jointing the concrete is accomplished by grooving tools (unless the slab will be sawcut later). The purpose is to control the location of cracks that may form when the slab "contracts" due to drying shrinkage or temperature changes.



Edgers produce a neat rounded edge along the slab perimeter which helps the slab resist chipping and spalling damage after the forms are removed. Perform edging after the bleedwater disappears from the concrete surface, but before the forms are removed



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KSA 114 – Using Manuals and Blueprints

Purpose of Drawings

- Drawings are used to convey information about a wide range of items such as:
 - Architectural building layouts
 - Electrical wiring
 - Pneumatic or Hydraulic layouts
 - Location of equipment
 - How to assemble equipment
 - Details of equipment

5

Parts Lists

- Parts Lists are called Bill of Materials. It is a list of the material that is used to build the item that is

BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	PART NUMBER
1			
1			
2			
3			
4			
5			
6			
7			
8			
9			
11			

11

Scales

- Drawing scale is a relationship of the size or distance of the item on a drawing to the real item.
- For example a scale of $\frac{1}{4}'' = 1'$ means a measurement of $\frac{1}{4}$ inch (the quote symbol " is a shorthand for inches) on the drawing equals 1 foot (the apostrophe symbol ' is shorthand for feet) of the real world item.

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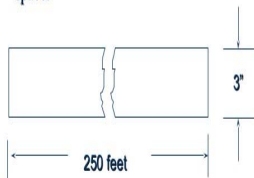
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KSA 114 – Using Manuals and Blueprints

Break Lines Example

The break line is being used to show a part reduced in length on the drawing to conserve space.



Basic Blueprint Reading

Basic Blueprint Reading

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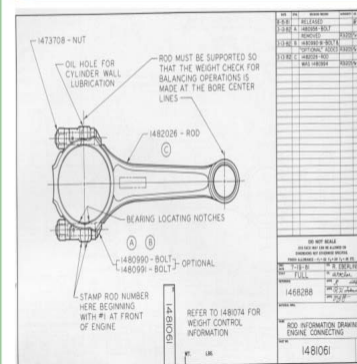
Mechanical

- Mechanical drawings are the plans for objects such as motors, assemblies for equipment, etc.
- There are many types of drawings associated with mechanical drawings such as:
 - Exploded view
 - Detail
 - Assembly

Basic Blueprint Reading

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Example Assembly Drawing



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KSA 115 – Working Relationships

Communications: What is the goal of the agency you work for ???

Listening carefully to an explanation of the problem without interruption allows time for the Operator to collect their thoughts and clearly identify what is not occurring.

Emphasize your willingness to work with the individual as a team in finding a solution.

Focus efforts on troubleshooting the equipment problem(s).

Take notes, that way if you are pulled away from that task, you have a record that you can refer back to.

Clear communication eliminates misunderstanding and reduces troubleshooting time.

The ability to adapt as the industry changes is crucial for success. New skills are required to remain current with advancing technology and grow in the maintenance task.

Maintenance Personnel make the most of each task by evaluating and refining strategies and skills.

In addition, new materials, tools and equipment are being developed regularly.

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KSA 116 – Communicate both Verbally and in Writing

If it is not written down "IT DID NOT OCCUR" this must not be taken lightly! At the end of the day your hand should hurt, from logging **pertinent** information.

DON'T just look or write down a number from a pressure gauge or other instrument, know what that means. This will assist you when it comes troubleshooting.

Work Orders should not just say "GREASED"

Log Books are legal binding documents that need to be treated like such.

Clear writing, single line corrections with initials (example: Serviced grit pump, checked cog-belt tension, deflection of 1 inch recorded.)

Never ever use correction fluid (white out). It is like saying I am trying to hide something.

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KSA 116 – Communicate both Verbally and in Writing

Hazardous Communication and Workers Right to Know laws were established to ensure that employers provide their employees with the training and PPE to properly handle and store chemicals. The basic elements of this program are:

- Identify Hazardous Materials – What chemicals are you exposed to on a daily bases in your work environment.
- Obtain Safety Data Sheets – These are provided by the chemical manufacturers and are required by Cal-OSHA. There are 16 sections on the new SDS sheets and they must be in English. Sections 1 through 8 contain general information about the chemical, identification, hazards, composition, safe handling practices, and emergency control measures (e.g., fire fighting). Sections 9 through 11 and 16 contain other technical and scientific information, such as physical and chemical properties, stability and reactivity information, toxicological information, exposure control information, and other information including the date of preparation or last revision. The SDS must also state that no applicable information was found when the preparer does not find relevant information for any required element.
- The SDS must also contain Sections 12 through 15, to be consistent with the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS), but OSHA will not enforce the content of these sections because they concern matters handled by other agencies.
- Properly Label Hazards – Specialized identification on the containers that identify their contents.
- Training – Making information available to staff for them to use in every day maintenance routines.

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Questions?

Thank You, Best wishes on your upcoming Test!

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