Handouts for Clarence Richard Asphalt Workshop's

Listing of PDF's and page numbers

When you are in need of a general reference this link has MANY, Many different options

The Engineering ToolBox · Free tools and information for engineering and design of technical applications. · Search · Engineering ToolBox - SketchUp Extension

https://www.engineeringtoolbox.com/

Steve's notes for Maintenance

R.T.F.M. Read The F**king Manuals!!

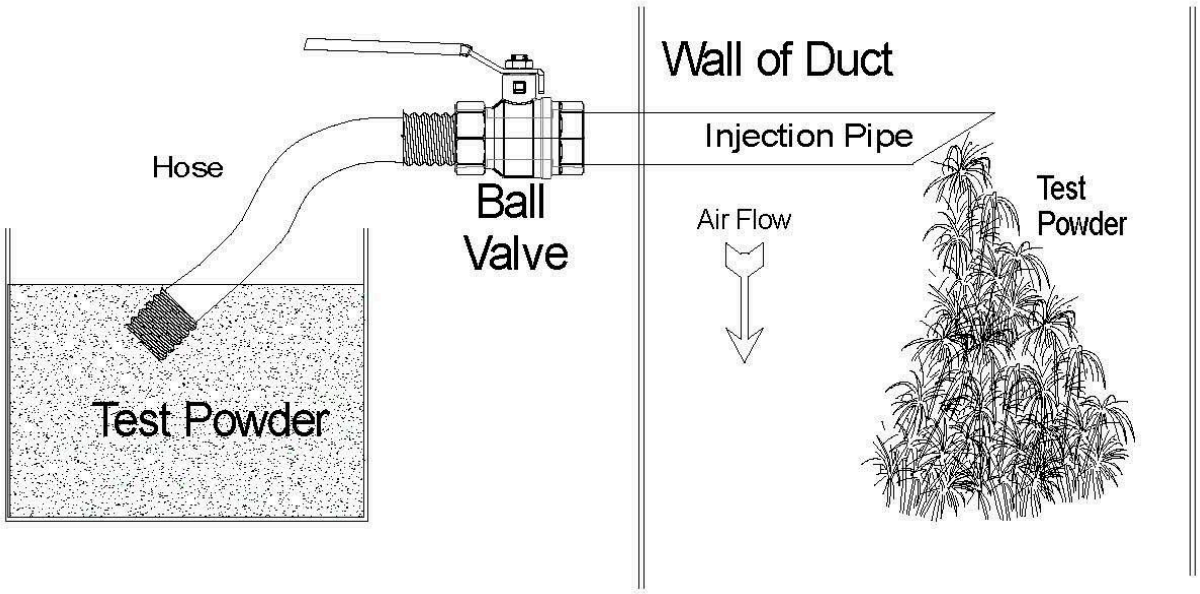
These are links that I've found helpful over time. Use the information as you can making your own choices to use the information and/or doing business with them.

Belting:
Martin Engineering links on conveyors
https://foundations.martin-eng.com/learningcenter/basics-of-belt-conveyor-systems
Links for Martin Engineering Pdf books
https://foundations.martin-eng.com/book-form-download-page

Super Screw Belt Splices
https://mltgroup-conveyor.com/permanent-splices-heavy-duty-belts/super-screw-evolution

Baghouse Bag Testing
http://www.etsi-inc.com/section_home.asp?SID=1002

Leak Detection Powder Injector



Hot Oil Testing
https://www.paratherm.com/services/heat-transfer-fluid-analysis/

Thermocouple Information
https://www.omega.com/en-us/resources/thermocouple-hub

Solid or Stranded Thermocouple Wire?
Both have advantages, depending on your needs for which one is best for you.
Solid
Normally less expensive.
In a permanent installation where the wire is seldom if ever relocated its a good choice.
Stranded
Initially more expensive per foot.
More flexible, less likely to break on plant moves.
Both
When running TC wire stay a set distance from high voltage wires. Leave extra slack on ends to allow shorting to replace break's. i.e. its less costly to start with a few extra feet than to be a few inches short when replacing a break close to an end. This will also allow extra flexibility for inserting and removal of probes. Shielding may in the long run be less expensive to sink induced signals from nearby wires.

NAPA Link
https://www.asphaltpavement.org/

Asphalt Institute FAQ
https://www.asphaltinstitute.org/engineering/frequently-asked-questions/asphalt-pavement-thickness-and-mix-design/

Thermal Electrical Inspections
https://www.fluke.com/en-us/learn/blog/thermal-imaging/electrical-systems

Asphalt Service Company
https://motionengineering.net/

Combustion Analyzers for Asphalt Plants, WHY?
https://www.enerac.com/asphalt/

Rental Testing Equipment
https://www.trsrentelco.com/

M.S.H.A. on Guarding
https://arlweb.msha.gov/s&hinfo/equipguarding2004.pdf

Toolbox Talks
https://arlweb.msha.gov/epd/efsms/toolbox/previous.asp

Handouts from Clarence Richard Workshop's
https://ezfloweighing.com/training/
Drop down from training for Safety, Process Quality Control, or Plant Production Attachments.

Speed Control
4-20 or 0-10?
0-10 was one of the first inputs used for controls. Speed control started out as 0-110vac on the panel that went back to the speed controller where the 110 was reduced to 0-10 volts ac then changed to DC control voltage. With this 0 volts was zero input and by getting this from the ac input the zero feed can not cross zero to a negative speed signal. A lot of the older controls could not follow crossing zero. With 4-20ma signal a true zero of the 4ma and a full speed trimmed at 20ma.
Type of Drive, DC (Direct Current), VFD (Variable Frequency Drive) or Eddy Current Drive
Steve's take on Drive History
The original drives on cold feeds were DC to handle the needed low end starting torque and operate at low speeds. This required the controls to operate on single phase power to the DC controllers. The next set of drives used was Eddy Current. With Eddy Current a 3ph motor is combined with a magnetic clutch that with increased speed signal couples more power to the load while the motor runs at full speed. 3ph Frequency controls have advanced to the point that with a suitable motor they now offer good starting torque and low end drive speeds.

Maintenance Links

Screw Augers
https://www.martinsprocket.com/view/material-handling-products/material-handling/screw-conveyor

Power Transmission Products
https://www.martinsprocket.com/view/power-transmission/power-transmission

Gates Engineering Application for Power Transmission
Design Vee belt drives and find tension for sonic meters
https://www.gates.com/us/en/knowledge-center/engineering-applications/design-power.html

Honeywell E-Solutions Combustion Program
https://process.honeywell.com/us/en/hts/e-solutions

Steve's Hints 2 Actuator / Linkage Adjustment

Duty Cycle what is it and why be concerned?
https://www.groschopp.com/duty-cycle-need-know/

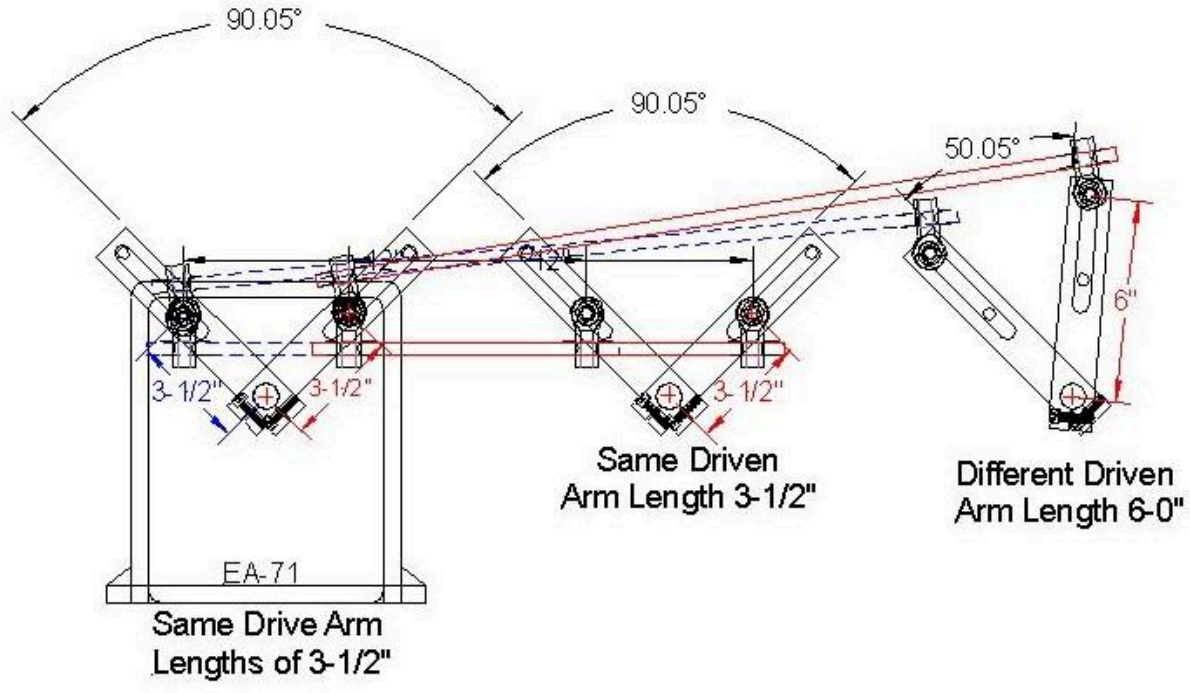
Why worry about stroke length or travel when replacing an actuator? Real simple, you only want it to push to the amount of travel of the damper or other load! If the actuator has more stroke length that the needed amount it WILL NOT STOP until!

1. It burns out trying to push on a hard stop
2. The linkage bends or breaks
3. The attachment point is broken

Duff-Norton SPA Actuator 2,000 pound
https://www.cmco.com/en-ca/products/power-and-motion-technology/actuators/linear-actuators/spa-series-2000-lbs/

EA 71 High Torque Actuator
https://www.eurotherm.com/download/instruction-manual-ea-series-electric-high-torque-actuators/

Linkage Adjustment by lever length adjustments for degrees of rotation.



Steve's Extra Video Links

General plant overview and walk-through.
https://youtu.be/UdoK4ZLh4I4?si=6alfKeTpSbA_3x5L

https://youtu.be/m_FkmxPeRFI?si=r81QqV0oFnPb2eF2

https://youtu.be/b5RYU45qtX0?si=DkIDu9hc4PhbwgIF

Plant Efficiency
https://you
tu.be/miW_Sj6rMb4?si=KFgSVn-K18CnOf8h

Asphalt Training
https://youtube.com/@vecat6629?si=Jxf9HFLke7J73MWb

Safety 3rd
https://youtu.be/s0RrhkMk2zY?si=XyFTWDCa6hzUqszq

Asphalt and Aggerate Publications

Asphalt Contractor
https://www.asphalt.com/

Asphalt Pro
https://theasphaltpro.com/

Pit and Quarry
https://www.pitandquarry.com/

Rock Products
https://rockproducts.com/

SECTION 1

FACTS ABOUT ELECTRICAL SYMBOLS AND BLUEPRINT READING

1. All symbols used by Barber-Greene are in appendix "BB" and are J.I.C. (Joint Industrial Commission) approved.

2. The voltages on the coil and contacts may be different due to isolation between the coil and contacts in a relay.

3. Motor circuitry is shown separately and has a high voltage applied, i.e. usually 480 VAC. Also, all physical wires used are colored black.

4. Control circuitry is shown separatley with ladder type schematic and has a working voltage of 120 volts or less. There are two types of voltage used.

   A. AC when used is usually 120 volts.

   B. DC when used is uaually less than 100 volts.

   C. Neutral wires in control circuits are color coded white.

   D. Ground wires in control circuits are usually color coded green.

5. On the control schematics the numbers on the left hand side are line numbers used for reference.

6. On the control schematic the number on the right hand side along side of a relay coil are the line numbers of its contact. The number that is underlined designates a normally closed contact.

7. A dotted line between two contacts designate a mechanical connection between the contacts.

8. A dotted line between two wire numbers indicate a jumper. (Also, it might have a symbol of a △).

9. On time delay contacts the arrow on the contact is:

   A. Pointing up = energized delay

   B. Pointing down = de-energized delay

10. On limit switches the switch is drawn:

    A. Under the line - normally open

    B. Over the line - normally closed

11. For ease of identification on a schematic the motor and motor controls for each motor is assigned a letter identification.

"A" = Asphalt Pump
"F" = Fuel Pump
"N" = Blower
"P" = Incline Conveyor

12. All motor schematics are drawn with symbolic drawings and are not actual wire connection drawings.

13. Actual wire connection drawings are called wiring diagrams.

SECTION 2

THE ENGINEER'S CORNER

HOW HOT IS HOT?

How often do you see a person placing his hand on an electric motor to determine if it is operating properly? This is one of the simplest and most common checks used today. From it we can quickly tell if there is any excess vibration in the system, along with getting a general idea if the motor is operating within its prescribed temperature limits.

Years ago, this method of motor checking was more reliable than it is today. The sense of touch is still fairly accurate for making a quick check of system vibrations; however, we can no longer place as much reliability in the touch test for a temperature check. Old motors were generally much underrated and, therefore, normally ran fairly cool. If the temperature ever rose to the point where it became uncomfortable to the touch, you knew that something was not functioning properly. Many of the motors in use today operate at higher temperatures under normal operation. Therefore, it is essential that one has a better understanding of motor operating temperatures.

At one time, most motors were wound with Class A insulation, which has a rating of 105° C (Centigrade). This means that the total permissible temperature on the insulation is 105° C, even though the actual temperature in many of the old motors did not even begin to approach this limit. Motors being built and re-rated today are designed to carry greater loads on smaller frames. Consequently, higher motor operating temperatures result. In some instances, it became necessary to go to higher classes of insultion - such as B, F, and H - which permit total temperatures of 130, 155 and 180 degrees C, respectively.

Today, when a person gives a motor a quick touch test, he may be forced to withdraw his hand quickly. Even though this may result, this is by no means any assurance that the motor is not operating within safe temperature limits.

Stop to think for a moment of the relationship between (C) Centigrade and (F) Fahrenheit and just exactly when these temperatures become uncomfortable to the human body. Most people's concept of heat is in Fahrenheit and, even then, the majority are not even aware that water boils at 212° F and the body temperature is 98.6° F. These figures are based on an elevation of sea level. They know that boiling water on the skin is very uncomfortable and, therefore, the closer the temperature approaches 212° F, the more unpleasant it is to the touch.

Centigrade is converted to Fahrenheit, and vice versa, by the following formula:

°F = (C x 9/5) plus 32 °C = (F - 32) x 5/9

Therefore:
105°C equals 221°F
130°C equals 266°F
155°C equals 311°F
180°C equals 356°F

Consideration must be given to the fact that the temperature of the external surface of the motor will always be somewhat cooler that the winding temperature. The difference in the two will depend mainly upon the design and type of motor enclosure. Therefore, the temperature of the outer motor enclousre should never be that of the total permissible temperature rise; however, it can, in some instances, become quite warm.

What sometimes becomes very misleading to people is that permissible temperature rise of a motor from standstill to full load operation normally ranges from 40°C to 55°C rise, but can be as high as 115°C rise on special motors. This is the temperature rise over and above room ambient. Totalling of the two - namely, room ambient and full load rise - could give a rather high temperature that would be very unpleasant to the touch. In addition to this, one should also consider that the use of motor service factors can cause the temperature to exceed its normal rated rise, still remaining within permissible limits.

Remember this the next time you check a motor and say it feels "hot". Keep in mind that there will be a difference in temperature between the outside of the housing and that of the stator winding but that this is dependent basically upon the motor design and enclosure. In most cases, it is possible for a motor to be operating within safe temperature limits and still be very uncomfortable to the touch. So, when your hand tells you it is hot, it is best to check it by a thermometer for a more accurate reading.

Temperature readings on a motor can be made very simply by affixing a thermometer to the stator coil, core or yoke by means of putty. Another simple thermometer method is to remove the lifting hook from the yoke, fill the resulting hole with oil and insert the thermometer. This method is not necessarily too accurate. Additional methods with reliable accuracy are the "winding resistance change" and also by the use of embedded detectors.

Coil or core temperature readings are generally much more accurate because they are closer to the insulation temperature. It is more desirable to take the temperature readings with the motor operating but internal readings under such conditions sometimes becomes becomes difficult.

Just because a motor surface is hot to the touch, does not confirm a diagnosis of improper operation. Take a temperature reading to determine how "hot" and then decide for yourself if your operating temperature is within safe limits.

GROUNDING

Before we undertake the explanation of grounding, some ground work must be done, "terminology."

CONDUCTOR: subtance or body capable of transmitting electricity.

GROUND: a large conducting body (as the earth) used as a common return for an electric circuit and as an arbitrary zero of potential.

GROUNDED: *connected to the earth* or to some conducting body which serves in place of the earth.

GROUNDED CONDUCTOR: a conductor which is *intentionally grounded,* either solidly or through a current limiting device.

GROUNDING CONDUCTOR: a conductor used to connect an equipment device or wiring system with a grounding electrode or electrodes. Grounding conductors are not intended to transmit current except where, as in the case of system grounding conductors, excessive voltages are imposed upon the system. Such excessive charges may be caused by lightning, contact with high-voltage systems, or in the case of an equipment frame-grounding conductor, by the breakdown of insulation in the equipment which would make the frame "*alive.*"

The following is only a combination of facts that one should realize when working with electrical grounding:

Today there exists two general types of grounds:

1. SYSTEM GROUNDS — in which one conductor, of the system, is permanently connected to the earth or ground.

2. EQUIPMENT GROUNDS — in which the non-current carrying metal parts (or frames) of electrical equipment are grounded.

Safety is the main objective for grounding. Why? Without proper grounding, shorts, shocks, and fires are common occurrences. But what does "GROUNDING" actually do? — It decreases the voltage of grounded systems between high voltage conductors and the ground.

At any time, when dealing with ground, four *important* factors should be considered:

1. The selection of the conductor, of the system, of the metal part of equipment to be grounded;
2. The selection, of the point, where the conductor is to be grounded;
3. The selection of the size of the ground wire, the arrangement of its mechanical protection, and the mode of its connection to the ground;
4. The selection of the size of the ground electrodes and the limitation of their resistance to the ground.

A reminder — when wiring with conduit or cable with metal armor, a grounding wire is not needed because the conduit or the armor of the cable serve as the grounding conductor.

The resistance of all grounds should be measured at the time of installation; and periodically thereafter. Depth or contact area, taken alone, is not a sufficient indication that the ground will

serve the protection purpose for which it is installed.

Dissimilar metals in contact at joints, which may cause galvanic action with resulting high joint resistance, should be avoided. Since copper conductors are generally used for grounding leads, *all* connections should be from copper to avoid "induced corrosion."

Grounding leads, from the apparatus to the ground, should be run in the most direct path possible and they should be well protected against mechanical injury.

Have you ever heard the terms *"SALT THE GROUND"*? By pouring salt water into the ground, around the grounding rod twice a year, it greatly reduces the ground resistance and gives a better ground.

ASPHALT PLANT GROUNDING

EQUIPMENT	TYPE OF GROUNDING
Plant Tower	Equipment Ground
Dryer	Equipment Ground
Burner Package	Equipment Ground
Incline Conveyor	Equipment Ground
Cold Feed	Equipment Ground
Collector Fans	Equipment Ground
Asphalt Transfer Pump Skid	Equipment Ground
Starter Panel	System Ground
Main Control Console	System Ground
Automatic Weighing Console	System Ground
Remote Scale System	System Ground
Burner Control Console	System Ground
Cold Feed Control Console	System Ground
Digital Recording (Printer) Console	System Ground
Accessories Console (Ammeters)	System Ground

INDEX

ELECTRICAL FUNDAMENTALS

COMPOSITION OF MATTER

1. All matter has as its basic components three minute particles . . . an electron, a proton, and a neutron.
2. An electron is a unit of negative electricity.
3. A proton is a unit of positive electricity.
4. A neutron has no electrical energy value. It contributes mass in the necleus of an atom.
5. Each electron is like all other electrons . . . each proton is like all other protons . . . each neutron is like all other neutrons.
6. Like units of electricity repel each other — opposite units attract.
7. Matter, in its different forms, is based on atomic structure the quantity of electrons and protons which band together in an atom explain the different properties in the approximately 100 elements known to man.
8. An atom is a structural unit consisting of a nucleus which houses protons and neutrons. It has electrons, in the same quantity as protons inside the nucleus, orbiting around the nucleus. The atom is also known as a basic element in nature.
9. An explanation of why there are comparatively few elementary combinations of electrons, protons, and neutrons known to man is not available. Accordingly, it is credited as being a "natural phenomenon".
10. A fixed number of electrons are required to complete an orbit or "energy level". An incomplete orbit contains free electrons; a complete orbit is stable.
11. Atoms with free electrons combine chemically with other atoms and serve as good conductors of electricity.
12. Atoms with stable structures avoid chemical combination and serve as good insulators.
13. Two atoms in combination are known as a molecule.

FUNDAMENTALS OF ELECTRICITY

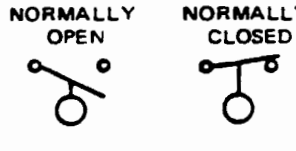
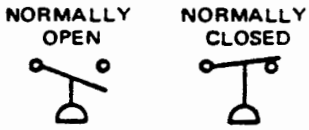
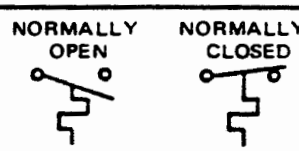
1. Current flow is the movement of electrons from one atom to another under pressure.
2. Electrons move from one atom to another at the speed of light (186,000 m.p.s.).
3. The unit of measurement for electrical pressure is the volt. (The symbol for voltage is "E".)
4. The unit of measurement for the flow of an electric current is the ampere. (The symbol for amperage is "I".)
5. The unit of measurement for an electrical resistance is the ohm. (The symbol for resistance is "R".)
6. Ohm's law prescribes the following equations for the relationship between amperage, voltage, and resistance.
   $I = E/R$, $R = E/I$, and $E = I \times R$.
7. The same amount of current flows through all units of a series circuit.
8. The flow of current divides through units in a parallel circuit.

FUNDAMENTALS OF MAGNETISM

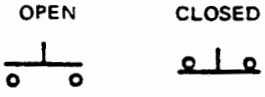
1. The north geographic pole is a south magnetic pole.
2. A magnet creates a field of force.
3. Only the magnetic materials, iron, nickel, cobalt, or their alloys can be strongly magnetized.
4. Like magnetic poles tend to repel each other.
5. Unlike magnetic poles tend to attract each other.
6. Lines of force are complete loops from the north pole to the south pole of a magnet.
7. Lines of force never cross each other.
8. There is no insulator for lines of force.
9. The space through which magnetic lines of force is called a magnetic circuit.
10. The conducting path for lines of force is called a magnetic circuit.
11. A current-carrying conductor creates a magnetic field around the conductor for the full length of the conductor.
12. Current-carrying conductors tend to move from a strong field into a weak field.
13. The magnetic strength of a coil is measured in ampere turns which is the product of amperes x turns.
14. Voltage is generated when a conductor is passed through lines of force.
15. Voltage is generated when lines of force are passed through a conductor.
16. The attractive force of an electro-magnet is not changed with polarity.

ELECTRICAL SYMBOLS

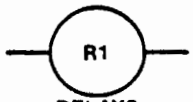
A. ELECTRICAL SYMBOLS — MOTOR STARTER CIRCUITS: (Switches)

 LIQUID LEVEL	Liquid Level Switches are float actuated used in such places as Asphalt Liquid Overflow.
 VACUUM & PRESSURE	Pressure switch, normally open (NO). Pressure will close this switch, release of pressure opens it. Pressure switch, normally closed (NC). Actuated by gas or water pressure which opens circuit, stopping motor, closing valve, etc.
 TEMPERATURE	Temperature Switches are pyrometer actuated and used in Dryer Discharges, Hot Bins and Exhaust Ductwork.
 FLOW (AIR, WATER, ETC.)	Flow Switches are usually diaphram actuated switches. Example is a Draft Switch for Burner Control.
 CABLE OPERATED (EMERG.) SWITCH	Cable Operated Switches are usually option itmes for conveyor or elevator systems.

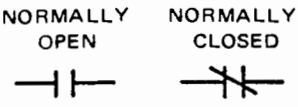
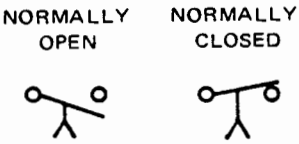
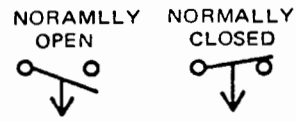
(Push buttons)

 SINGLE CIRCUIT	Push button switch, normally open (NO). Push switch to close circuit. May be used as a "START" button. Switch opens when pressure on button is released. Push button switch, normally closed (NC). Push to break or open circuit. May be used as a "STOP" button. Switch closes when pressure on button is released.

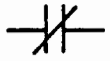
(Coils)

 RELAYS TIMERS OR TIMER COIL	Coil. The numeral and letter identify the coil in the circuit. This may be the operating coil of a starter, relay, timer, etc., which, when energized or de-energized, causes contacts to open or close.

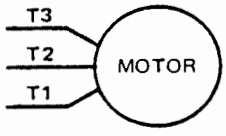
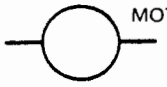
(Contacts)

 RELAY ETC.	Contact, normally open (NO). Contact, normally closed (NC). May be from starter, relay, thermal overload, step switch, etc.
 TIME DELAY ENERGIZED	This is the symbol for the contacts for a timer that closes a circuit a time interval after energizing of the timer coil. As shown, it is normally open (NO). When the circuit is broken by a switch or other means, the contacts will open and timer will reset. This is a normally closed timer (NC). It operates in the reverse manner from that described above in that its contact will open a time interval after energizing of the coil.
 TIME DELAY DE-ENERGIZED	Timer contact NO which closes on energizing the coil. When coil is de-energized there will be a time delay before contact opens. Timer contact NC which opens on energizing the coil. When coil de-energized there will be a time delay before contact closes.

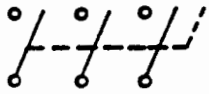
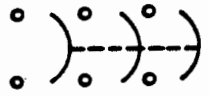
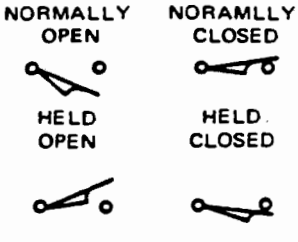
(Heaters)

 THERMAL OVERLOAD ELEMENT  THERMAL OVERLOAD	Thermal overload relays. The OL designates overload. Continuous overcurrent due to overload raises the temperature melting the alloy, allowing a ratchet wheel to rotate opening the overload contacts in the motor control circuit stopping the motor. A few moments after the motor control circuit has been broken, the melted alloy resolidifies and the relay may be reset.

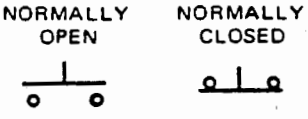
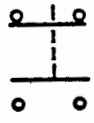
(Motors)

 AC 3 PHASE MOTOR	Three phase motor. Direction of rotation can be reversed by interchanging any two leads. Operates on 220 or 440 volts, 50 or 60 cycles. Will operate at other voltages and frequencies if so designed.
 DC MOTOR	DC Motors. This straight two lead type is used on special applications only. However, the variable D.C. motor with field and armature winding is used on Feeder Applications (4 leads).

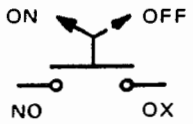
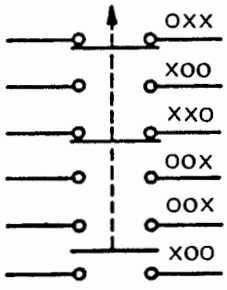
B. ELECTRICAL SYMBOLS — SYSTEM CONTROL CIRCUITS: (Switches)

 DISCONNECT	Disconnect switch. This illustrates a disconnect switch for a three phase circuit. The three blades are connected by a non-conducting material which incorporates a handle for manually opening or closing the switch.
 CIRCUIT INTERRUPTER	Circuit breaker is a device which operates directly on overload current as compared to thermal protection which operates on the heat generated by the overload current. It is faster in operation than a fuse or a thermal overload and can be reset.
 LIMIT	Limit switches are actuated by some mechanical device. Limit switch, normally open (NO). Limit switch, normally closed (NC).
 TOGGLE	This is a two way toggle switch. It is either maintained open or maintained closed.

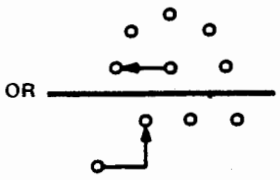
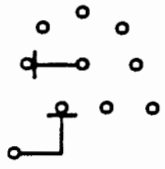
(Push buttons)

 SINGLE CIRCUIT	Push button switch, normally open (NO). Push switch to close circuit. May be used as a "START" button. Switch opens when pressure on button is released. Push button switch, normally closed (NC). Push to break or open circuit. May be used as a "STOP" button. Switch closes when pressure on button is released.
 DOUBLE CIRCUIT	

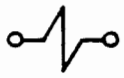
(Selector)

	Selector switch (2 position) — normally open (NO). Identified by a small lever or handle that is turned to close circuit. The top arrow points to the way switch is used (i.e.: N.O. in the ON position).
 2-POSITION	Selector switch (2 position) — normally closed (NC). Turn handle to open circuit. The top arrow points to the way switch is used. (i.e.: N.C. in the ON position).
 3-POSITION	Selector switch (3 position). (0) indicates that the contact is open, (X) indicates contact is closed. Dotted line indicates both contacts are in the same switch. TOP CONTACT — When handle is in center position or turned to left the circuit is open. Turning handle to right will close circuit. LOWER CONTACT — When handle is in center position circuit is closed. When handle is to right, circuit is closed. When handle is turned to left, circuit is open. Contact blocks are marked (NO) or (NC) for ease of wiring.

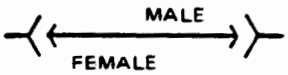
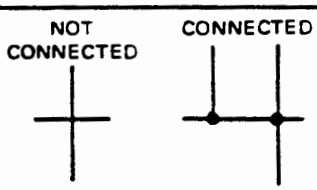
(Rotary Selector)

 NON-BRIDGING CONTACTS	Rotary Selector Switch. This is used when manual switching of circuits is desired. The NON-BRIDGING Contacts make sure of a complete isolation of circuits between any two positions.
 †BRIDGING CONTACTS	Rotary Selector Switches. The bridging contacts assure a non-break of circuits between any two positions.

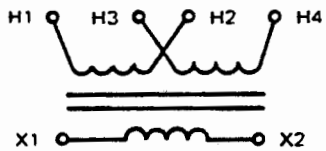
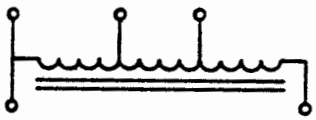
(Coils)

 SOLENOID	Solenoid. An electrical device used to push or pull an iron core. This core may be directly connected to an operating device or used as a pilot device to direct air, oil, etc.

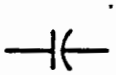
(Connections, Etc.)

	Plug-in connection. Symbol shown is for 2 pole. This may be any number of poles.	
		

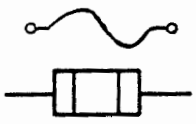
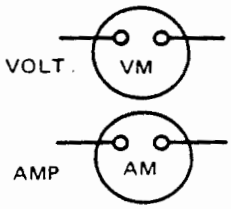
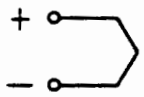
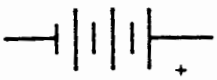
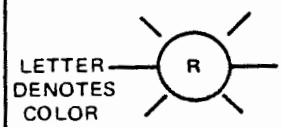
(Transformer)

 CONTROL CIRCUIT TRANSFORMER	Transformer. Used to step down or step up an AC voltage. In this illustration the top is the high voltage (primary) side, and the lower is the low voltage (secondary) side. Voltage induced in the secondary may be greater than or less than the primary voltage depending on the ratio of primary and secondary turns. Transformers are frequency rated and should not be operated at frequencies other than rated.
 AUTO TRANSFORMER	

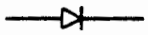
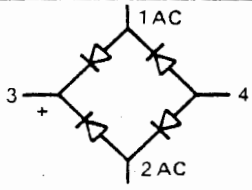
(Resistors, Capacitors, Etc.)

 RESISTOR	Fixed resistance unit. Will carry the letter "R" followed by a numeral to identify the resistor. Used as a voltage dropping or current limiting unit.
 POTENTIOMETER	Potentiometer — or pot. Used on back of scale, on preset or span adjust. Actually this is a small adjustable resistant unit used in balancing voltages in a circuit. Designated by an "R" followed by a numeral to identify resistor. (Scale pots are precision units and require special test procedure.)
 CAPACITORS FIXED	Capacitor is a device for storing electricity. Consists of two or more conducting surfaces separated by an insulator. Applying a voltage across the capacitor causes it to store a voltage equal to the applied voltage.

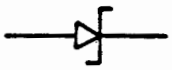
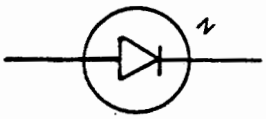
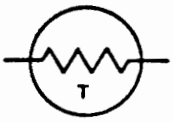
(Resistors, Capacitors, Etc. (cont'd.)

 FUSES (ALL TYPES)	Used as circuit protection device. If defective has to be replaced.
 METERS	Voltmeter — used in parallel to circuit being tested. Ammeter — used in series to circuit being tested.
 THERMOCOUPLE	The Thermocouple in most cases is an Iron - Constatan. The two wires are twisted together and are soldered together at tip. Polarity is important.
 BATTERY	Designates the storage type Battery.
 PILOT LIGHTS	Lamp. The letter "R" in the circle indicates a red light and the letter "G" indicates green. Bulbs are 110 volt, 6 watt, or 6 volt type if transformer indicator is used.

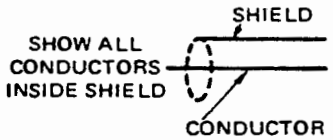
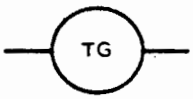
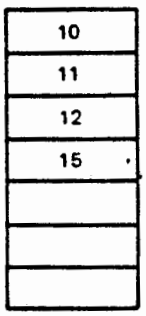
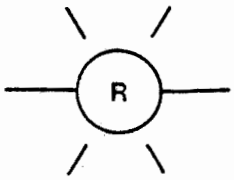
(Semiconductors)

 RECTIFIER DIODE	A semiconducter device which permits current to flow through it in one direction only.
 RECTIFIER BRIDGE	Rectifier (full wave) used to change AC power to DC power. This unit is a full wave rectifier circuit. The DC output is measured across terminals 3 and 4 when 1 and 2 are connected to an AC source of proper voltage.

(Semiconductors (cont'd)

 SILICON CONTROLLED RECTIFIER	A high powered device that will pass current through it when switched on by powering the gate.
 OPTO ISOLATOR	A light coupled relay that uses one signal to switch another signal. Operates identically to a relay except there is no mechanical linkage between the coil (Light) and the contacts (Photo Sensor). Input: Yellow 120V AC to 5V. DC. Output: Black 5V. DC to 120V AC.
 ZENER DIODE	A semiconducter device that is used as a voltage regulator. Example: A 5V. Zener will hold a steady 5V. if the voltage applied is higher (up to the point of peak inverse voltage (PIV)). If the voltage is below 5V. it will not pass any current.
 LED	A solid state device that emits light when a forward current is forced through it.
 THERMISTOR	

(Miscellaneous)

 HORN, SIREN ETC.	 SHIELDED CABLE	 SYNCHRO OR RESOLVER	 TACHOMETER GENERATOR
 TERMINAL BLOCK	 PILOT LIGHT LETTER INSIDE SYMBOL DENOTES COLOR OF LENS.		

C. ELECTRICAL SYMBOLS — ABBREVIATIONS

RELAYS

R = Main Control Relay
CR = Auto Weigh Control Relay
Example: CRIA = Control Relay No. 1 Aggregate
CRIT = Control Relay No. 1 Asphalt
BR = Burner Control Relay
FR = Cold Feeder Control Relay
PR = Ticket Printer Control Relay
X = Motor Interlock Relay

MOTOR AND STARTER

Letter designation for each motor
A = Asphalt Pump
B = Hydraulic Pump
C = Spray Pump
D = Pugmill

CONTROL COMPONENTS

R = Resistor
POT = Potentiometer
RT = Diodes & Rectifiers
IPB = Illuminated Push Button
CTR = Counter
SS = Selector Switch
BSS = Batch Size Selector
PT = Transformer
FS = Formula Selector
SU = Sensing Unit
CRS = Control Relay Stepping Switch

TIME DELAY RELAY

ED = Energize Delay Relay (On Delay)
DD = De-energize Delay Relay (Off Delay)

ELECTRICAL SCHEMATIC READING

A. MOTOR CONTROL CIRCUITS:

The motor starter schematic is divided into two types of symbolic layouts:

1. **Starter Circuit Schematic** — The circuit is all 110 Volts A.C. It consists of the starter push-buttons (located on the Main Control Console), overloads, starter coil and time delay relay (if used).

The Starter Circuit Schematic is drawn with two legs, the left leg is hot and the right leg is ground, (Refer to Figure BB-1.) Down the left leg the numbers are used as line numbers. The circuits are parallel with each other. With power applied (line 1) the starter circuit can be activated. Current flows through the normally closed STOP BUTTON (line 5). If the START BUTTON is then depressed, the

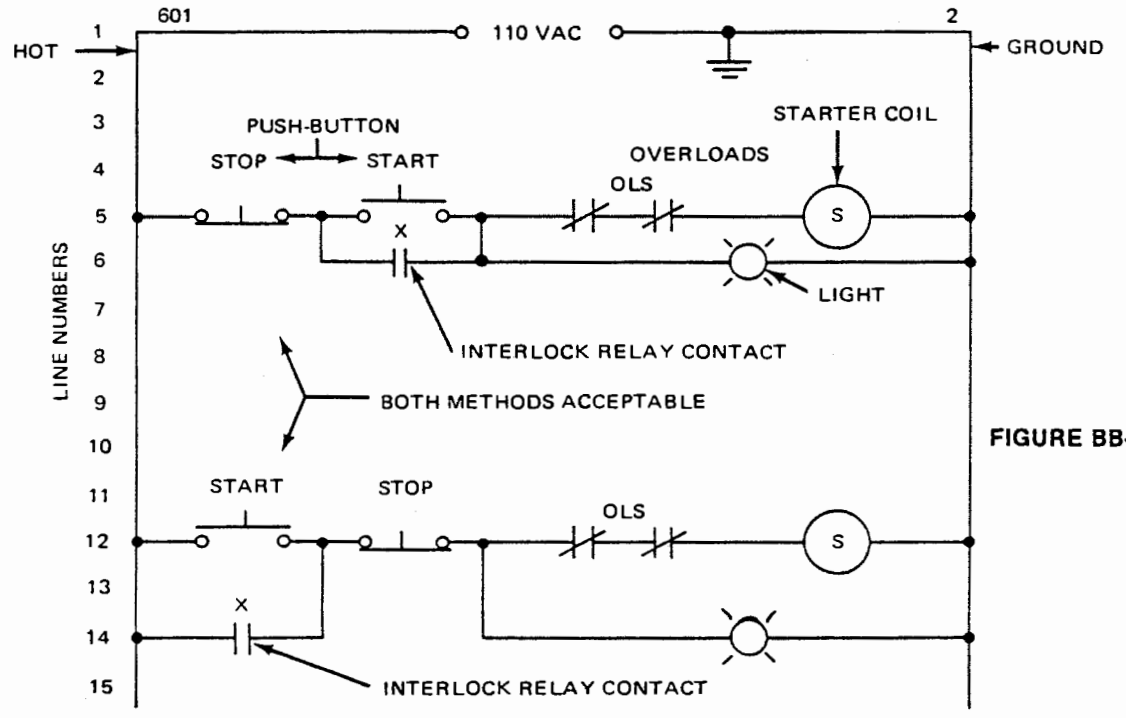


FIGURE BB-1 — "Starter Circuit - Typical"

starter coil is energized. The starter then "closes" its contacts to give power to the motor and a interlock relay. The interlock relay being energized, "closes" the "X" interlock contact (line 6, Figure BB-1). This allows the start button to be released.

2. **Motor Circuit Schematic** — The circuit is high voltage (220 VAC or Higher). It consists of the starter main contacts, starter overloads, motor, and interlock "X" relay (if used). The Motor Circuit Schematic is drawn with Symbolic Diagrams rather than the actual wiring diagram in an effort to simplify the drawing. In a Symbolic Diagram, for the motor circuit wiring, the one line symbolic represents the three legs of the motor.

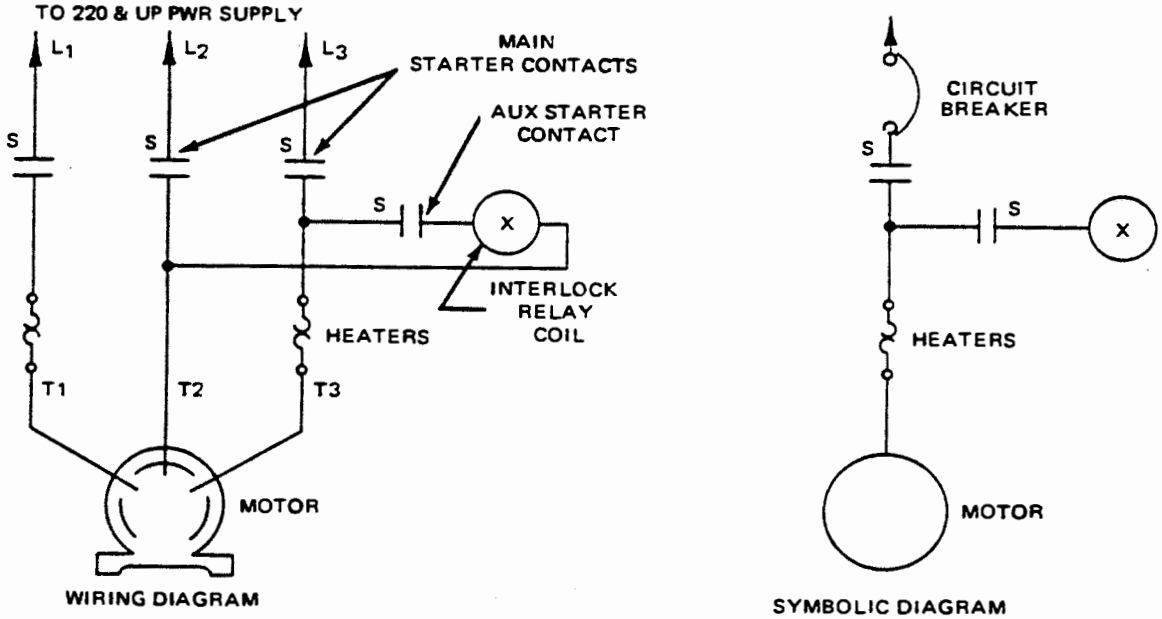


FIGURE BB-2 — "Motor Circuit - Symbolic"

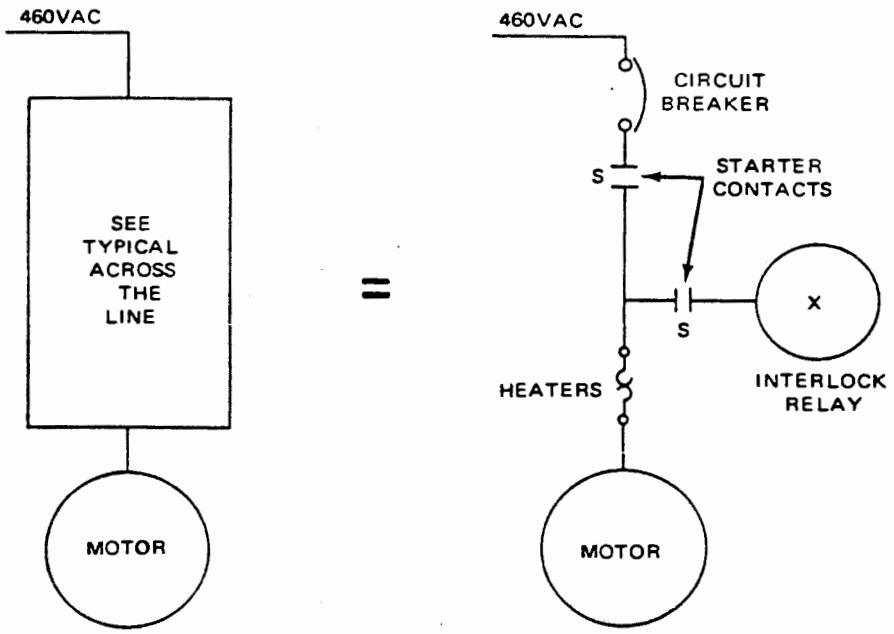


FIGURE BB-3 — "Motor Circuit - Typical"

Each motor, on the plant, is called out and given a letter designation. This letter is then used to identify the corresponding starter and interlock relay (if used).

EXAMPLE: A = Asphalt Pump
B = Spray Pump
C = Hydraulic Pump
D = Pugmill

When the main starter contacts are pulled in, current flows through to the thermal overload to give power to the motor. Current also flows to energize the interlock relay.

NOTE: Thermal Overload Relays — Continuous over-current, due to overload, raises the temperature that melts the alloy. The melting of the alloy allows a ratchet wheel to rotate and open the contacts in the motor circuit, stopping the motor. A few moments after the motor circuit has been broken, the melted alloy solidifies and the relay may be reset. Another method used is when continuous over-current, due to overload, raises the temperature to a heater; the heater expands and trips the overload relay switch.

In an effort to conserve space on a drawing, the following might be seen as a symbolic drawing for a motor schematic. (Refer to Figure BB-3.)

3. **Control Schematics** — The circuits used in the Barber-Greene Electrical Systems use a ladder type schematic and has a working voltage of 110 volts or less. There are two types of voltages used:
   a. A.C., when used, is usually 110 volts and the wire is physically color coded RED.
   b. D.C., when used, is usually less than 110 volts and the wire is physically color coded BLUE.
   c. Ground wires, in a control circuit, is usually color coded WHITE.

B. SYSTEM CONTROL CIRCUITS:

The Control Circuit Schematic is drawn with two legs. The left leg is hot; the right leg is ground and the circuits are parallel to each other, (Refer to Figure BB-5). Down the left leg the numbers are used as line numbers. Down the right side, along side of a relay coil, are the LINE numbers of its contacts. The numbers that are underlined designate a normally closed (N.C.) set of contacts.

The action of an electrical relay and how it is drawn in a schematic is illustrated in Figure BB-4.

A few other reminders when reading the Control Circuit Schematics are:

1. A dotted line between two contacts designate a mechanical connection between the contacts, usually in the same switch.

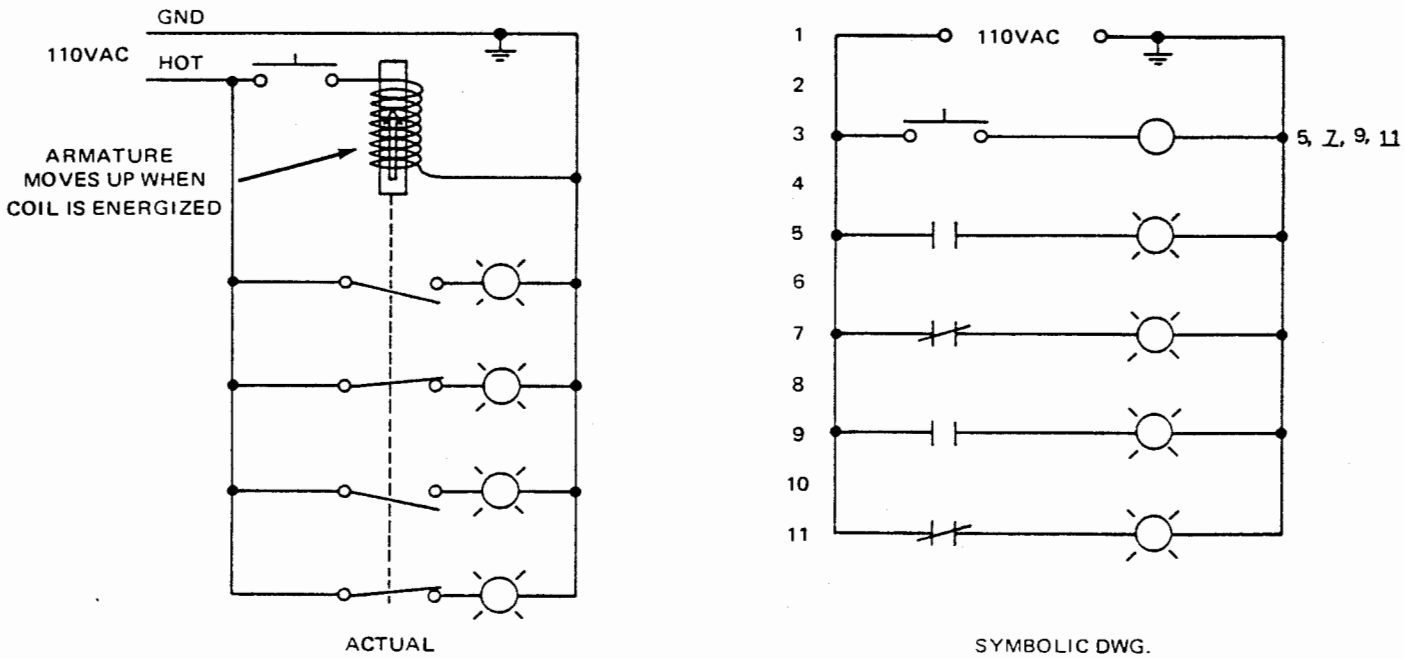


FIGURE BB-4 — "Relay Function"

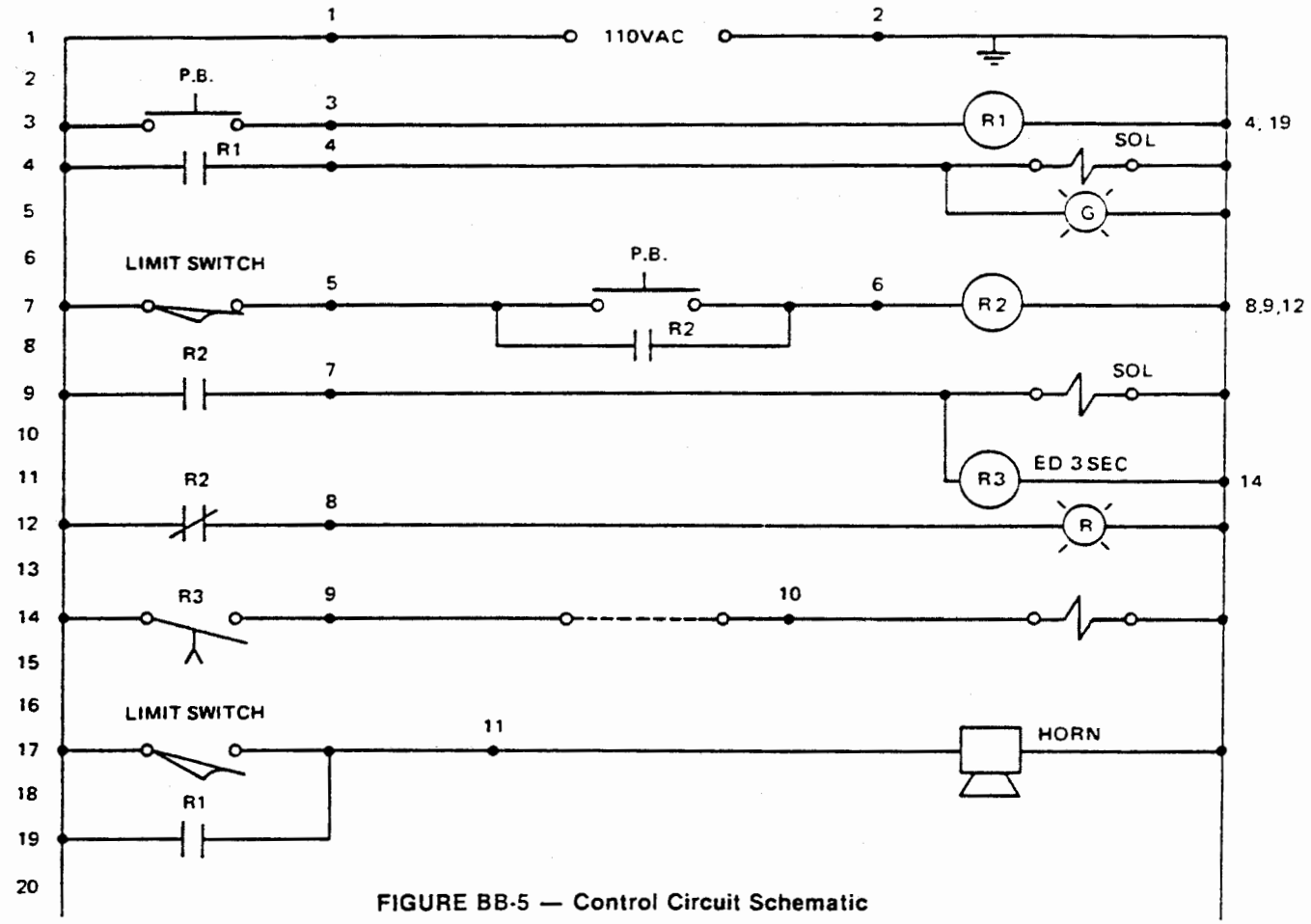


FIGURE BB-5 — Control Circuit Schematic

2. A dotted line between two wire numbers indicate a jumper.
3. On time delay contacts the arrow on the contacts indicate:
   Pointing up — Energize Delay
   Pointing down — De-energized Delay
4. On limit switches the switch is drawn:
   Under the line — Normally Open (N.O.)
   Over the line — Normally Closed (N.C.)

Referring to Figure BB-5 (Control Circuit Schematic) lets talk some of the circuit through.

On line 1, 110 volts A.C. is applied down the left leg. Then on line 3, if the normally open push button is depressed, the coil of the R1 relay is energized. When the R1 relay is energized, it closes a set of (N.O.) contacts on line 4 to energize a solenoid and lite a light. The R1 relay also closes a set of (N.O.) contacts, line 19, to sound a horn.

NOTE: The above circuit is only activiated when a button is depressed, once you let up, the circuit collapses.

On line 7, if the limit switch is closed (drawn N.O., held closed) current passes to the normally open push button. If the push button is depressed, the R2 relay is energized which closes a set of (N.O.) contacts, line 8, establishing a holding circuit so you can release the push button. When R2 is energized it also opens a set of (N.C.) contacts, line 12, which de-energizes a light and closes a set of (N.O.) contacts, line 9, which energizes a solenoid and the R3 relay. When the R3 relay is energized, since it is a Energize Delay of three seconds, three seconds later its (N.O., E.D.) contacts, line 14, will close and energize a solenoid.

Whenever the limit switch (N.O., line 17) is tripped or held closed, it will sound a horn.

GLOSSARY OF TERMS

Actuator. The cam, arm or similar mechanical device used to trip limit switches.

Alternating Current. An electrical current which alternates back and forth in direction of flow.

Ambient Conditions. The condition of the atmosphere adjacent to the electrical apparatus. The specific reference may apply to temperature, contamination, humidity, etc.

Ambient Temperature. Ambient temperature is the temperature of the surrounding cooling medium, such as gas or liquid, which comes into contact with the heated parts of the apparatus.

Ammeter. An instrument for measuring the flow of an electric current.

Amplifier (Sensing Unit). A device of electronic components used to increase power, voltage or current of a signal.

Amphere. "Amps". The current flowing through 1 ohm resistance at 1 volt potential.

Armature. The movable part of a dynamo or motor consisting essentially of coils of wire around an iron core. When the armature moves through the magnetic field between the pole pieces, an electric current is induced (as in the dynamo); when the current is passed through the coils they are caused by electro-magnetic induction to move through this field (as in the motor). The movable part of a relay or electric bell, moving in a variable magnetic field.

Atom. The smallest particle of an element. This particle contains electrons, protons, and neutrons in a predetermined quantity of each.

Auxiliary Contacts. Auxiliary contacts of a switching device are contacts in addition to the main-circuit contacts and function with the movement of the latter.

Block Diagram. A block diagram is a diagram showing the relationship of separate sub-units (blocks) in the control system.

Brush. One of two or more plates, rods or bundles of some conducting material, esp. copper or carbon, bearing against a commutator, slip ring or the like, and providing a passage for electric current.

Calibration. The act of determining or rectifying the graduations used on a testing instrument.

Capacitor. A device used to block the flow of direct current while allowing alternating and pulsating currents to pass.

Chassis. Sheet metal box, frame, or simple plate on which electronic components and their associated circuits are mounted.

Circuit. The complete path of an electric current, including, usually, the generating device. This complete path is called a closed circuit, and when its continuity is broken, an open circuit.

Parallel (Circuit). That arrangement of an electrical system, as of the cells of a battery, in which all positive poles, terminals, etc., are joined to one conductor, and all negative poles, etc., to another conductor, so that each unit is practically on a parallel branch or shunt.

Primary (Circuit). In an induction coil or transformer pertaining to or designating the inducing current or its circuit, as a primary coil.

Secondary (Circuit). In an induction coil or transformer pertaining to or designating the induced current or its circuit; as the secondary coil; secondary winding.

Series (Circuit). The arrangement of connecting the separate parts of a circuit successively end to end to form a single path for the current, parts so arranged being in series.

Series — Parallel (Circuit). A combination of series and parallel circuits.

Circuit Breaker. A device designed to open and close a circuit by non-automatic means, and to open circuit automatically on a predetermined overload of current, without injury to itself when properly applied within its rating.

Coil. A spiral of wire, or an instrument composed of such a spiral and its accessories.

Compound. Matter produced by the union of several elements or parts.

Connector. A device used to link the components of an electrical circuit together.

Control Circuit. The control circuit of a control apparatus or system is the circuit which carries the electric signals directing the performance of the controller, but does not carry the main power circuit.

Control Circuit Transformer. A control circuit transformer is a voltage transformer utilized to supply a voltage suitable for the operation of control devices.

Current. A movement of electricity analogous to the flow of a stream of water. Sometimes used to identify the rate of such movement.

Direct Current. An electrical current flowing in one direction only.

Draw (Amperage). The quantity of current used to operate an electrical device.

Drop (Voltage). The net difference in electrical pressure when measured across a resistance.

GLOSSARY OF TERMS (Cont'd)

Dynamic Braking. Dynamic braking of an electric drive is a system of braking in which the motor is used as a generator, and the kinetic energy of the motor and driven machinery is employed as actuating means of exerting a retarding force.

Electricity. One of the fundamental quantities in nature, consisting of elementary particles, electrons and protons. Electricity is characterized especially by the fact that it gives rise to a field of force possessing potential energy and that, when moving in a stream (an electric current) it gives rise to a magnetic field of force with which kinetic energy is associated. The elementary particles of electricity, the electron and the proton, are opposites electrically.

Electrode. Either terminal of an electric source; especially either conductor by which the current enters and leaves an electrolyte. As a component of a spark plug, its insulated center rod.

Electrolyte. A substance in which the conduction of electricity is accompanied by chemical decomposition. In a battery it is a mixture of sulphuric acid and distilled water.

Electromotive Force. That which moves, or tends to move, electricity; the amount of energy derived from an electrical source per unit quantity of electricity passing through the source.

Electromagnet. A core of magnetic material, in practice always soft iron, surrounded by a coil of wire through which an electric current is passed to magnetize the core.

Electron. A very light particle associated with the elementary charge of negative electricity. Electrons are consitutents of atoms.

Element. An atom or fundamental form of matter. In a battery, one set of positive plates and set of negative plates complete with separators in assembled form.

Elementary (Schematic) Diagram. An elementary (schematic) wiring diagram is a diagram using symbols and a plan of connections to illustrate in simple form the scheme of control.

Energy. The capacity for doing work. This capacity may have as its source chemical reaction, electrical action or mechanical action.

Fail-Safe Operation. An electrical system so designed that the failure of any component in the system will prevent unsafe operation of the controlled equipment.

Farad. The unit of electrical capacity; the capacity of a condenser which, charged with one coulomb, gives a difference of potential of one volt.

Field. Short for field magnet, field winding, etc. Also used to designate the area in which a magnetic flow occurs.

Field Coil. A coil of insulated wire surrounding the field pole.

Flux Density. Flux is the rate of flow. Flux density is a rate — mass relationship. Also the lines of magnetic force passing or flowing in a magnetic field.

Fuse. An electrical safety device consisting of a wire or a strip of fusible metal inserted in a circuit which will melt when the current becomes too strong.

Gap. Any break in the continuity of a circuit.

Generator. A machine by which mechanical energy is changed into electrical energy.

Ground. The connection made in grounding a circuit. In automotive use, the result of attaching one battery cable to the body or frame which is used as a path by various electrical components for completing a circuit in lieu of a direct wire from that component.

Insulator. A non-conducting substance or body, as porcelain or glass, used in insulating wires, etc.

Interlock. An interlock is a device actuated by the operation of some other device with which it is directly associated, to govern succeeding operations of the same or allied devices.

NOTE: Interlocks may be either electrical or mechanical.

LED. A solid state device that emits light when a forward current is forced through it.

Limit Switch. A limit switch is a switch which is operated by some part or motion of a power-driven machine or equipment to alter the electric circuit associated with the machine or equipment.

Live. Electrical parts attached to the insulated part of an electrical system, often called the "hot lead".

Magnetism. A property of the molecules of certain substances such as iron, by which they may be magnetized.

Matter. That particle or combination of particles of which any physical object is composed; material, constiutents, also a particular kind or portion of material.

Megohm. 1,000,000 ohms.

Microfarad. 1/1,000,000 farad.

Milliampere. 1/1,000,000 ampere.

GLOSSARY OF TERMS (Cont'd)

Negative. Designating or pertaining to a kind of electricity. The negative plate of an electrolytic cell.

Negative Pole. The point from which an electrical current flows. Also referred to as the South Pole in magnetism.

Normally Open and Normally Closed. The terms "normally open" and "normally closed", when applied to a magnetically operated switching device, such as a contactor or relay, or to the contact thereof, signify the position taken when the operating magnet is de-energized. These terms apply only to non-latching types of devices.

Necleus. The central part of an atom, containing most of its mass and having a positive charge equal to the atomic number of the element. The nucleus of ordinary or light hydrogen as the proton; according to present theory, all other nuclei are combinations of protons and neutrons.

Neutron. An uncharged particle of slightly greater mass than the proton. Neutrons are constituents of atomic nuclei (except those of ordinary hydrogen).

Ohm. The practical unit for measuring electrical resistance, being the resistance of a circuit in which a potential difference of one volt produces a current of one ampere.

Opto Isolator: A light coupled relay that uses one signal to switch another signal. Operates identically to a relay except there is no mechanical linkage between the coil (Light) and the contacts (Photo Sensor). Input: Yellow 120V AC to 5V. DC. Output: Black 5V. DC to 120V AC.

Overload Relay. A device that provides overload protection for electrical equipment.

Plugging. Plugging is a control function which provides braking by reversing the motor line voltage polarity or phase sequence so that the motor develops a counter-torque which exerts a retarding force.

Polarity. The quality or condition inherent in a body which exhibits opposite, or contrasted, properties or power, in opposite or contrasted parts or directions; the having of poles, polarization.

Positive. Designating or pertaining to a kind of electricity tending to lose electrons and thus become positive (in sense).

Proton. nucleus of the atom of the light isotope of hydrogen, constituting the principal part of its mass and exhibiting a unit of all atoms.

Raceway. Any channel for holding wires, cables or busbars, which is designed expressly for, and used solely for, this purpose.

Rectifier. A device used to convert alternative current into a unidirectional current by removing or inverting that part of the wave lying on one side of the zero amplitude axis.

Rectifier Diode: A semiconducter device which permits current to flow through it in one direction only.

Relay. A relay is a device which is operative by a variation in the conditions of one electric circuit to effect the operation of other devices in the same or another electric circuit.

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

Resistor. A device which offers resistance to the flow of electric current. It's electrical size is specified in ohms.

Shielded Cable. Shielded cable is single or multiple conductor cable surrounded by a separate conductor (the "shield") intended to minimize the effect of adjacent electrical circuits.

Rheostat. A resistor for regulating a current by means of variable resistance.

Rotor. A rotating conductor which carries current from a central source to individual outlets, as required.

Short Circuit. Most often used to identify an unintentional grounding of a circuit.

Shunt. A conductor joining two points in a circuit so as to form a parallel or derived circuit through which a portion of the current may pass, in order to regulate the amount passing in the main circuit.

Silicon Controlled Rectifier: A high powered device that will pass current through it when switched on by powering the gate.

Solenoid. A solenoid magnet (solenoid) is an electromagnet having an energized coil approximately cylindrical in form and an armature whose motion is reciprocating within and along the axis of the coil.

Specific Gravity. The ratio of the weight of any volume of a substance to the weight of an equal volume of some substance taken as a standard or unit as, usually, water for solids and liquids and air or hydrogen for gases.

Static. Of, pertaining to, or designating stationary charges of electricity; also, producing such charges as by rubbing unlike bodies together.

GLOSSARY OF TERMS (Cont'd)

Stepping Relay (Switches). A multi-position relay in which moving wiper contacts mate with successive sets of fixed contacts in a series of steps, moving from one stop to the next in successive operations of the relay.

Switch. A device for making, breaking, or changing the connection in an electrical circuit.

Tachometer. A device for measuring and indicating the rotative speed of an engine.

Terminal. A point of connection in an electrical circuit.

Terminal Block. A terminal block is an insulating base or slab equipped with one or more terminal connectors for the purpose of making electrical connections thereto.

Transformer. A device, without moving parts, that transfers electromagnetic induction from one or more circuits to one or more other circuits. May be used to step up or step down voltage.

Variable Resistor (Potentiometer) "Pot". A resistor having a sliding contact so that it's resistance value can be changed.

Volt. The unit of electromotive force; defined by the Internation Electrical Congress in 1893 and by U.S. statute as that electromotive force which steadily applied to a conductor whose resistance is one ohm will produce a current of one ampere.

Voltage. The electrical pressure that makes current flow through a conductor. One volt is the force which will send one amphere through a resistance of one ohm.

Voltmeter. An instrument for measuring in volts the differences of potential between different points of an electrical circuit.

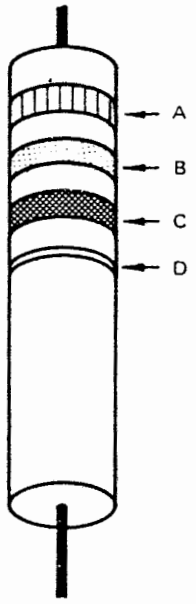
Watts. The practical unit of electric power, and in a direct current circuit, equal to volts multiplied by amperes. In an alternating current circuit, true watts are equal to effective volts multiplied by effective amperes, then multiplied by the circuit power factor.

Winding. The coiling of a wire about itself or about some object. Often identified as a series winding, a shunt winding, etc.

Zener Diode: A semiconducter device that is used as a voltage regulator. Example: A 5V. Zener will hold a steady 5V. if the voltage applied is higher (up to the point of peak inverse voltage (PIV)). If the voltage is below 5V. it will not pass any current.

COLOR CODE FOR RESISTORS

All carbon resistors are produced and color-coded to meet the standards set up by the RETMA (Radio, Electronics and Television Manufacturer's Association). Here is your guide to resistors by color bands.



COLOR-CODE CHART

BAND A		BAND B		BAND C		BAND D	
COLOR	VALUE	COLOR	VALUE	COLOR	VALUE	COLOR	TOLERANCE
Black	0	Black	0	Black	None	None	± 20%
Brown	1	Brown	1	Brown	0	Silver	± 10%
Red	2	Red	2	Red	00	Gold	± 5%
Orange	3	Orange	3	Orange	000		
Yellow	4	Yellow	4	Yellow	0000		
Green	5	Green	5	Green	00000		
Blue	6	Blue	6	Blue	000000		
Violet	7	Violet	7	Violet	0000000		
Gray	8	Gray	8	Gold	÷ 10		
White	9	White	9	Silver	÷ 100		

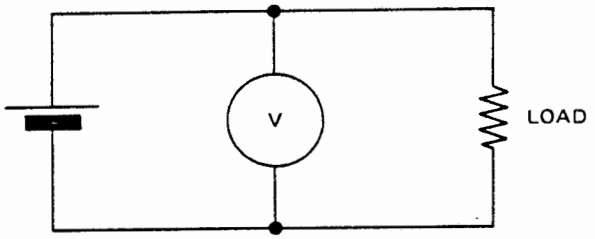
NOTE: The first band (A) shows the first figure of the resistor value, the second band (B) shows the second figure, and the third band (C) indicates the number of zeros to be added. The fourth band (D), which is not included in all resistors, merely indicates the tolerance. If the last band (D) is omitted, the tolerance of the resistor is plus or minus 20%.

INDEX

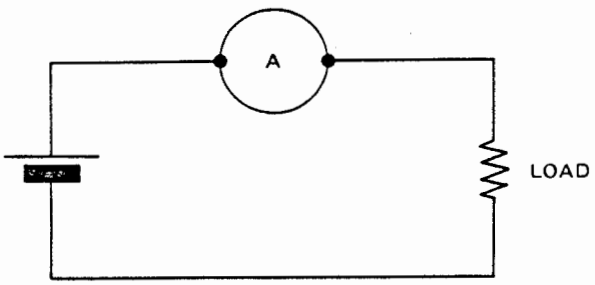
VOLT-OHM METER USAGE AND SOLDERING TECHNIQUES

Diagnosing troubles in the electrical system is one of the more important duties of the Asphalt Plant Technician. With proper instruments connected in the circuit he must be able to determine whether changes in adjustments are required, whether the system is performing satisfactorily or whether a specific unit or part needs repairs or replacement. Of course, the accuracy of the readings will depend upon the accuracy of the meters used. Voltmeter scales should be calibrated in 0.1 volt divisions, as settings with one-tenth volt variation will be specified. Ammeters may be calibrated in 0.5 ampere divisions. If a choice is available, greater accuracy is desired in the voltmeter than in the ammeter.

Most modern meter movements are of the moving-coil type which consists of a permanent horseshoe or hoop shaped magnet and a movable coil. Current flowing through coil reacts with the permanent magnetic field causing the coil to rotate against a light spring tension. The relative movement of the coil is in proportion to the amount of current flowing in the windings. A pointer attached to the coil moves across a calibrated scale indicating the amount of current flowing in the coil.



VOLTMETERS CONNECTED IN PARALLEL



AMMETERS CONNECTED IN SERIES

ILLUSTRATION A

The same meter movement may be used for either a voltmeter or ammeter. It becomes a voltmeter in series with the proper amount of external resistance. It becomes an ammeter when connected with the proper shunts.

AMMETERS are connected in SERIES with the circuit in which the current is to be measured. Where necessary external shunts are provided so that only a small proportional part of the total current passes through the instrument. Since the current value in a circuit should be the same after the meter is inserted in series as it was before the meter was hooked up, it follows that ammeters must have a low resistance between terminals. (See illustration A).

VOLTMETERS are connected ACROSS (in parallel with) the circuit. They must have a very high resistance so that the small amount of current they take will not disturb the circuit. The voltage of a circuit should be essentially the same after a voltmeter is hooked up across the circuit as it was before. If the voltmeter does not have a sufficiently high resistance, this will not be true.

VOLT — OHM METER USAGE

In addition to reading drawings, you must have a means of determining if a wire is alive or dead. In some cases, this can be accomplished with a test light using a small wattage bulb and suitable leads.

By using a volt-ohm meter more satisfactory results may be attained. The volt meter measures the voltage or difference in potential between two points. The ohm meter measures the resistance of a conductor to pass a current. By it, we can measure the continuity of a portion of a circuit. By continuity, we mean a continuous path for the electricity to follow.

Regardless of the brand name, or make Volt-Ohm Meter, you will find the meter has an Ohm scale and one or more volt scales.

To measure either volts or ohms (resistance), from zero to the maximum amount we are interested in, would require an extremely long scale. To keep the length of the scale within practical limits, the meter is made so we can change the range of the scale.

All meters are most accurate when reading in the mid-section of the scale. To accomplish this and to change the span, we have a selector switch.

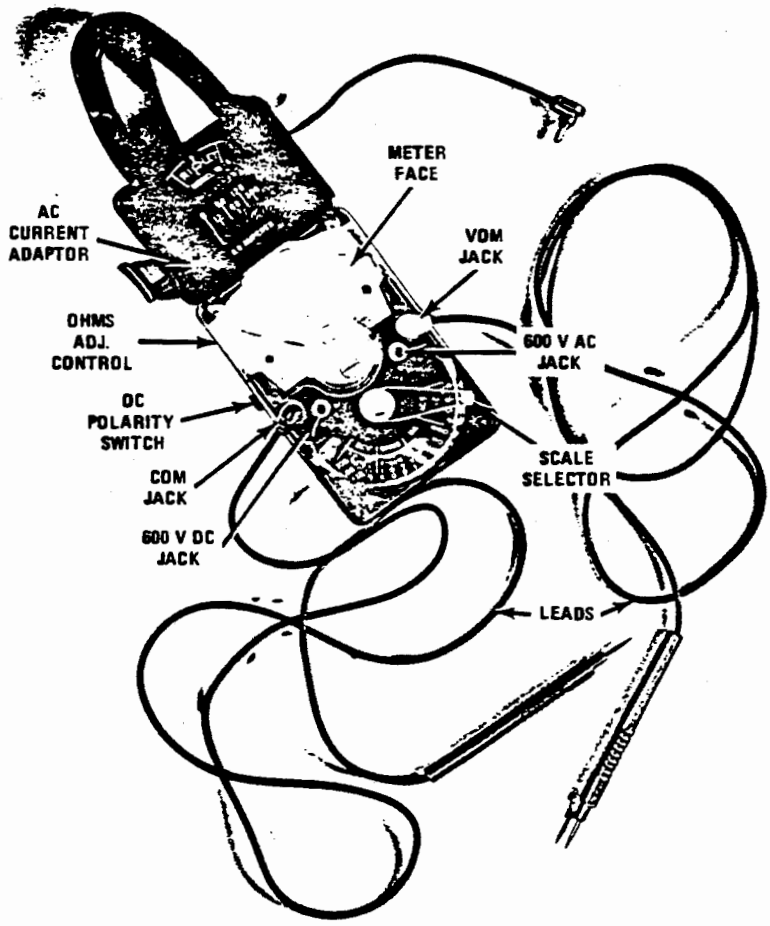


FIGURE 1 — Meter

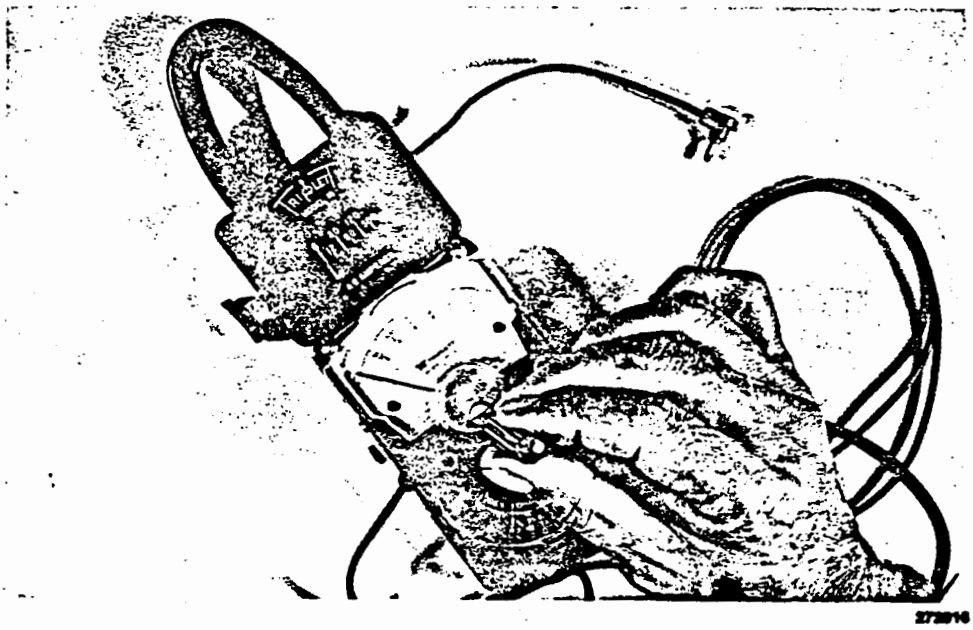


FIGURE 2 — Zero Adjust

The VOM we will use in the discussion is the triplett Model 310 with the Model 10 A C Amperes Adapter. However, the use and operation of any VOM is much the same and the knowledge learned here will greatly assist you.

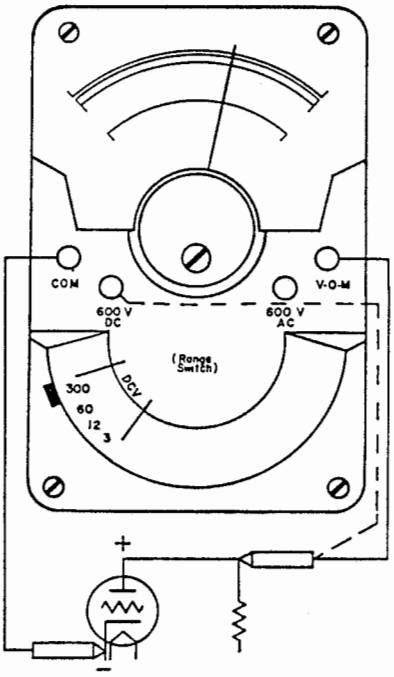


FIGURE 3 — DC Voltage

USING THE METER

A. Adjust the meter to read zero (Refer to Figure 2).
   1. Use screw driver of proper size and turn screw in center of meter at lower center of meter.

B. DC Voltage measurements (Refer to Figure 3).
   1. Select DC V scale higher than supply voltage. If not known, select highest scale and work down.
   2. Adjust meter to zero.
   3. Real all DC volts on black scale (only this meter).
   4. Plug black lead in "COM" jack.
   5. Plug red lead in "VOM" or "600 V DC" jack, and adjust scale to 300 DC V depending on voltage.

NOTE: Triplett Model 310 has 1200 DC jack.

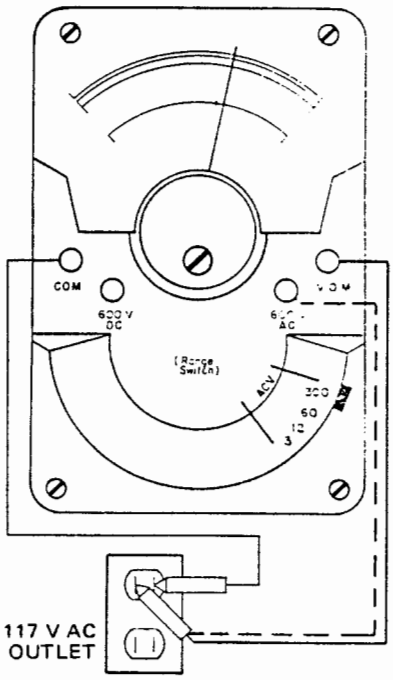


FIGURE 4 — AC Voltage

6. Touch leads across line (parallel).
   a. CAUTION: If needle travels down scale (below zero), change leads to correct polarity. (Red to Black, Black to Red).
   b. If meter shows only a small movement, change to lower scale.

CAUTION: Do not touch high voltage without proper insulation.

C. AC Voltage measurements (Refer to Figure 4).
   1. Select AC V scale higher than supply; if not known, select highest scale and work down.
   2. Adjust meter to zero.
   3. Read all AC volts on the red scale (this meter only).
   4. Plug black lead in "COM" jack.
   5. Plug red lead in "VOM" or "600 AC V" jack, and adjust scale to 300 AC V, depending on voltage.

NOTE: Triplett Model 310 has 1200 AC V jack.

6. Touch leads across line (parallel).
   a. If meter shows only small movement, change to lower scale.

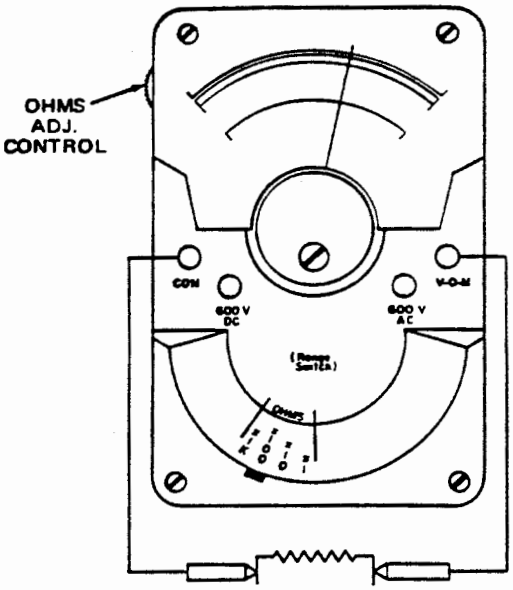


FIGURE 5 — Resistance

CAUTION: Do not touch voltage without proper insulation.

D. Resistance measurements (ohms scale).

READING RESISTANCE
(Refer to Figure 5)

Note the ohms scale first, it shows 0 on the right side and 500 or more on the left. Also note the divisions on the left cannot be read with any degree of accuracy. If the pointer is on the RX1 scale, the reading would be direct.

CAUTION: Do not use the ohm meter on any part of the circuit with power on.

Parts to be checked for resistance should be isolated from any other part of the circuit.

1. There are four resistance ranges on this meter:
   a. 0-20,000 ohms X-1
   b. 0-0200,000 ohms X-10
   c. 0-2 meg ohms X-100
   d. 0-20 meg ohms X-1K
   e. Other meters will have comparable scales.
2. Plug black lead in "COM" jack.
3. Plug red lead in "VOM" jack.

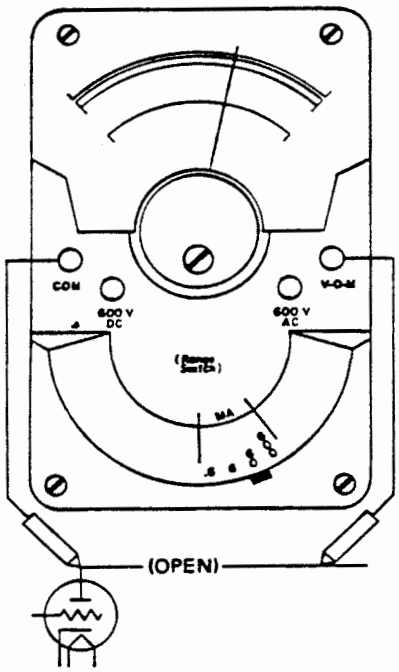


FIGURE 5 — DC Current

4. Select range to be used and short leads together, turn OHM Adjust Control until pointer rests on "0" of the Ohms scale.
   a. Right side of scale.
   The meter is actually measuring the current passing through the object being checked; therefore, it is wise to use the highest range possible and still read the scale on the meter. This will reduce the possibility of burning out the object being checked.
5. Do not touch the metal probes of the meter as it will pick up body resistance.
6. Read across the component with the component taken out of the circuit.
7. Do not use ohm meter on any circuit that has electricity or damage could occur to the meter. When through with the ohms scale, turn the pointer to one of the voltage scales to prevent accidentally shorting the leads and running down the batteries.

E. DC Current measurements. (Refer to Figure 6).

1. There are four current ranges on this meter.
   a. 0-6 Millamperes.
   b. 0-600 Microamperes.
   c. 0-60 Millamperes.
   d. 0-600 Millamperes.
2. All four ranges are read on 0-60 scale.
   a. 0-.6 divide reading by 100.
   b. 0-6 divide reading by 10.

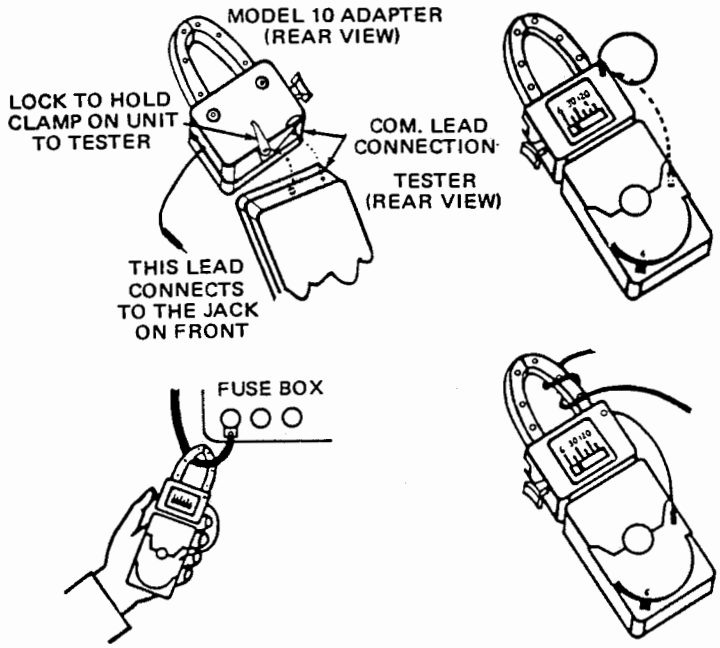


FIGURE 7 — Ammeter Adapter

c. 0-60 read scale directly.
d. 0-600 multiply the reading by 10 or add one zero.

3. Check zero of pointer.
4. Black lead in "COM" jack.
5. Red lead in "VOM" jack.
6. Select proper range.
7. Connect test probes in series, (in line) with the circuit to be measured.
   a. CAUTION: Do not test directly across any potential circuit (parallel) or damage will occur to the meter.
   b. The reading may be backwards; if so, simply reverse leads. Reverse reading does not damage the meter.

F. Using the Model 10 AC Adapter. (Refer to Figure 7).

1. Install the adapter to the meter.
   a. Plug red lead wire of adapter into "VOM" jack.
2. Set selector switch to 3 AC Volt position.
   a. Use 3 AC Volt for all Ampere tests. Read red 3 volt scale for reading.
3. Reading will be multiplied by ratio of range setting to 3 volt scale.
   a. EXAMPLE: Range switch on 6 multiplier would be 2; worked out this way $3\sqrt{6} = 2$.
   If meter reads 20.0, the ampere is 40 (2 x 20 = 40).
   b. EXAMPLE: Range switch on 120 multiplier would be 40; worked out in this way $3\sqrt{120} = 40$.
   If meter reads .5, the ampere is 20 (.5 x 40 = 20).
4. When reading is below half scale and range is on lowest scale (6 amp) greater accuracy may be had by wrapping the conductor around the jaws. Divide the reading by the number of wraps.
   a. 3 wraps — meter shows 1.5.
   $\frac{2 \text{ (multiplier)} \times 1.5}{3} = \frac{3.0}{3} = 1$ amp.
5. Ampere Adapter should only be used on single conductor.
   a. Keep jaw surfaces clean — if film appears, clean with very fine sand paper.
6. Take good care of your meter and it will take good care of you.
   a. A good idea is to have it tested once a year.
   b. You can quickly check the meter by using known values.
      1. Ohm meter use resistors, 1K, 5K, 10K, 20K.
      2. AC volts — House current.
      3. DC volts — Car battery.

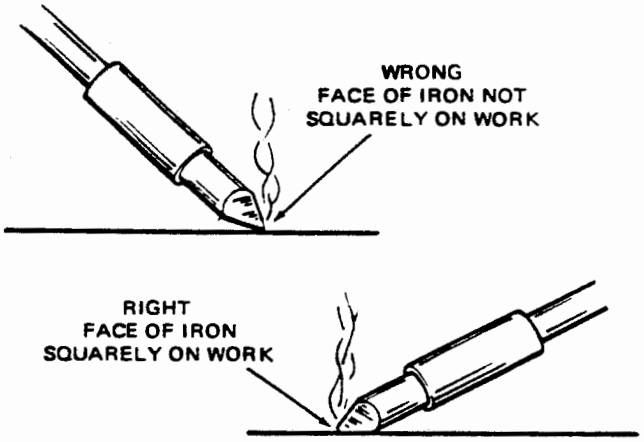
SOLDERING TECHNIQUE

Soldering is the technique of joining pieces of metal under heat by means of a dissimiliar metal or alloy. The heat for soldering is produced in several different ways:

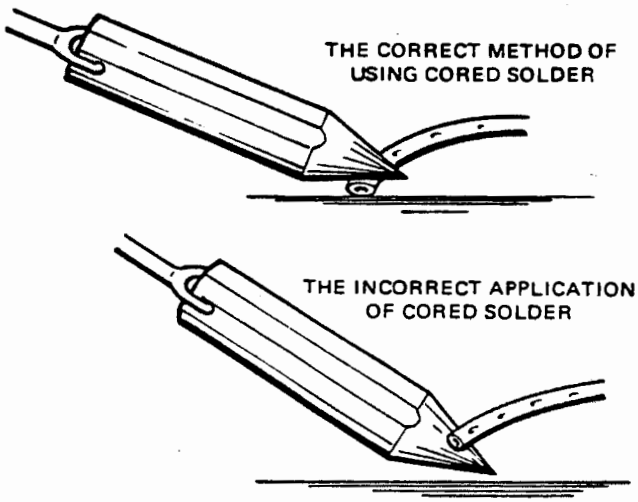
1. You can use an ordinary soldering iron to perform the electrical connections that need soldering. A guideline to size of soldering iron is:
   a. For circuit boards use a 15 Watt.
   b. For wire and plug connections use an iron 15 to 50 Watts, (use a halfway point and work toward size that fits your need).
   The Electric Soldering Iron is made in a great number of sizes and has a resistance element which heats up when the unit is plugged into an outlet.
2. While an electric soldering iron takes a short time to heat up, an electric soldering gun is also available and ready for use within a few seconds after trigger is pulled.
3. TYPES OF FLUXES
   When any work is is to soldered, it is essential that the surfaces be perfectly clean. Furthermore, the metal solvent action — the actual joining of the metals by the solder — will not take place if the metals are separated or insulated from each other by a film or layer of oxide. For this reason, a chemical is used to insure the continuous removal of this oxide film as fast as it forms in order that the solder can adhere to the two surfaces.
   Even when the metals are clean, a surface film of oxide will form quickly as heat is applied. The substance whose purpose is the removal and prevention of the oxide formation during soldering is known as a flux. It is necessary in all soldering.

SOLDER AND FLUX TO USE

METAL	SOLDER TO USE	FLUX TO USE
Aluminum	50/50	None
Black Iron	50/50	Zinc chloride or acid
Brass	50/50	Rosin or acid
Bronze	50/50	Rosin or acid
Copper	50/50	Rosin or acid
Electrical connections	50/50	Rosin—NEVER ACID
Galvanized steel	50/50	Acid
Lead	60/40	Rosin or acid
Pewter	80/20	Rosin or acid
Stainless steel	70/30	Glycerine
Tin	60/40	Acid
Tin-plated steel	60/40	Glycerine



PROPER WAY TO USE A SOLDERING TIP—
THE FACE OF THE IRON SHOULD BE
SQUARELY ON THE WORK.



CORRECT METHOD OF USING CORED SOLDER IS TO PLACE THE SOLDER BETWEEN THE WORK AND THE FACE OF THE IRON. HOWEVER, IF YOU USE A FLUX TO COVER THE METAL AND A PURE SOLDER, THEN IT IS PROPER TO HAVE THE SOLDER FLOW OFF THE FACE OF THE IRON ONTO THE WORK.

FIGURE 8

Fluxes are divided into three groups: (1) acid or chloride type fluxes, (2) organic type fluxes and (3) rosin type fluxes.

Some solders, known as cored solders, are made with the flux enclosed in the core, but you can purchase the fluxes separately and use pure solder with them.

4. In soldering, apply the hot soldering copper to the joint until the wire itself is hot enough to melt the solder when it is touched to the wire as shown in Figure 8. Having a bit of solder on the soldering copper, as it is held against the wire, forms a liquid contact between the soldering copper and the wire, leading to a more rapid heating of the wire than if the bare copper were used. If the soldering copper is at the right heat, the wire will quickly heat sufficiently for good soldering. If the soldering copper is not hot enough, the wire will heat slowly because the heat will flow from the splice onto the wire under the insulation, causing a poor joint and possibly damage to the insulation.

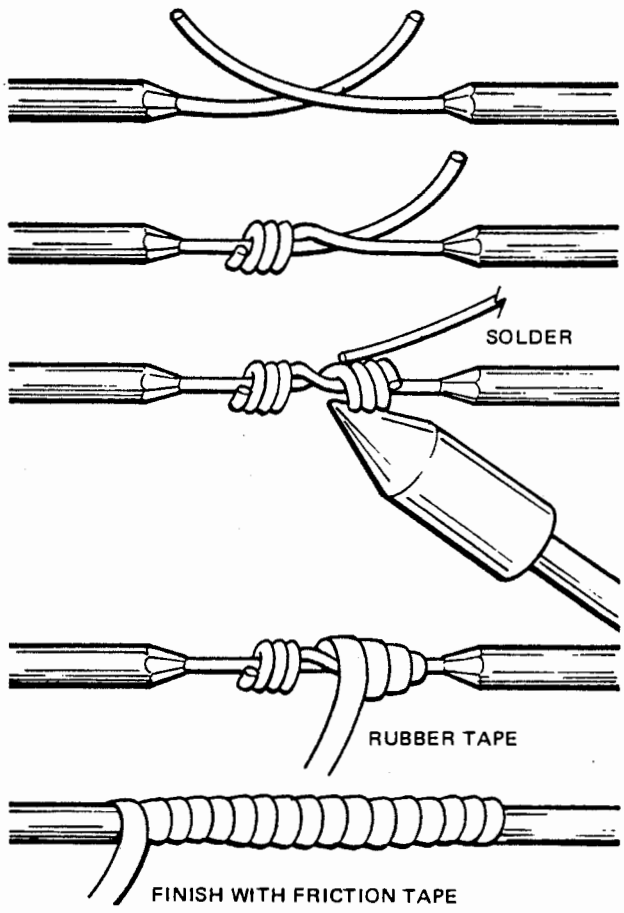
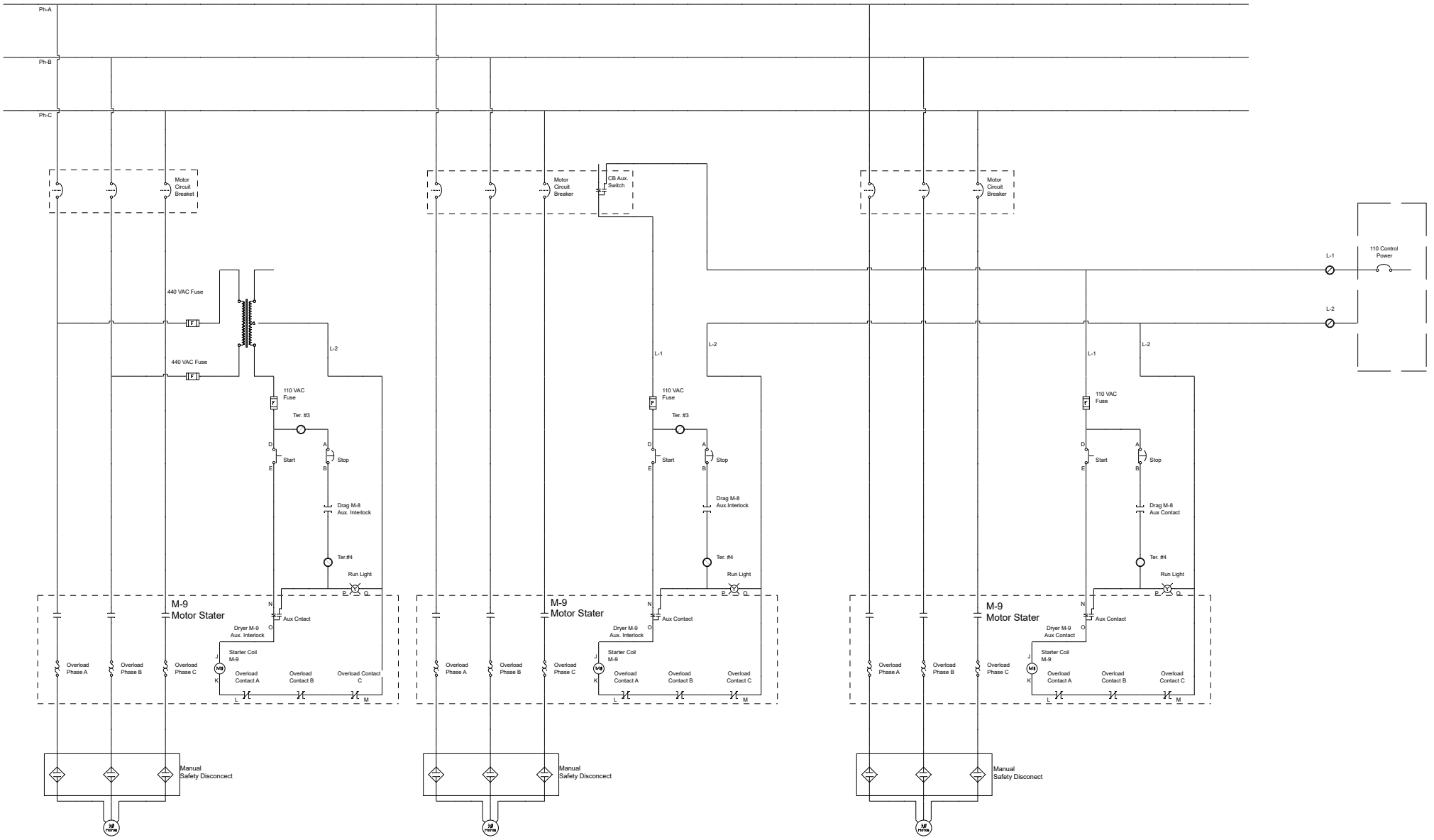
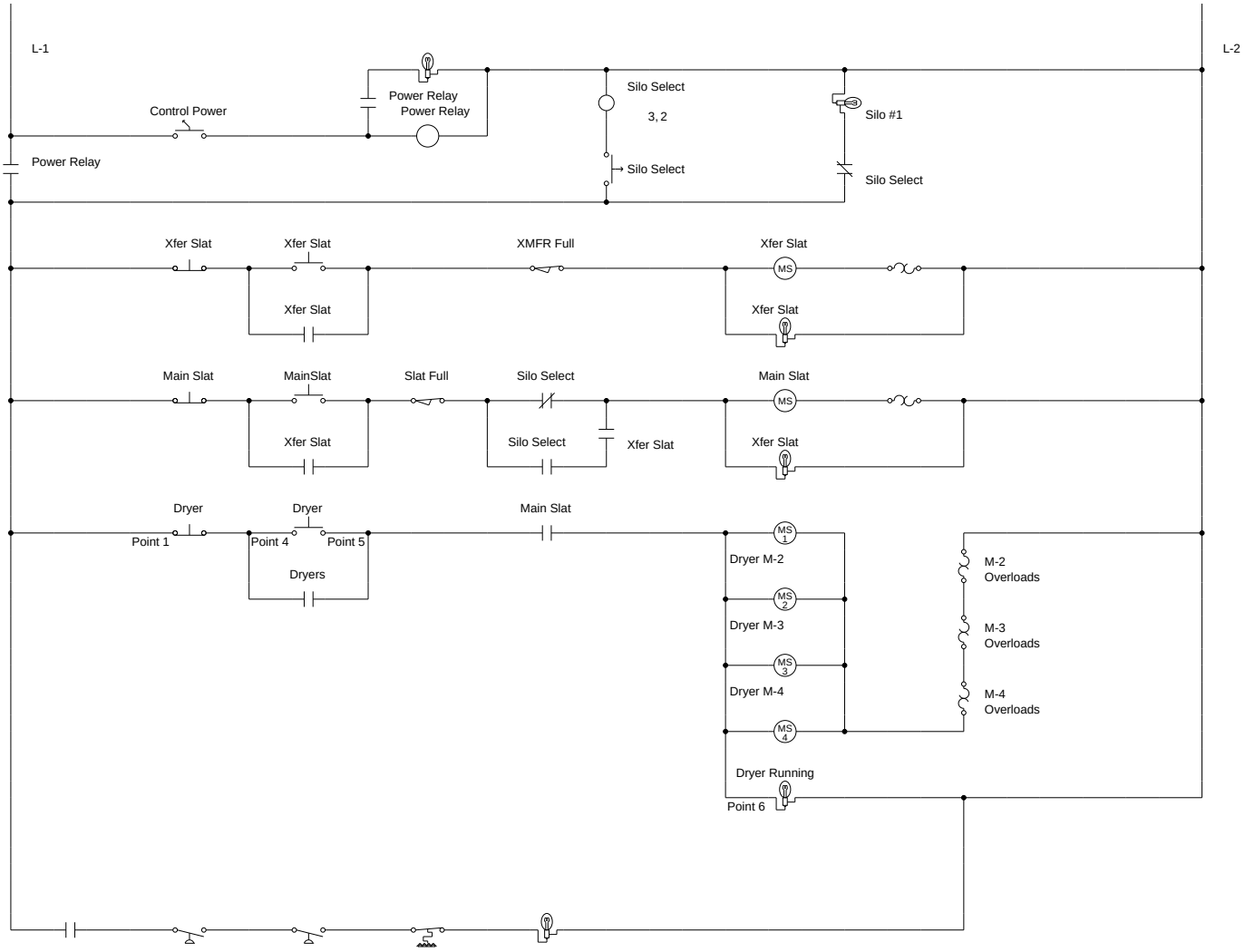
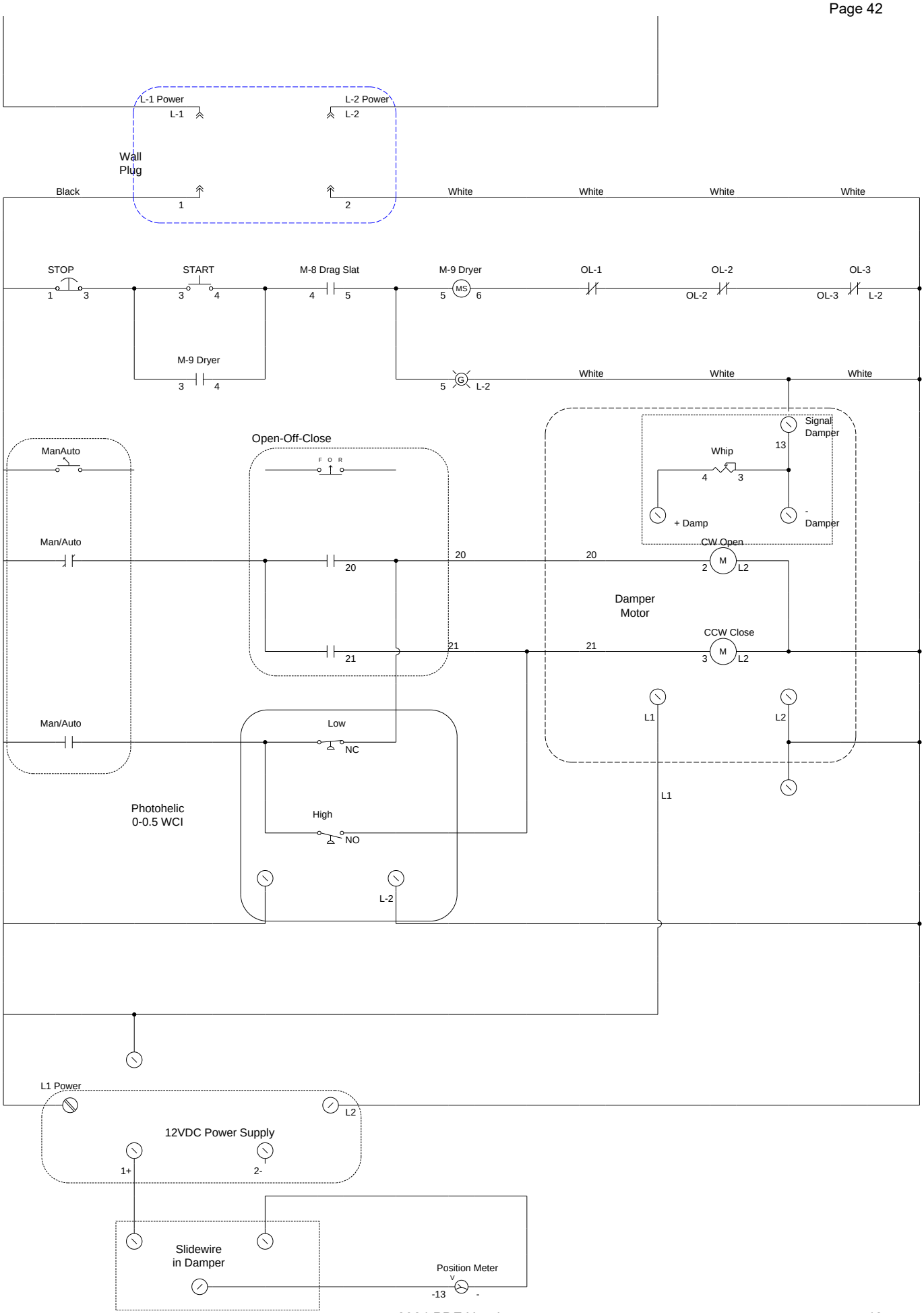
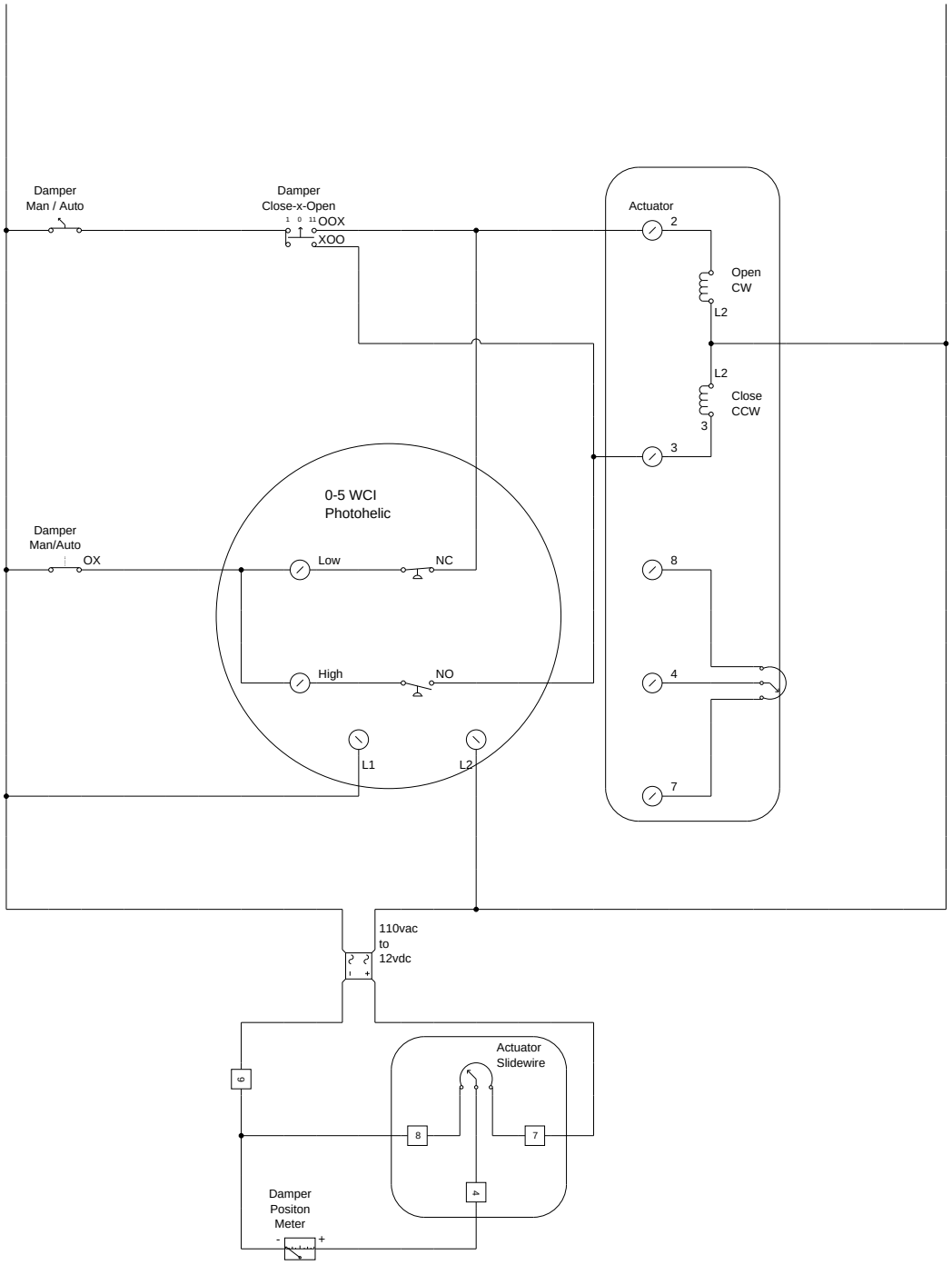


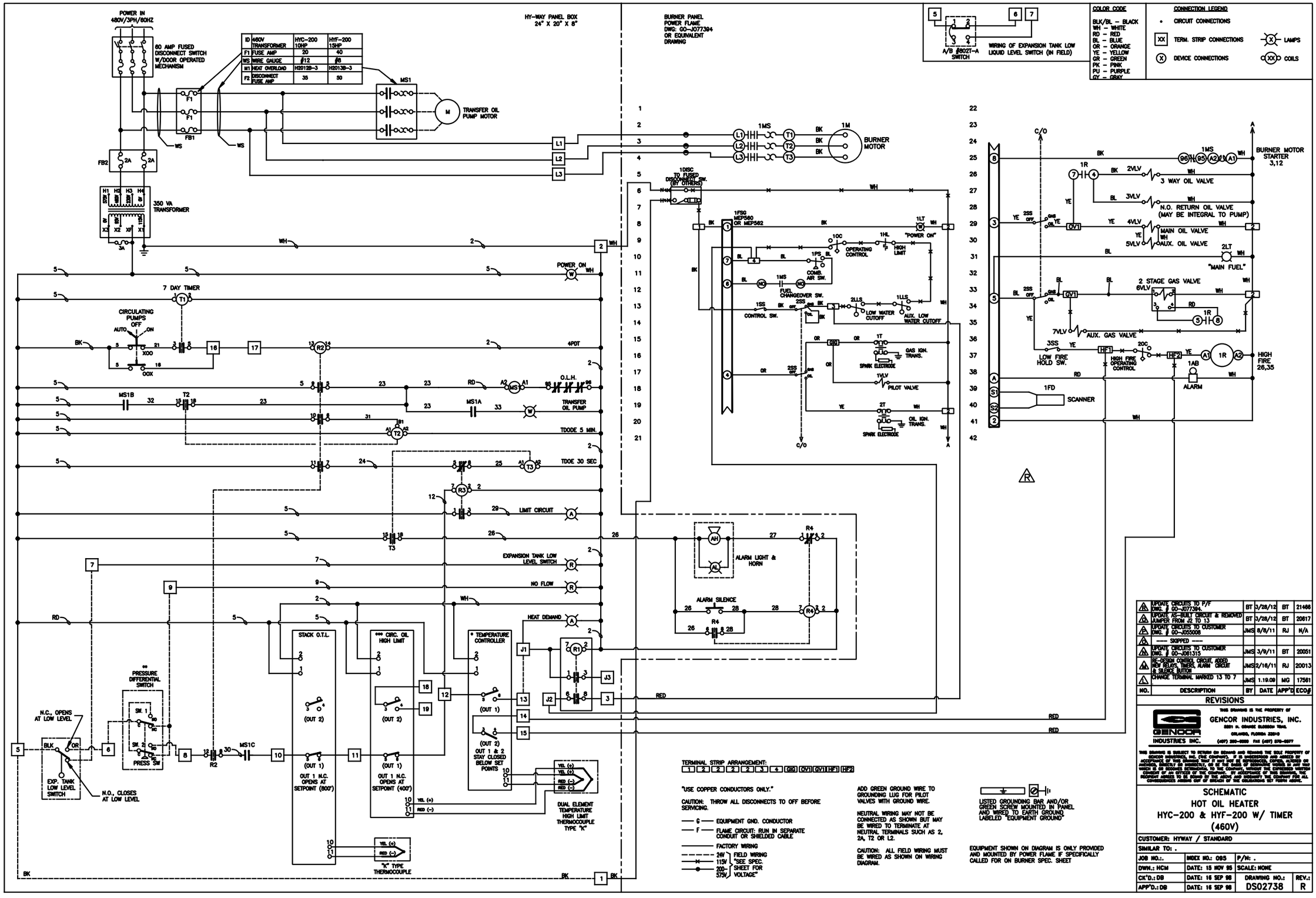
FIGURE 9 — How to make, solder and tape an electrical splice.

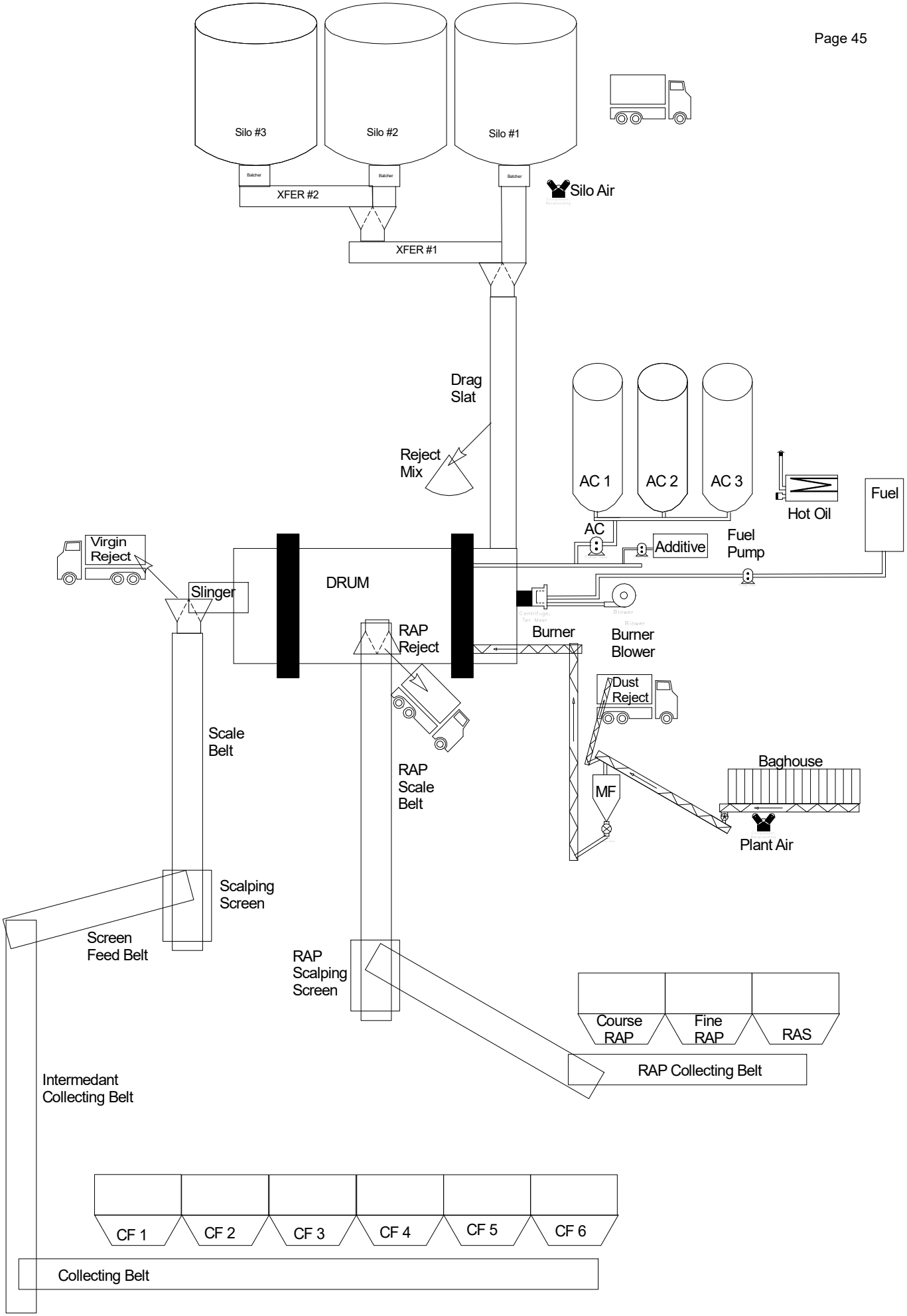

Ph-A
Ph-B
Ph-C
Motor Circuit Breaker
CB Aux. Switch
440 VAC Fuse
440 VAC Fuse
110 VAC Fuse
Ter. #3
Start
Stop
Drag M-8 Aux. Interlock
Drag M-8 Aux.Interlock
Drag M-8 Aux Contact
Ter.#4
Ter. #4
Run Light
M-9 Motor Stater
Aux Cntact
Aux Contact
Dryer M-9 Aux. Interlock
Dryer M-9 Aux Contact
Starter Coil M-9
Overload Phase A
Overload Phase B
Overload Phase C
Overload Contact A
Overload Contact B
Overload Contact C
Manual Safety Disconcect
L-1
L-2
110 Control Power


L-1
L-2
Control Power
Power Relay
Power Relay
Power Relay
Silo Select
3, 2
Silo Select
Silo #1
Silo Select
Xfer Slat
Xfer Slat
Xfer Slat
XMFR Full
Xfer Slat
MS
Xfer Slat
Main Slat
MainSlat
Slat Full
Silo Select
Main Slat
MS
Xfer Slat
Silo Select
Xfer Slat
Xfer Slat
Dryer
Dryer
Main Slat
Point 1
Point 4
Point 5
Dryers
MS 1
Dryer M-2
MS 2
Dryer M-3
MS 3
Dryer M-4
MS 4
M-2 Overloads
M-3 Overloads
M-4 Overloads
Dryer Running
Point 6


L-1 Power
L-1
L-2 Power
L-2
Wall
Plug
Black
1
2
White
White
White
White
STOP
START
M-8 Drag Slat
M-9 Dryer
OL-1
OL-2
OL-3
1
3
3
4
4
5
5
6
MS
OL-2
OL-3
L-2
M-9 Dryer
3
4
G
5
L-2
White
White
White
Signal
Damper
13
Whip
4
3
+ Damp
-
Damper
CW Open
M
2
L2
20
20
20
Damper
Motor
CCW Close
M
3
L2
21
21
21
Open-Off-Close
F O R
ManAuto
Man/Auto
Man/Auto
Low
NC
High
NO
L-2
L1
L2
L1
Photohelic
0-0.5 WCI
L1 Power
L2
12VDC Power Supply
1+
2-
Slidewire
in Damper
Position Meter
V
-13
-


Damper
Man / Auto
Damper
Close-x-Open
1 0 11
OOX
XOO
Actuator
2
Open
CW
L2
L2
Close
CCW
3
3
0-5 WCI
Photohelic
Damper
Man/Auto
OX
Low
NC
8
High
NO
4
L1
L2
7
110vac
to
12vdc
Actuator
Slidewire
6
8
7
4
Damper
Positon
Meter
-
+


POWER IN
480V/3PH/60HZ
60 AMP FUSED DISCONNECT SWITCH W/DOOR OPERATED MECHANISM
HY-WAY PANEL BOX
24" X 20" X 8"
ID 460V TRANSFORMER | HYC-200 10HP | HYF-200 15HP
F1 FUSE AMP | 20 | 40
WS WIRE GAUGE | #12 | #8
M1 HEAT OVERLOAD | H20128-3 | H20138-3
F2 DISCONNECT FUSE AMP | 35 | 50
MS1
TRANSFER OIL PUMP MOTOR
350 VA TRANSFORMER
BURNER PANEL
POWER FLAME
DWG: GO-J077304
OR EQUIVALENT
DRAWING
1MS
1M
BURNER MOTOR
1DISC
TO FUSED DISCONNECT SW. (BY OTHERS)
1FSG MEP560 OR MEP562
1LT "POWER ON"
10C OPERATING CONTROL
1HL HIGH LIMIT
1PS COMB. AIR SW.
FUEL CHANGEOVER SW.
1SS CONTROL SW.
2SS
2LLS LOW WATER CUTOFF
1LLS AUX. LOW WATER CUTOFF
1T GAS IGN. TRANS.
SPARK ELECTRODE
1VLV PILOT VALVE
2T OIL IGN. TRANS.
SPARK ELECTRODE
C/O
A
WIRING OF EXPANSION TANK LOW LIQUID LEVEL SWITCH (IN FIELD)
A/B #802T-A SWITCH
COLOR CODE
BLK/BL – BLACK
WH – WHITE
RD – RED
BL – BLUE
OR – ORANGE
YE – YELLOW
GR – GREEN
PK – PINK
PU – PURPLE
GY – GRAY
CONNECTION LEGEND
CIRCUIT CONNECTIONS
TERM. STRIP CONNECTIONS
DEVICE CONNECTIONS
LAMPS
COILS
BURNER MOTOR STARTER 3,12
3 WAY OIL VALVE
N.O. RETURN OIL VALVE (MAY BE INTEGRAL TO PUMP)
MAIN OIL VALVE
AUX. OIL VALVE
"MAIN FUEL"
2 STAGE GAS VALVE
AUX. GAS VALVE
LOW FIRE HOLD SW.
HIGH FIRE OPERATING CONTROL
HIGH FIRE 26,35
SCANNER
ALARM
7 DAY TIMER
CIRCULATING PUMPS OFF
O.L.H.
TRANSFER OIL PUMP
TDODE 5 MIN.
TDODE 30 SEC
LIMIT CIRCUIT
EXPANSION TANK LOW LEVEL SWITCH
NO FLOW
HEAT DEMAND
ALARM LIGHT & HORN
ALARM SILENCE
POWER ON
4PDT
MS1B
MS1A
MS1C
PRESSURE DIFFERENTIAL SWITCH
N.C., OPENS AT LOW LEVEL
N.O., CLOSES AT LOW LEVEL
EXP. TANK LOW LEVEL SWITCH
PRESS SW
STACK O.T.L.
*** CIRC. OIL HIGH LIMIT
* TEMPERATURE CONTROLLER
OUT 1 N.C. OPENS AT SETPOINT (600')
OUT 1 N.C. OPENS AT SETPOINT (400')
OUT 1 & 2 STAY CLOSED BELOW SET POINTS
DUAL ELEMENT TEMPERATURE HIGH LIMIT THERMOCOUPLE TYPE "K"
"K" TYPE THERMOCOUPLE
TERMINAL STRIP ARRANGEMENT:
1 2 2 2 2 3 4 GND OV1 GV1 HF1 HF2
"USE COPPER CONDUCTORS ONLY."
CAUTION: THROW ALL DISCONNECTS TO OFF BEFORE SERVICING.
G — EQUIPMENT GND. CONDUCTOR
F — FLAME CIRCUIT: RUN IN SEPARATE CONDUIT OR SHIELDED CABLE
FACTORY WIRING
FIELD WIRING "SEE SPEC. SHEET FOR VOLTAGE"
24V
115V
200-575V
ADD GREEN GROUND WIRE TO GROUNDING LUG FOR PILOT VALVES WITH GROUND WIRE.
NEUTRAL WIRING MAY NOT BE CONNECTED AS SHOWN BUT MAY BE WIRED TO TERMINATE AT NEUTRAL TERMINALS SUCH AS 2, 2A, T2 OR L2.
CAUTION: ALL FIELD WIRING MUST BE WIRED AS SHOWN ON WIRING DIAGRAM.
LISTED GROUNDING BAR AND/OR GREEN SCREW MOUNTED IN PANEL AND WIRED TO EARTH GROUND, LABELED "EQUIPMENT GROUND"
EQUIPMENT SHOWN ON DIAGRAM IS ONLY PROVIDED AND MOUNTED BY POWER FLAME IF SPECIFICALLY CALLED FOR ON BURNER SPEC. SHEET
UPDATE CIRCUITS TO P/F DWG. # GO-J077304. BT 3/28/12 BT 21466
UPDATE AS-BUILT CIRCUIT & REMOVED JUMPER FROM J2 TO 13 BT 3/28/12 BT 20617
UPDATE CIRCUITS TO CUSTOMER DWG. # GO-J055008 JMS 8/8/11 RJ N/A
—— SKIPPED ——
UPDATE CIRCUITS TO CUSTOMER DWG. # GO-J061315 JMS 3/9/11 BT 20051
RE-DESIGN CONTROL CIRCUIT, ADDED NEW RELAYS, TIMERS, ALARM CIRCUIT & SILENCE BUTTON JMS 2/16/11 RJ 20013
CHANGE TERMINAL MARKED 13 TO 7 JMS 1.19.09 MG 17561
NO. DESCRIPTION BY DATE APP'D ECO#
REVISIONS
GENCOR INDUSTRIES, INC.
SCHEMATIC
HOT OIL HEATER
HYC-200 & HYF-200 W/ TIMER
(460V)
CUSTOMER: HYWAY / STANDARD
SIMILAR TO: .
JOB NO.: INDEX NO.: 095 P/N: .
DWN.: HCM DATE: 15 NOV 95 SCALE: NONE
CK'D.: DB DATE: 16 SEP 96 DRAWING NO.: DS02738 REV.: R
APP'D.: DB DATE: 16 SEP 96


Silo #3
Silo #2
Silo #1
Batcher
Batcher
Batcher
XFER #2
XFER #1
Silo Air
Drag
Slat
Reject
Mix
AC 1
AC 2
AC 3
Hot Oil
Fuel
AC
Additive
Fuel
Pump
Virgin
Reject
Slinger
DRUM
RAP
Reject
Burner
Burner
Blower
Dust
Reject
Scale
Belt
RAP
Scale
Belt
MF
Baghouse
Plant Air
Scalping
Screen
Screen
Feed Belt
RAP
Scalping
Screen
Course
RAP
Fine
RAP
RAS
RAP Collecting Belt
Intermedant
Collecting Belt
CF 1
CF 2
CF 3
CF 4
CF 5
CF 6
Collecting Belt

Asphalt Plant Interlocking Logic

The following is the interlock logic for a typical asphalt plant. Your plant may or may not have all of the listed items. Additionally, your system may have more or different items. The additional items should follow the basic logic layer out below.

Layout is from discharge to start.

1. Silo Traverse Conveyors
    - Over full Silo Batcher limit
    - Transfer over full limit
    - Flop chute set to silo or additional transfer
2. Drag Slat
    - Over full Silo Batcher limit
    - Drag Slat over full limit
    - Flop chute set to silo or additional transfer or silo top reject chute open
3. Mixing/Drying Drum
    - Slat running or pre-Drag Reject Chute Open
4. Slinger Belt
    - Slinger Forward
        i. Drum running or set to reverse discharge
    - Slinger Reverse
        i. None
5. Virgin Scale Belt
    - Slinger running or Reject Chute open
6. Scalping Screen
    - None
7. Collecting Belt or Intermediate Belts
    - If the Bypass Screen Chute is on the Virgin Scale Belt running
    - If Bypass is to Screen, it needs to be running
8. Virgin Cold Feed Bins
    - Collecting belt running
9. Recycle Asphalt Scale Belt
    - Drum running or Reject Chute open
10. **RAP** Screen
    - None
11. **RAP** Collecting Belt or Intermediate Belts
    - If Bypass Screen Chute is on **RAP** Scale Belt running
    - If Bypass is to Screen, it needs to be running
12. Dryer burner
    - Baghouse Slam Damper closed If equipped
    - Exhaust fan running and at pressure
    - Burner air on and at pressure (this may be multiple fans)
        i. Combustion
        ii. Atomization

iii. Tertiary

13. Fuel limits
    i. Liquid pressure
        1. Low
        2. High
    ii. Liquid temperature
        1. Low
        2. High
        3. Liquid flow
    iii. Gas limits
        1. Low pressure
        2. High pressure
    - Temperature Limits
        1. Air over temperature
        2. Mix over temperature
14. Dust Injection Auger
    - Drum Running and program call for dust
15. Intermediate Augers
    - Àuger being discharged into running and zero speed switch ok
16. Airlock
    - Àuger being discharged into running and zero speed switch ok
17. Baghouse Discharge Auger
    - Àuger or Airlock being discharged into running and zero speed switch ok
18. Baghouse pulse or cleaning system
    - Discharge Auger running
    - Cleaning air or fans running and at pressure

Air Compressors
- Silo used for Gob Hoppers, Flop Chutes and Loadout
- Plant used for
    i. Baghouse cleaning
    ii. AC Injection valve
    iii. Aggregate and **RAP** bypass chute cylinders
    iv. Screen bypass cylinders

Hot Oil Heater
- None

Liquid Fuel Line Oil Heater
- Fuel pumps running and flow
- Elements below over-temp settings

Timing factors normally used in Asphalt Blending Systems

The virgin aggregate scale is the major point for mix blending. Times before **VAŴb** (Virgin Aggregate Weight belt) are negative times to reach the weigh point. Such as the last Coldfield

bin takes longer to get to the scale than the first ones. Delay times are sometimes called transport times to get all materials to the scale point simultaneously.

Times after the **VAWb** are the Asphalt Injection Time **(AIT)** and beyond that mix Discharge to slat, reject chute, silo top, and individual silo drop times.

The **AIT** timing point is used to time **RAP** system delay from the **RAP** Scale and **RAP** or **RAS** (recycled asphalt shingles) feed bins.

AIT and also used to control dust and/or additional additives

Note: The start and stop times in many systems are adjustable to match your mixes and plant design. When in doubt, consult your plant/blending system manufacturer.

Spare Parts, What Should We Have On Hand?

What parts should we have on hand at the plant? This depends on your conditions and location. If you have only one plant and are located a fair distance from parts suppliers. Locations with one or more plants in close proximity to each other and major parts suppliers may be able to have fewer part's safely. If you run at off hour's or days often more parts are needed on hand. The cheapest parts you will ever buy is the one on the shelf when you need it. A few questions that should be looked at is what is the true cost of downtime? To start with you have the plant staff, paving crew, trucking and traffic control. Loss of product at $ per ton. Will the downtime put the project into penalties, will it push other jobs. How is the weather and other conditions affected? Are parts on hand or a ways out? Are parts local or a few days out. If from out of country how long will they take in customs? Are there supplies headed to the plant that need to be stopped or redirected? Is the AC going to fit the available space and whats the lead time? 1 or 2 hours or 12 to 14 travel time to that plant? Also fuel supplies.
There are 2 major categories for parts in my thinking. First is common wear parts that you use day to day or week to week. Second is critical parts, these are the parts not needed often But will shut the operation down until replaced. This is not to say a common wear part such as a bolt may if you run out becomes a critical part to get operational again! Following is a common listing of items to consider. NOTE: In some cases the minimum number of an item may be required by law in an operational permit. Common are air permits were 10 to 25% spare parts may be listed.

- Baghouses
    - Bags
        - Bag blanking plug. This can be a circle of plywood with a 1x2 and a carriage bolt to hold it into place.
    - Cages
    - Bearings inserts for augers
    - Ex Fan drive components
        - Vee Belts
        - Belt Sheaves
        - Bearings
    - Air Lock parts
        - Extra drive chain and repair links
        - Replacement blade tips if equipped
    - Pulse Air Valves (complete)
        - Repair kits for air solenoids
        - Replacement hoses for blast pipes
    - Damper Control Instrument and Guages
    - Door Seal
        - Glue to hold seals
        - Spare seals
    - Leak Detection Kit
        - Two different colors of leak powder
        - Working test lights
- Conveyors
    - Spare belting a few feet of each width used
    - Spare idlers a few of each width and profile. Flat, 20 or 35 degree also returns.

Spare Parts, What Should We Have On Hand?

    - If you have same size belts a head and tail pulley 1 of each
    - Spare return pinch point guards a few for each width
    - Mechanical belt Splices 2 buckets or so
    - Superscrew belt splice 1 or 2 to repair vulcanized belts if needed
    - A set of head and tail bearings
    - Load Cell
    - Speed Tach
- Screens
    - Extra screen cloth
    - Extra screen tension bolts 5 to 10
    - Impact wear pad if used to prevent early screen wear (this can be used belt)
    - crown rubber at least 2 times the length needed for one piece
    - Vee Belts
    - Note: Screen drive sheaves can be long lead time items so a set may be a wise investment
- General Fabrication Items
    - Nuts and bolts in commonly used sizes plus expected needs for upcoming scheduled maintenance including cutting edges
    - Steel sheet, angle, bar stock
    - HDPE ie plastic wear sheets/plate
    - AR plate
- Petroleum Lube Oils
    - Heat Transfer Oil
    - Gearbox Oil
    - Grease normal and special use
    - Chain Grease for roller chain and larger drive chains
    - Hydraulic oils for mobile equipment
    - Engine Oil
- Dryer Items
    - Drum flights 1 or 2 of each type. May be used but good enough for emergency.
    - Drive parts
        - Vee belts
        - If drive chain master and half links
- Drag Slats
    - Spare chain Links for main drag chain and drive
    - Spare support rollers
    - Spare drive sprocket replacement segments
- Controls
    - Limit Switches
        - Air Pressure
        - Limit Arm
        - Oil pressure
        - Bin and other level gauges/switches

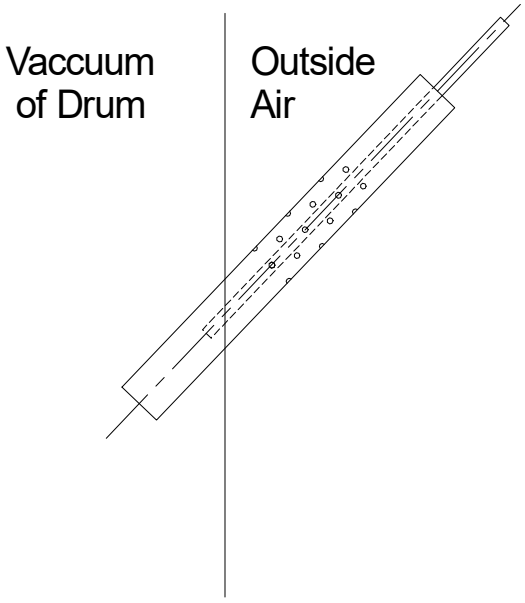
Spare Parts, What Should We Have On Hand?

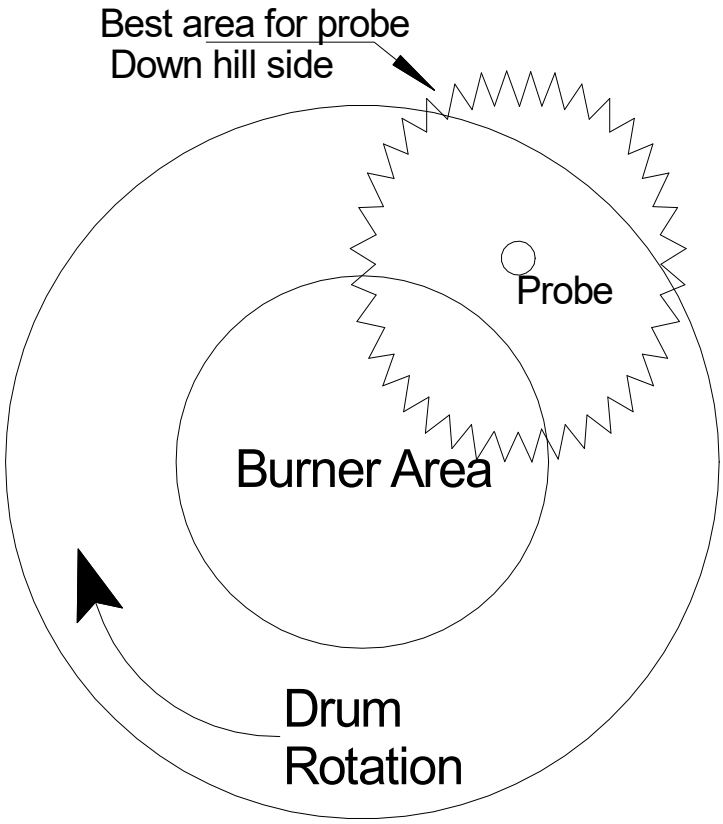
- Air Control solenoids
  - Chutes, valves, gates etc.
- Thermocouple
  - Wire
  - Mix probes
  - Air probes
- Blending Controls
  - Spare cards
  - Spare io modules
  - Spare fuses
  - Backup data and programs
  - Spare monitor or display
  - Spare air pressure controls (photohelic switches
- Basic Electrical Supplies
  - Tape
  - Meter
  - Wire
  - Solderless crimps, wire nuts, motor connections etc.

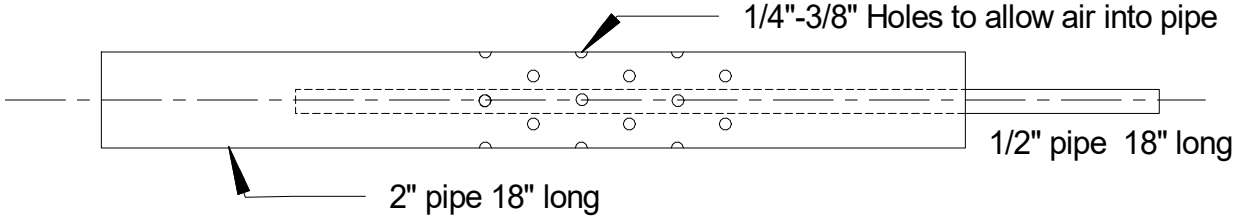
Each plant and operator will have a different list dictated by experience and conditions as noted before as to location and availability of spares. 15 minutes down the road or 3 to 10 days if all goes well. Now is the time to look over your needs Before it's crunch time with work piling up and weather changing. ***The cheapest parts you will ever buy is the one on the shelf when you need it.***

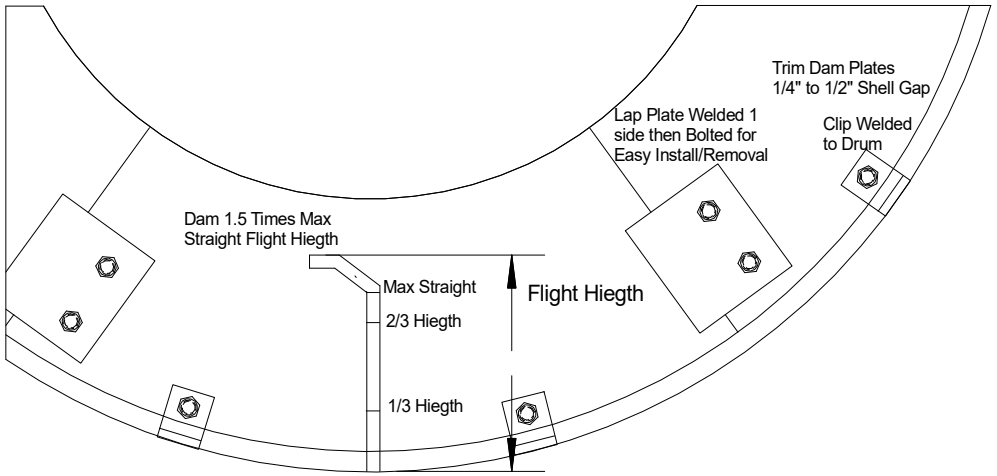
Now that you've made your list of that plants, normal spares what next. One recommendation is to add checking this list weekly or daily to NOT RUN OUT! If you don't check it and solely rely on memory it quickly comes to the point of, did or did I not note those couple of bolts or foot of angle iron that was used to fix X,Y or Z? That list and checking it will save many hours and dollars of downtime going forward. As you gain more insight remember to modify the list to remove surprises.

Drum Bulkhead

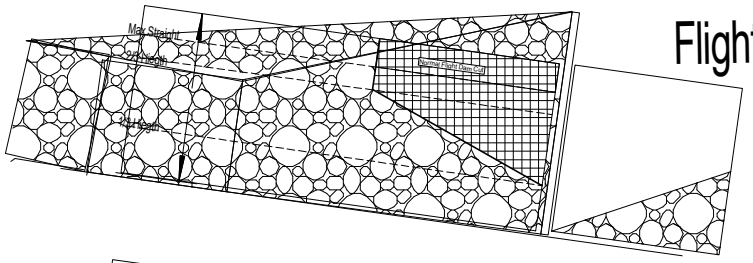




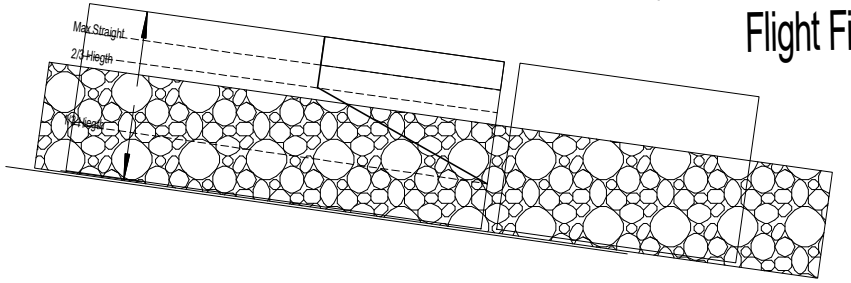


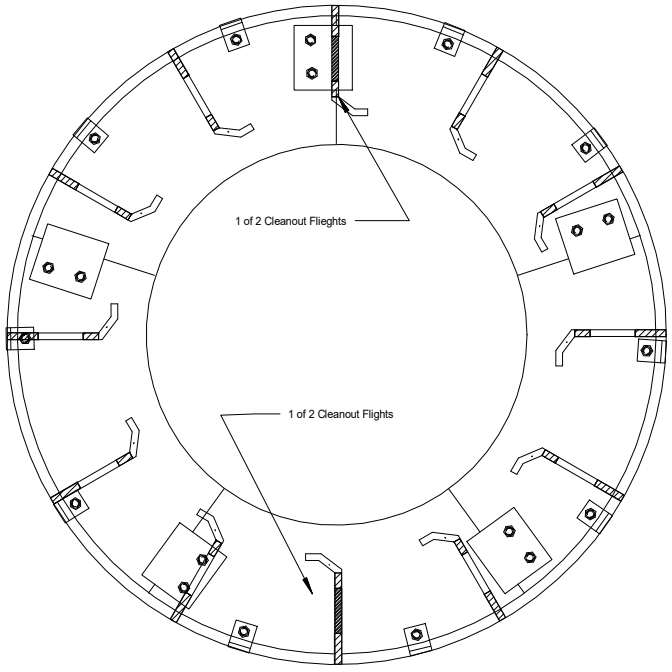


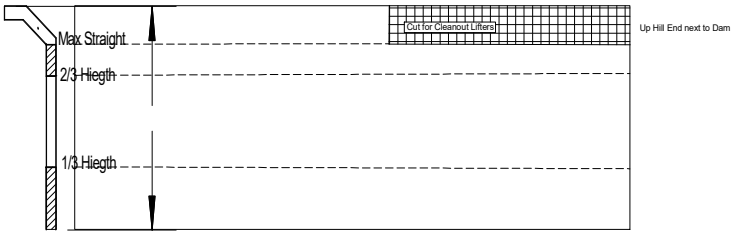
Flight Fill With Dam

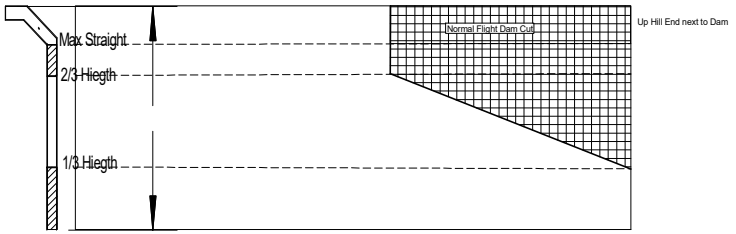


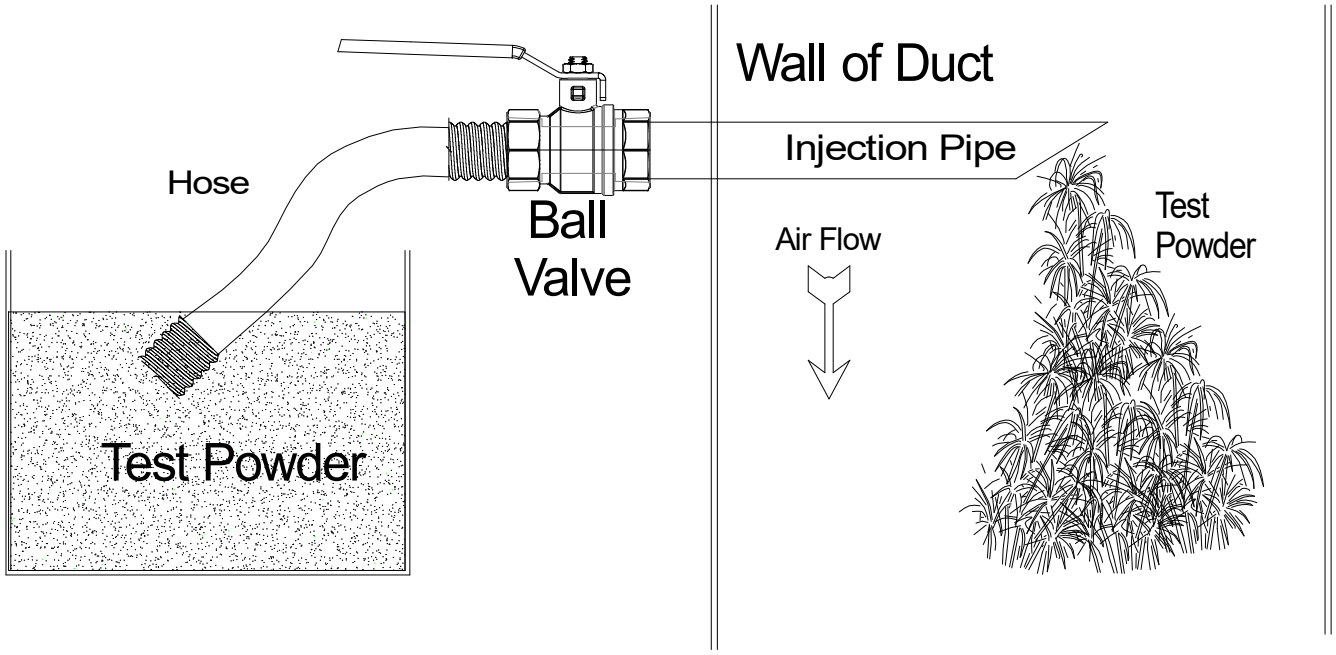
Flight Fill Normal

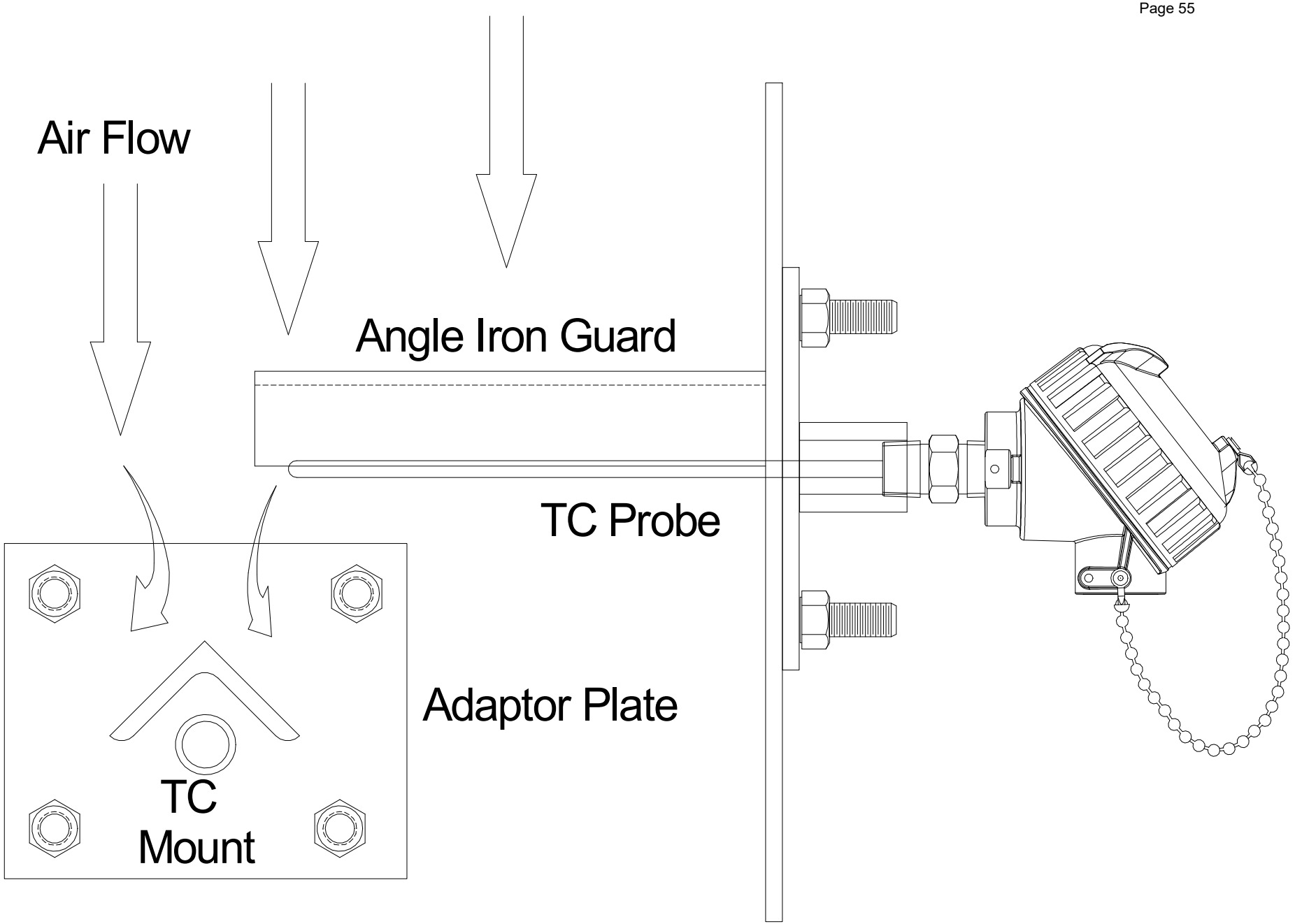









Wall of Duct
Injection Pipe
Hose
Ball
Valve
Air Flow
Test
Powder
Test Powder


Air Flow
Angle Iron Guard
TC Probe
Adaptor Plate
TC
Mount

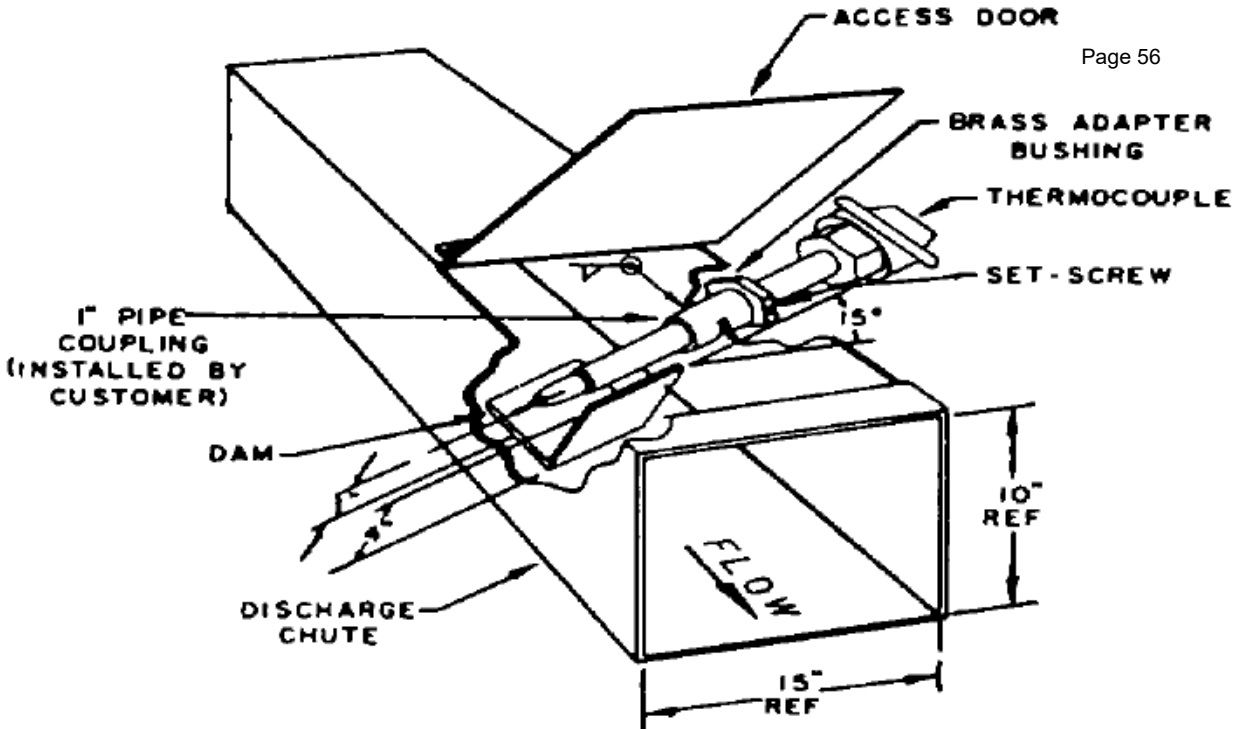
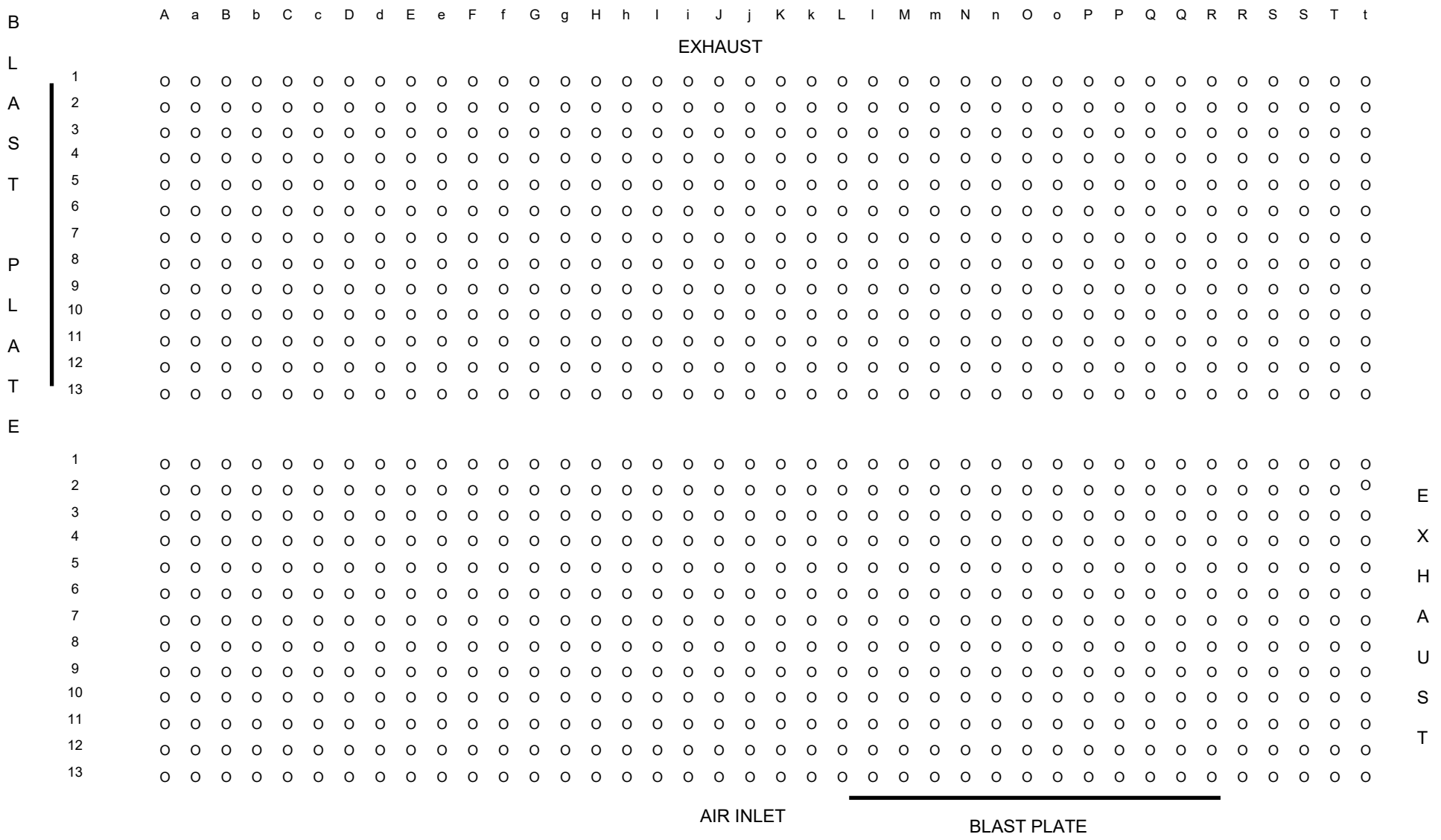


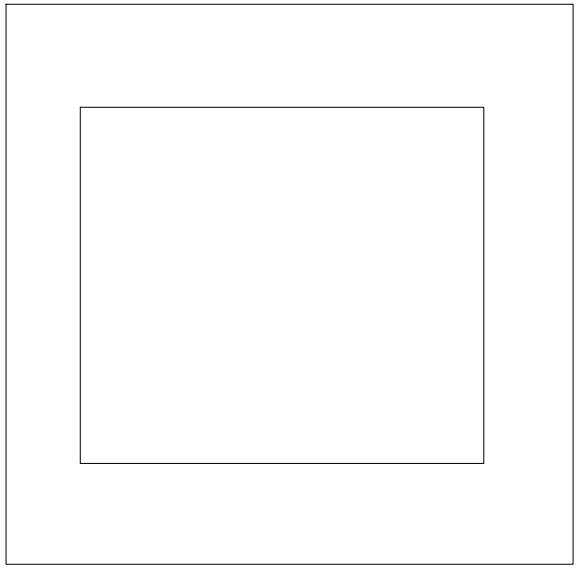
Fig. 2-Drawing showing the placement of the thermocouple and "dam" in the dryer discharge chute.

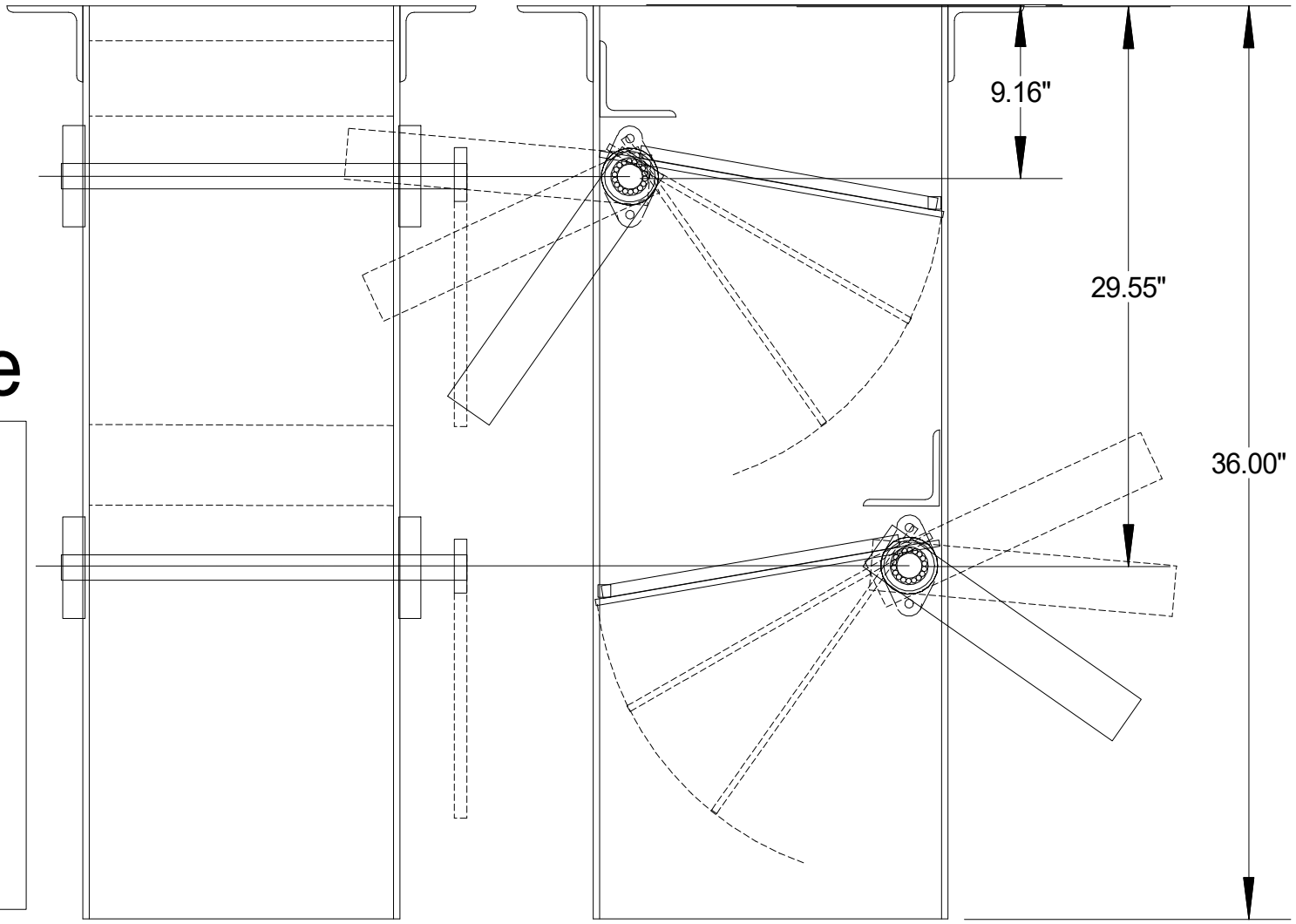
INSTRUCTIONS: Block off all portions of diagram that do not pertain to your baghouse. Locate proper location of air inlet and exhaust. Keep records of bag replacements with “X”s over each bag changed. Use a separate form for each bag change and keep all forms in a binder. After a period of time a pattern of bag wear will develop and aid in anticipating problems and maintenance.

Date of change: _____ Number of Bags Changed:_____



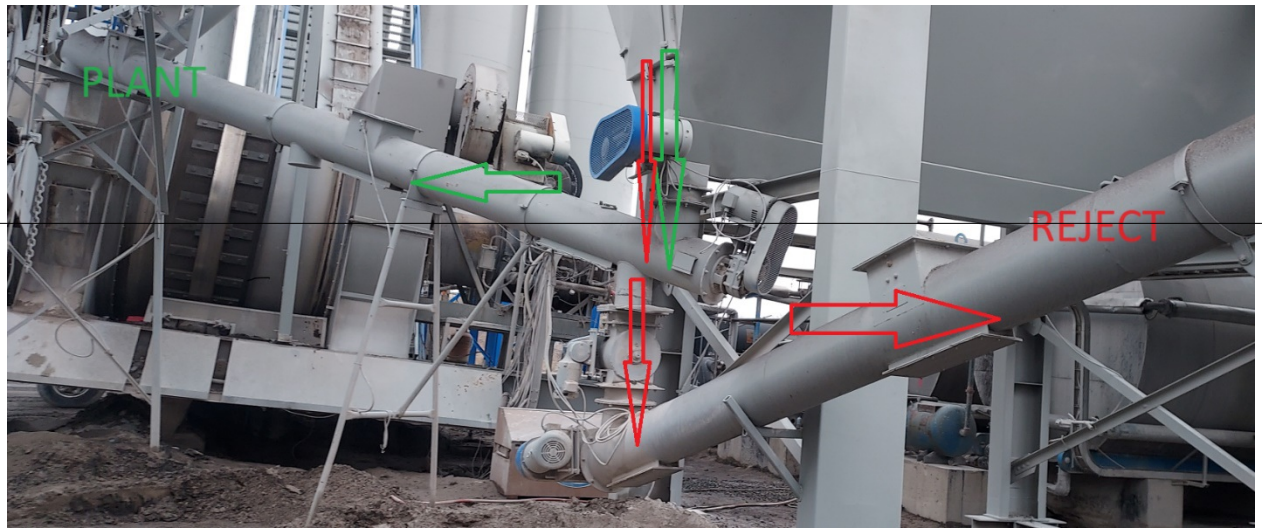
12" x 14" Box
19"x19" Flange



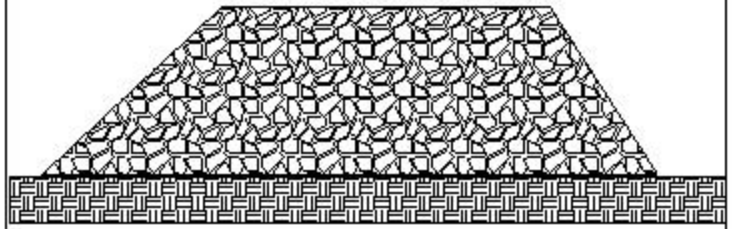


Dust Return Control

Below. What's wrong with this picture?

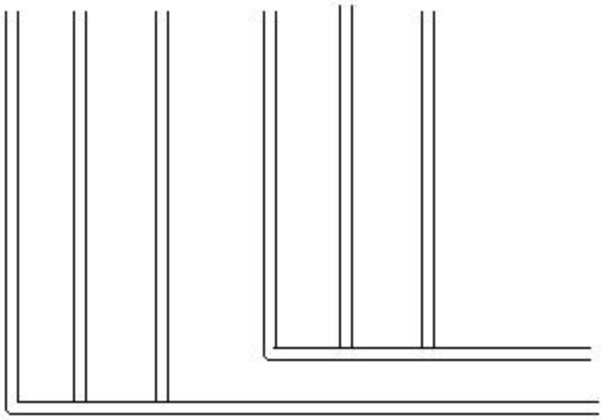


Under Stockpiles



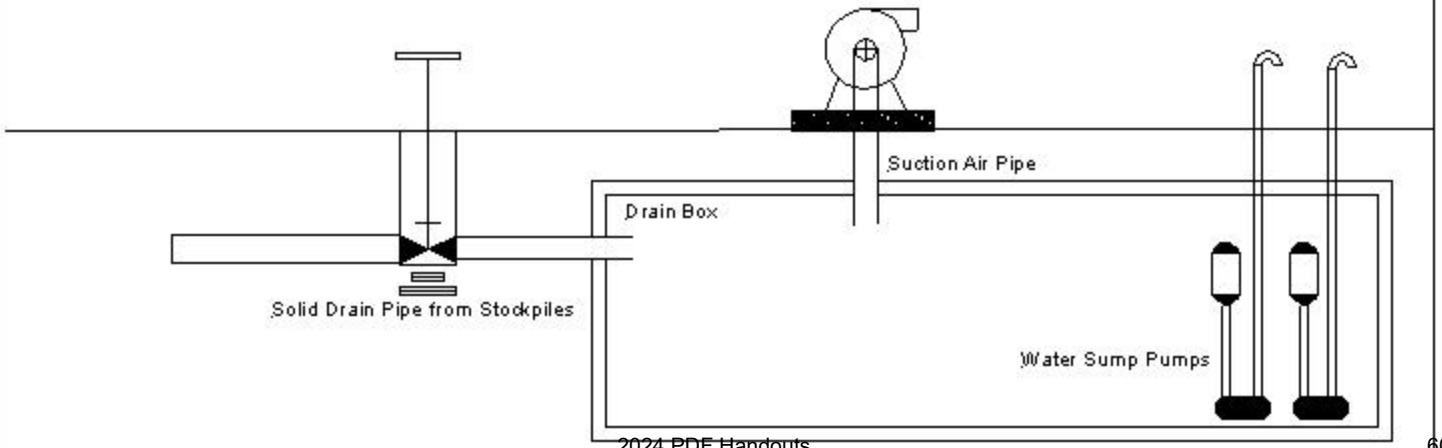
Fabric covered drain tile.

Fabric covered drain tile.



Solid drain tile to Box

Air Suction Blower



Accelerating Stockpile Drainage

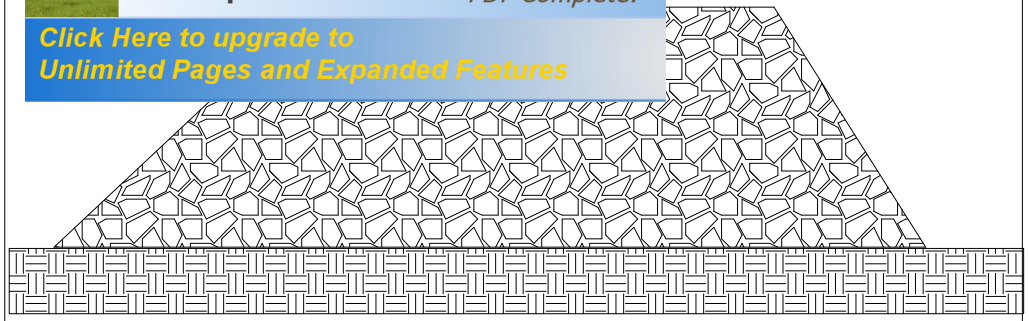
by
Steve Klein

How can we make stockpiles of aggregate drain faster? Other than piling on area with sloped drainage and time there have been few other ways. Adding a tile drainage system under the pile area will help, but how can we speed this?
In the United Kingdom Vacuum Stockpile Drainage has been found to greatly reduce time needed to de-water stockpiles. This system has been in use for some time being applied to different industry. Andrew Burden of Moisture Reduction Systems Co. LTD of London, England told me of a project were fresh silica sand was stockpiles at 15% moisture and in 1 day was reduced to only 2.86%. There system was written up in https://www.agg-net.com/ .
Andrew noted that in the English system there is no drainage tile. What we do is to total seal the floor and base and therefore create an entirely vacuumised floor underneath the stockpile. This generates a negative pressure and vacuum that forcibly pulls the water down and out of the stockpile. The seal is one of the main parts of our patented system. We then have a super-fast water transfer and vacuum control section which allows for greater control in the water removal. So customers can control their moisture level.

Why is the moisture so important?
In the chart below you can see the change in fuel needs to dry aggregate with a change in moisture. With the change from 6% to 5% the fuel per ton is 2.1139- 1.8812 or a 0.2327 gallon per ton difference. That's a 23.27 gallons in a hundred tons of production, with the fuel savings paying for the investment quickly.
Example,
a plant is making 200 tph of hot mix with a fuel cost of $6.34 per ton @ $3.00 gal. fuel or $1,268.34 an hour just for fuel. Reduce the stockpile from 6% to 5% Now the cost per ton is $5.64 a ton or $1,128.72 an hour. This is a $139.62 savings per hour from just the moisture reduction along with room in the baghouse for an 28 ton per hour increase to production.

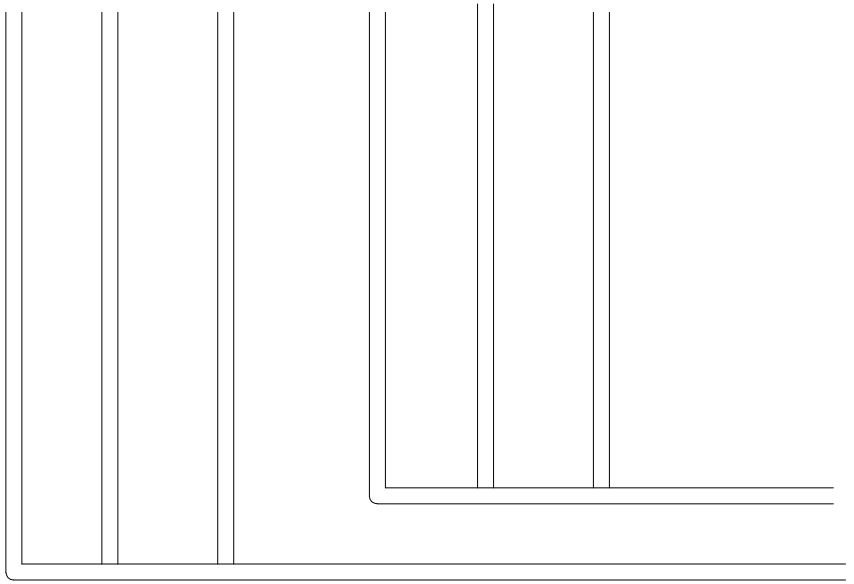
Fuel Consumption with change in moisture

Aggregate Moisture Content	% Production Rate (Dry)	ton/hr Fuel Flow Rate, Gal/h	Gal/ton
1	493.1	484	0.9815
2	371.8	446	1.1995
3	297.1	422	1.4203
4	146.9	407	2.7705
5	210.5	396	1.8812
6	182.6	386	2.1139
7	161	380	2.3602
8	143.7	374	2.6026



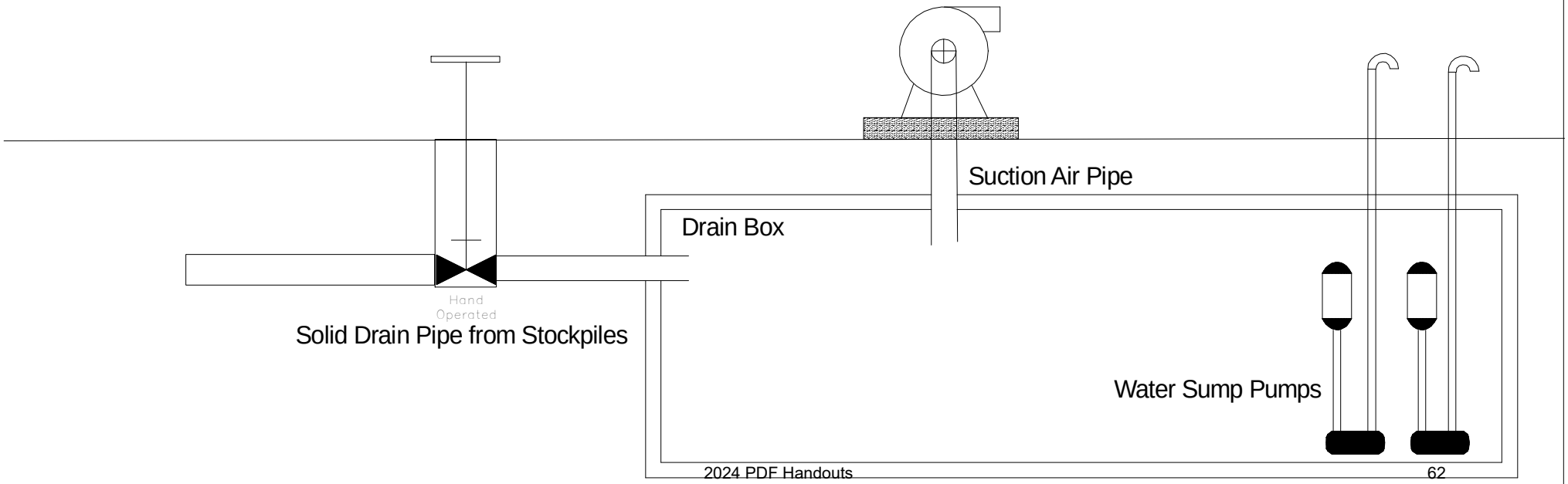
Fabric covered drain tile.

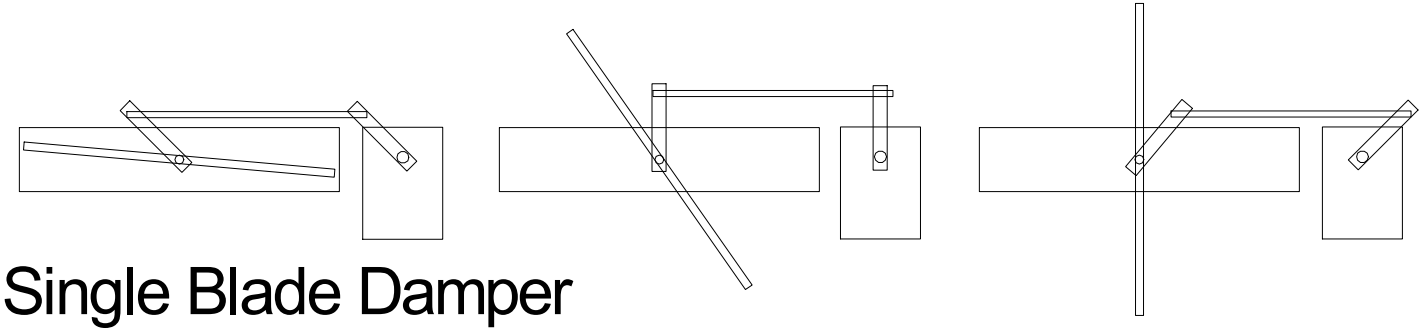
Fabric covered drain tile.



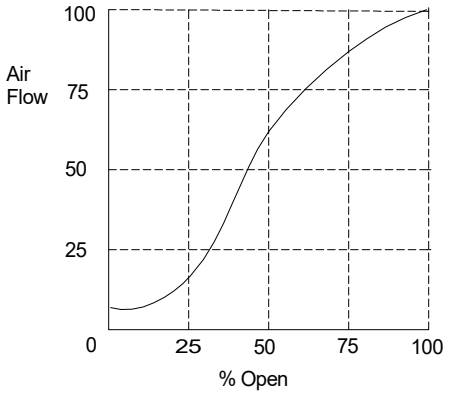
Solid drain tile to Box

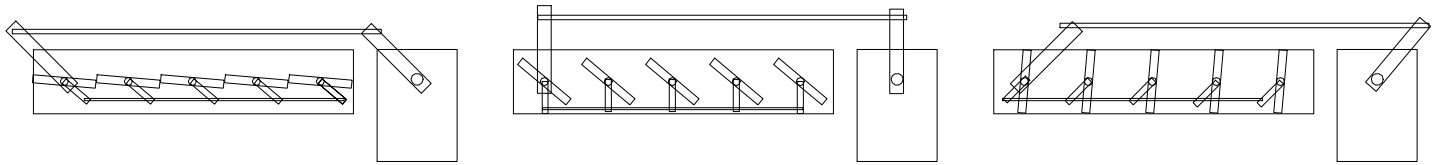
Air Suction Blower



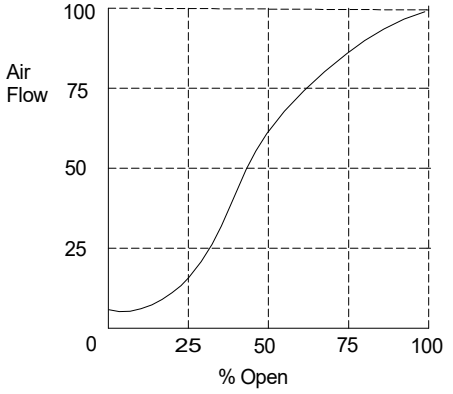


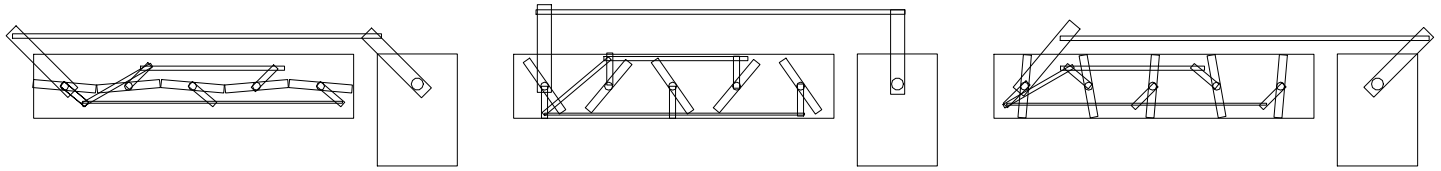
Single Blade Damper



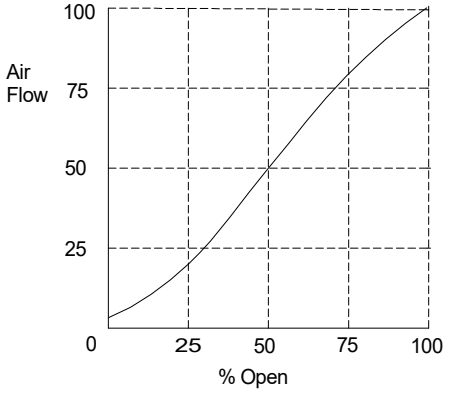


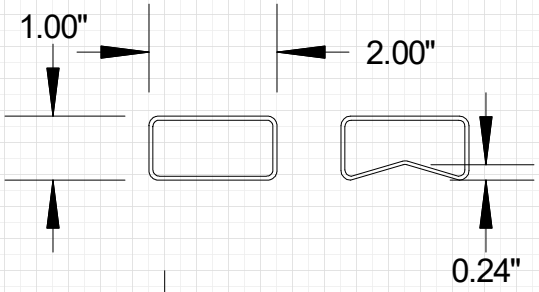
Paralle Blade Damper



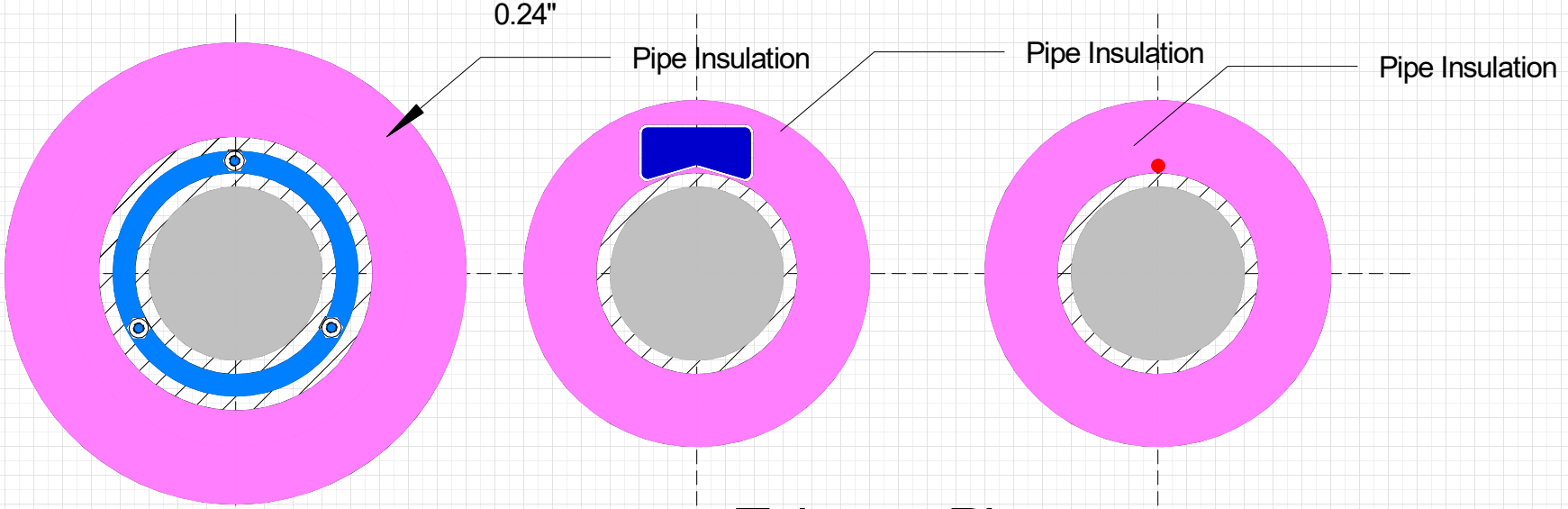


Opposed Blade Damper





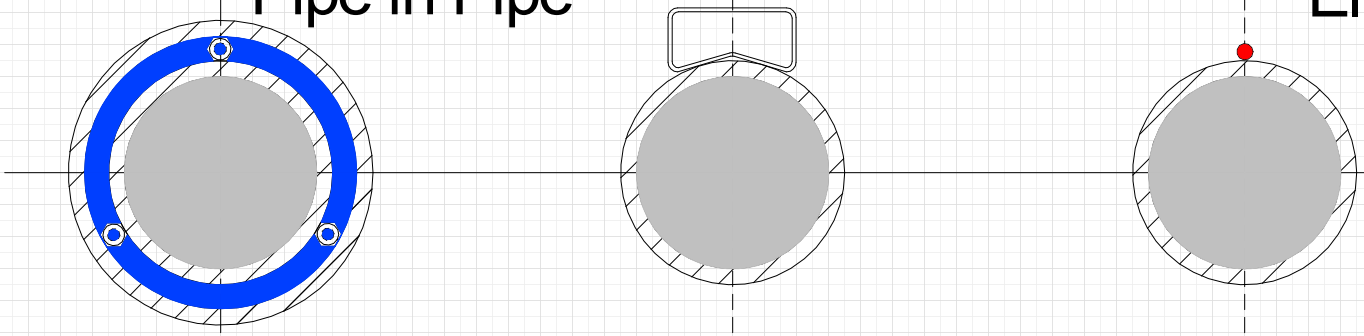
3" Asphalt Pipe
4" Heat Trace Pipe
1"x2" Rec. Tubing w/Bend



Pipe in Pipe

Tube on Pipe

El Heat Trace



https://www.buyinsulationproductstore.com/Fiberglass-Pipe-Insulation-SSL-ASJ/
https://www.buyinsulationproductstore.com/special-finish-aluminum-pipe-jacketing/

MOTION ENGINEERING LINE OIL HEATERS

Motion Engineering is proudly announcing the return of the ME Line Oil Heater line in the following Sizes and Capacities.

Model #		Oil Temperature Rise (°F)											FLA Ratings
Kw Rating		40°F	50°F	60°F	70°F	80°F	90°F	100°F	110°F	120°F	130°F		FLA ^ SCR
ME-048	48 Kw	837	670	558	478	418	372	335	304	279	258	GPH	64.15 ^ 100
ME-96	96 Kw	1,674	1,339	1,116	956	837	744	670	609	558	515	GPH	128.3 ^ 150
ME-144	144 Kw	2,511	2,008	1,674	1,434	1,255	1,116	1,004	913	837	773	GPH	192.5 ^ 200
ME-192	192 Kw	3,348	2,678	2,232	1,912	1,674	1,488	1,340	1,218	1,116	1,030	GPH	256.6 ^ 300

NOTES:

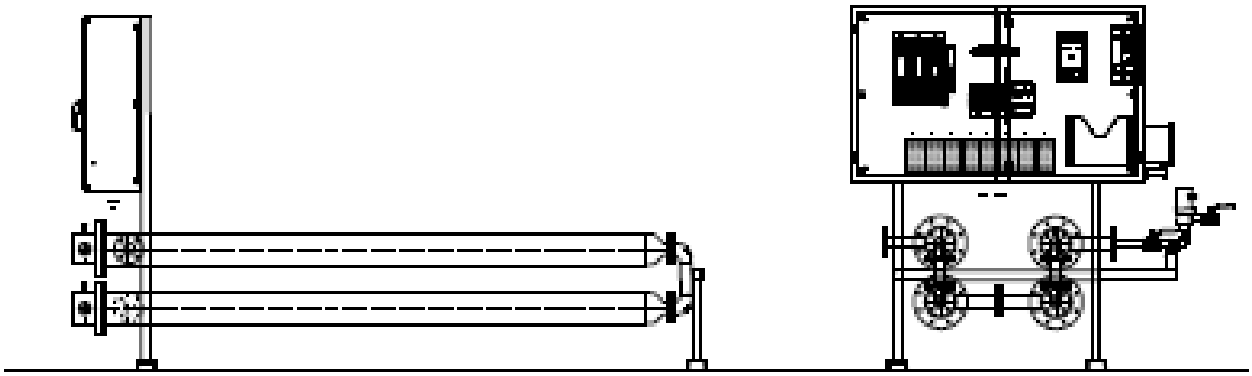
1. Oil Capacities based on No. 6 fuel oil exiting the oil line heater at a viscosity of 90 SSU and includes a 20% safety factor.

2. Maximum inlet pressure is 150psig.

3. Standard supply voltage is 460V/3Ph/60Hz unless otherwise specified on order.

The units are offered with three levels of control.

1. With the Proven MDI heavy duty (Mercury Displacement Contactors) for prolonged life in the heating application. In this unit you set the desired temperature to achieve the needed viscosity for your Burner Fuel. The elements are turned on and off as needed with 1 to 4 elements online controlled from a dual type J thermocouple.
2. With a SCR (Silicon Control Rectifier) the desired temperature is set and the elements are turned on atv a varying percentage to offer smoother control.The elements are turned on and off a percentage of time as needed with 1 to 4 elements. Controllers are controlled from a dual type J thermocouple.
3. The tightest control SCR (Silicon Control Rectifier) with Ametek Brookfield FAST Viscometer control package. With this unit you set the desired viscosity and let the inline viscometer controls match the heating needs to what is needed to reach your viscosity setpoint. No need to check every load or to reset the control for each change in supply. This tighter control will save money by not over or under heating your fuel. In this manner your burner will have the most optimum fuel viscosity for the cleanest and most economical burning.



Current Pricing and lead times as of April 2023

Motion Engineering PRICE		1 PASS	2 PASS	3 PASS	4 PASS
With MDI Controls		$21,539.80	$31,889.72	$45,488.67	$56,619.12
With SCR Controls		$21,316.78	$30,997.64	$45,042.63	$55,727.04
With Viscometer and SCR Controls		$33,174.78	$42,855.64	$56,900.63	$67,585.04

Motion LOH (Line Oil Heater) uses only low density elements with only 12 watts per square inch. This reduces the likelihood of fuel break down due to hot spots in the LOH. In the event you may need replacement elements Motion Engineering maintains a ready stock.

Normal lead times are 6 to 8 weeks on receipt of order. FOB Motion Engineering Kenosha, Wisconsin. Contact us at:

MOTION ENGINEERING
6926 46TH STREET
KENOSHA, WI 53144

Web site: ***motionengineering.net***
Phone: 414-389-1778

Honeywell

AGGREGATE DRYER MATERIAL AND HEAT BALANCE

11/8/2021

Project: CR School Example

Project Description:

Case: Batch Plant

INPUTS:

Fuel: Oil #2

Fuel Composition (% by weight):

C	87.3	H	12.5	S	0.21
O2	0	N2	0	Ash	0
Water	0				

Specified Process Conditions

Elevation above Sea Level	0	ft
Drum Diameter	10	ft
Drum Length	40	ft
Height of Flights	8	in.
Combustion Zone Length	10	ft
Aggregate Moisture Content	5	%
Aggregate Material Specific Heat	0.2	Btu/lb*F
O2 Concentration in Drum (Dry Basis)	9	%
O2 Concentration at Stack (Dry Basis)	11	%
O2 Concentration at Burner (Dry Basis, FGR Option)	20.9	%
Maximum Drum Shell Temperature	500	F
Ambient Temperature	60	F
Final Product Exit Temperature	300	F
Flue Gas Exhaust Temperature at Stack	320	F
Flue Gas Rate at Stack	40000	acfm

OUTPUTS:

Material Balance

Material In		Material Out	
Aggregate Wet, (ton/hr)	221.6	Final Product (Dry), (ton/hr)	210.5
RAP Material, (ton/hr)	0		
Asphalt Cement, (lb/hr)	0		

ECLIPSE kromschroder MAXON

Honeywell

AGGREGATE DRYER MATERIAL AND HEAT BALANCE

Fuel-Air-Flue Gas Flow Rates

Flow In		Flow Out	
Fuel Flow Rate, (Gal/h)	396	Exhaust Fan Volume, (acfm)	40,000
Recirculation Flue Gas, (acfm)	0		

Mean Flue Gas Velocity in Drum - 452.3 ft/min

Composition of Flows

-Composition of Flue Gas at Stack (% by volume):

	CO2	H2O	O2	N2	SO2
Wet Basis	4.93	33.46	7.32	54.29	0
Dry Basis	7.41	0	11	81.59	0.01

Temperature Dew Point at Stack - 161.6 F

Heat Balance

Flow In			Flow Out		
	MM Btu/hr	%		MM Btu/hr	%
Heat of Fuel Combustion	55.851	100	Heat of Final Product	20.212	36.2
Heat of Recirculation Flue Gas	0	0	Heat of Moisture	26.023	46.6
			Heat of Flue Gas	8.58	15.4
			Heat of Drum Loss	0.376	1.8
Total Heat Input	55.851	100	Total Heat Out	55.851	100

Specific Fuel Consumption: 1.88 Gal/(ton of dry material out)

Specific Heat Consumption: 265,266 Btu/(ton of dry material out)

ECLIPSE kromschroder MAXON

Honeywell

AGGREGATE DRYER MATERIAL AND HEAT BALANCE

Production Rate (Dry) Versus Aggregate Moisture Content at Fixed Exhaust Flow Rate of 40000 Gal/h

Aggregate Moisture Content, %	Production Rate (Dry), ton/hr	Fuel Flow Rate, Gal/h
1	493.1	484
2	371.8	446
3	297.1	422
4	246.9	407
5	210.5	396
6	182.6	386
7	161.0	380
8	143.7	374

ECLIPSE kromschroder MAXON

BURNER ANALYSIS SHEET

Date: _____

Company: _____

Plant: _____

Probe Placement: ☐ Dryer ☐ Dryer Exit Duct ☐ Stack

Fuel: _____ Aggregate Moisture: ____ % Mix Temp: ___ °F Product: _____

Oil Viscosity Target: _____ SSU Draft Target: ___″ WC

TIME (HH:MM)	TPH	BURNER POSIT. 0-10	EXHAUST DAMPER POSIT. 0-10	DRYER DRAFT 0-1”	DRYER EXIT TEMP	BAGHOUSE PRESSURE DROP 0-10”	COMP AIR PRESS	FUEL VALVE POSIT. 0-10	BLOWER DAMP POSIT. 0-10	FUEL PRESS.	OIL TEMP °F	OXYGEN %	CARBON MONOXIDE PPM	CORRECTIVE ADJUSTMENT AFFECTING NEXT ROW OF READINGS

BURNER ANALYSIS SHEET

Date: 12/29/2009

Company: Clarence Richard Company

Plant: Minnetonka

Probe Placement: ☐ **Dryer** ☒ **Dryer Exit Duct** ☐ **Stack**

Fuel: #6 Oil **Aggregate Moisture: 5.1 %** **Mix Temp: 300 °F** **Product: Base**

Oil Viscosity Target: 92 SSU **Draft Target: 0.3″ WC**

TIME HH:MM	TPH	BURNER POSIT. 0-10	EXHAUST DAMPER POSIT. 0-10	DRYER DRAFT 0-1”	DRYER EXIT TEMP	BAGHOUSE PRESSURE DROP 0-10”	COMP AIR PRESS	FUEL VALVE POSIT. 0-10	BLOWER DAMP POSIT. 0-10	FUEL PRESS.	OIL TEMP °F	OXYGEN %	CARBON MONOXIDE PPM	CORRECTIVE ADJUSTMENT AFFECTING NEXT ROW OF READINGS
07:00	250	4	4.0	0.50	225	4.9	104	4.1	4.8	150.0	125	16.0	1500	Reduce fuel pressure
07:30	250	4	4.0	0.45	235	4.4	104	4.1	4.8	140.0	125	15.5	1200	Reduce fuel pressure
07:40	250	4	4.0	0.55	195	4.9	104	4.1	4.8	130.0	125	14.0	600	Increase fuel pressure
07:50	250	4	4.0	0.45	235	4.4	104	4.1	4.8	140.0	125	15.5	1200	Increase fuel temp
08:00	250	4	4.0	0.40	240	4.4	104	4.1	4.8	140.0	140	13.0	400	Close exhaust damper
08:10	250	4	3.0	0.30	250	4.0	104	4.1	4.8	140.0	140	11.0	375	Close exhaust damper
08:20	250	4	2.5	0.25	250	3.8	104	4.1	4.8	140.0	140	9.0	375	Open exhaust damper
08:30	250	4	3.0	0.30	250	4.0	104	4.1	4.8	140.0	140	11.0	375	Decrease compressor air press.
08:40	250	4	4.0	0.28	245	3.9	94	4.1	4.8	140.0	140	10.8	475	Increase compressor air press.
08:50	250	4	4.0	0.33	255	4.1	115	4.1	4.8	140.0	140	11.2	275	Document target visc., draft

Belt Scale Weighbridge Alignment

When Should You Consider Belt Scale Weighbridge Re-alignment? •First, insure that there is no other outside influence on the weighbridge such as rocks, material buildup or any other materials that will cause the scale to read improperly.

•Second, insure that the load cell, load cell cable, and speed sensors are not damaged, or that there are not any defective wires, cables and wire terminals and connections (corrosion).

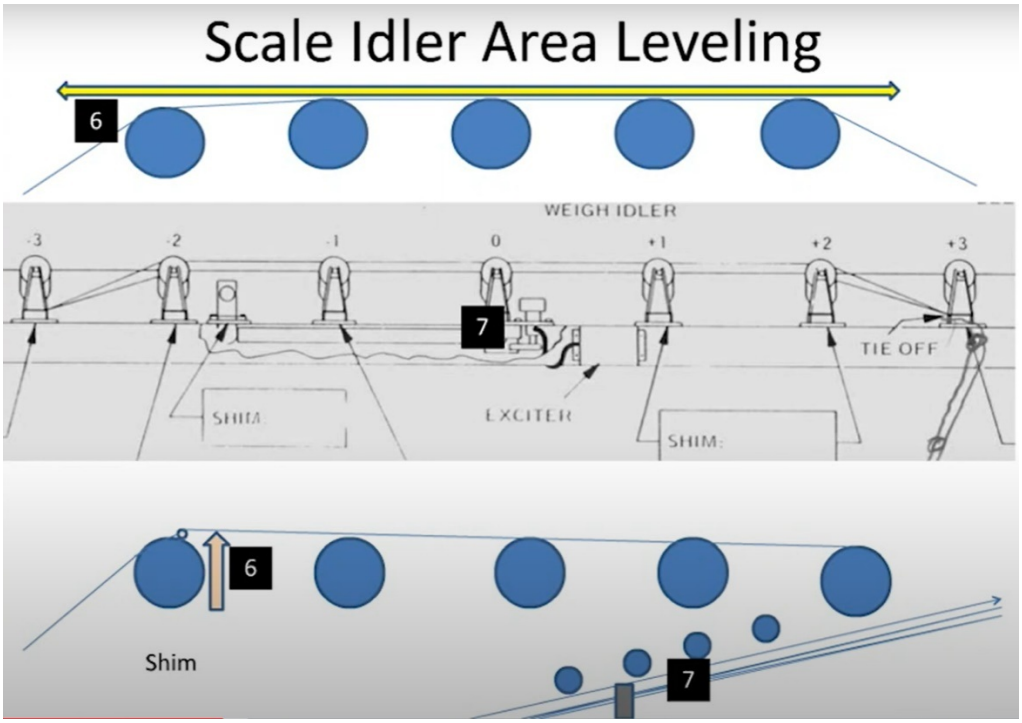
•Third, insure that the truck scale has been certified and that it also has repeatability. After these have been verified consider the following: When weighed load test accuracy will not repeat. When accuracy can't be obtained from weighed load tests at different feed rates. When accuracy doesn't fall within the established allowable tolerances. Belt scale re-alignment requires specific tools to complete this process. Mono Filament Fishing Line (min. 100'). 1-shim pack (1/6", 1/8", ¼"). 4-C clamps or wide jaw vise grips . 1-2' square. 1-felt tipped pen. 1-hammer. 1-punch. 1-25' tape measure.

When referring to plus (+) rollers/idlers, it means the rollers/idlers that are on the head pulley side of the weighbridge. The minus (-) would be referring to rollers/idlers that are on the tail pulley side of the weighbridge. The Idler is the three rollers and roller support carriage that sits on the conveyor frame. The Stringer referred to is the part of the conveyor frame that the ears of the idler sets on. Troughing idlers should not have the side rollers mounted at more than 30 degrees from horizontal. The objective of the re-alignment process is to better arrange the mechanical alignment of the belt scale. The mechanical belt scale consists of the -2 idler, -1 idler, the weigh-idler, +1 idler and +2 idler. The squaring of these idlers to each other and to the conveyor stringers and mounted all to the same plane makes a very important contribution to the belt scale accuracy. Without proper alignment between each idler, acceptable belt scale accuracy cannot be achieved. Follow the Belt Scale Weigh Bridge Alignment Procedure detailed on this slides notes (steps 1-7) and the next two slides to perform a re-alignment.

9+

0:01 / 20:20

2



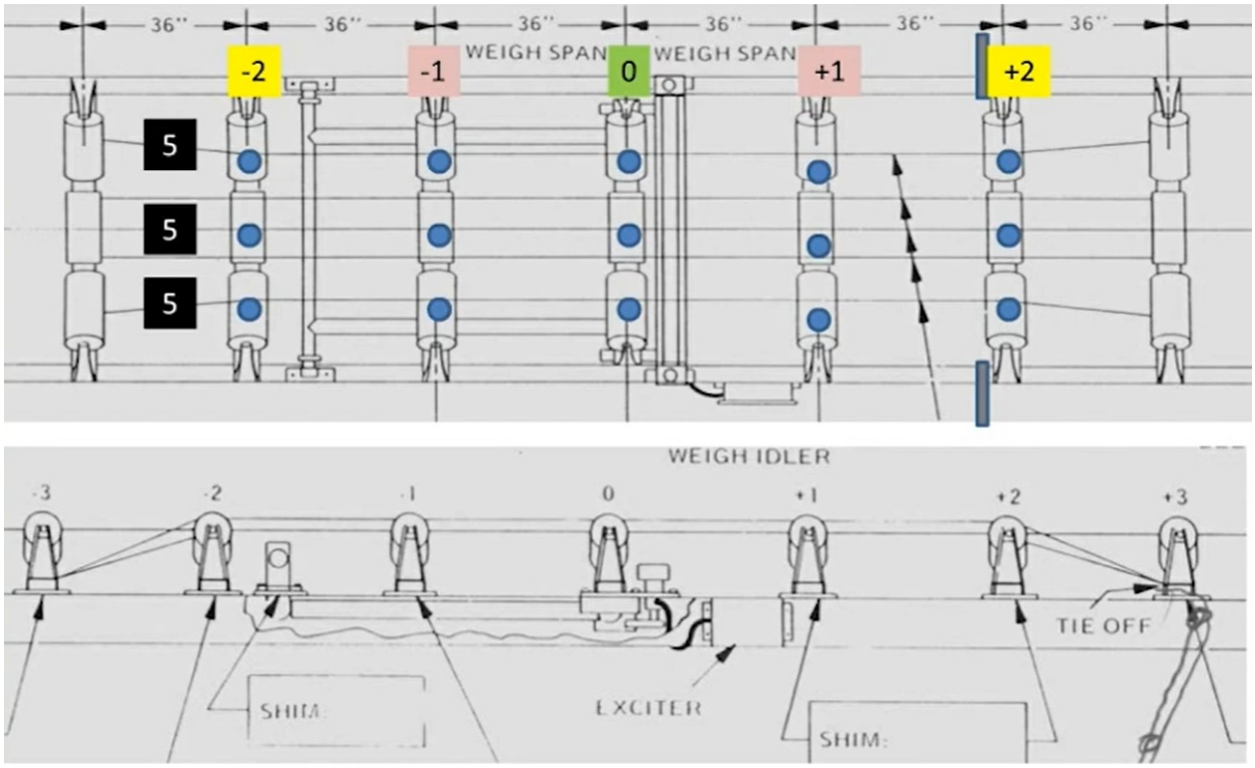
•Lockout and Tagout the scale conveyor motor and any other conveyor or equipment motors that may pose danger while performing the belt scale alignment procedure.

•Loosen the scale conveyor belting generously enough so the belt can be raised above all rollers in the belt scale area. This area includes -2 to +2 idlers and also the weigh idler. •Remove + 1 idlers and weigh idler.

•Measure all three rollers of each idler to find center of each roller. Mark center of each roller with your felt tipped pen. Do this for all five idlers -2 through +2. Center punch all felt tip marks for each idler.
•Square the -2 idler to the conveyors stringer or truss.

•Square the +2 idler and the -2 idler to each other by equal-distance from each other on both sides. Then check diagonally the distance to insure square. After these idlers are square, snug the idler hold down bolts.

•Since Step 5 squared the -2 idler to the conveyor frame and Step 6 squared –2 to +2, can we assume that +2 is square with the conveyor frame? No . Check to see that the +2 idler is Square to the stringer or truss (a idler edge being closer to one stringer edge than the other idler edge to the other stringer edge). If not square, recheck the last two steps. If the last two steps were accurate, the stringer or truss is not straight and square. Adjust the square rectangle of the +2 idlers to a happy medium over the stringers.



•This step requires string line. Consider using 3 fishing rod/reels. They make great counterweights and makes tying not necessary when using the leader hook clasp. The rod/ reel also keeps your line under control. Anyhow, attach mono filament line to the bottom of the -3 idler but over the top of the -2 idler as shown on Figure Four. Extend the fishing line over the same group of rollers for all idlers -2 through +2, tighten the line taut and attach to the bottom of the +3 idler . Do this for all three groups of rollers in the scale area. Align the fishing line over all center punches for +2 idler rollers to -2 idler rollers. •Re-install the –1 and +1 idlers at this time. Equal-distance them to the –2 and +2. They should be square with each other and to the + 2 rollers. Checking for equal measurements (within 1/16”) diagonally and side to side from + 1 roller to – 1 roller proves the rectangle to be square. •Place the +1 idlers height so they are the same height as +2 idlers and that all of the center punches line up with the string line.

•Check the gap between the string line and the idler rollers. The goal here is to position all idlers in the scale area on the same horizontal plane. The string should rest next to the top of the roller. If they are not on the same plane (same height to each other), shim –2 or +2 so they are equal to their respective + or - 1 idler roller. Sometimes it is difficult to determine if the string is slightly touching a + or -1 idler or a + or -1 idler is actually too high and is holding the filament up 1/16” or more. Lift the string at the respective + 2 roller in 1/16” shims under the adjacent 2 idler to determine if shimming of that 2 idler is necessary.

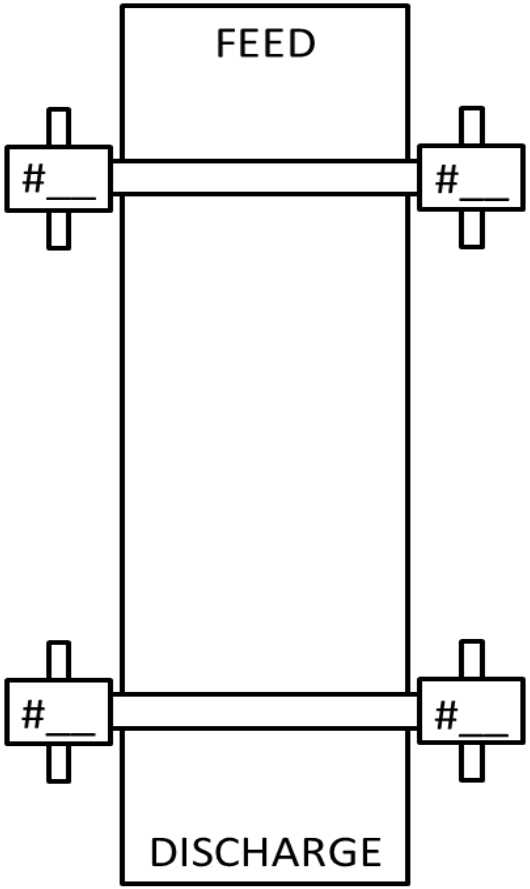
• Re-install the weigh idler to the weighbridge. Equal-distance the weigh idler to the –1 and +1 idlers. Adjust the weigh idler height, by means of the load cell adjusting bolt. Adjust the weigh idler so it just reaches the bottom of the three mono fishing lines located above it. Insure that the center punches line up with the mono lines.

•If the mono filament is not directly over each center punch mark, then loosen the hold down bolts located on each side of the idler and with a hammer tap the idler frame the amount of distance necessary to bring the idler directly under the center punches. Inspect all idlers in relation to the mono fishing line and center punches and adjust accordingly

•Re-inspect the belt scale to insure that all of the adjustments just made have not slipped or has changed, as that will compromise the entire effort.

Trunnion Adjustment Log

Date	Time	#1 Left	#1 Right	#2 Left	#2 Right	#3 Left	#3 Right	#4 Left	#4 Right



Courtesy of: e-Plant Operation Workshop • 952-939-6000• www.clarencerichard.com

e-Spot Check (HMA Plant Scales Spot Check)

**** Unless noted otherwise, all units are in tons. ****

courtesy of EZ-Flo Scales
courtesy of e-Plant Operation Workshop
www.clarencerichard.com

Plant:
Operator:

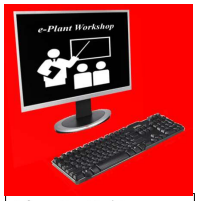
Mix Design:

Select this field to start next Spot Check sheet.

Date: (MM/DD/YYY)	Spot Check Start Time: (HH:MM am/pm)	Spot Check End Time: (HH:MM am/pm)	Spot Check Duration: (HH:MM)
1/1/2011	** 7:00 AM	** 10:00 AM	3:00

** Enter the time followed by a space, then enter an a or p after the time; for example, 9:00 p

**Enter these fields at start of Spot Check:
**Enter these fields at end of Spot Check:



Information Disclaimer:
The information provided in the workshops is considered by us as always being in a state of continuous improvement. This information is our opinion and the opinion of others gathered through knowledge, experience and research. The information here is true to the best of our knowledge. Your experiences and research may be different. This information is provided as a guide. Consult professional engineering for your application. CR Company liability for any costs incurred at anytime is limited to the course fee of a particular participant or Ez-Flo Scale.

Mix Design	
Aggregate	0.0%
Oil	0.0%
RAP	0.0%
Shingles	0.0%
Lime	0.0%
Filler	0.0%
Fiber	0.0%
Total (100%)	0.0%

Truck Tickets	
Start	0.0
End	0.0
Net	0.0

Mix Silo	
Start	0.0
End	0.0
Net	0.0

Plant	
* Pipe Line Net	0.0
Produced Mix	0.0
Plant Rate: (w/o Hot Stops)	0.00 TPH

Aggregate	
Aggregate Moisture(%)	0.0%
Wet Agg. Totalizer Start	0.0
Wet Agg. Totalizer End	0.0
Wet Agg. Totalizer Used	0.0
Dry Agg. Used	0.0
Wet Agg. Required	0.0
Dry Agg. Required	0.0

RAP	
RAP Moisture(%)	0.0%
Wet RAP Totalizer Start	0.0
Wet RAP Totalizer End	0.0
Wet RAP Totalizer Used	0.0
Dry RAP Used	0.0
Wet RAP Required	0.0
Dry RAP Required	0.0

Asphalt Oil	
Oil in tank at start	0.00
Oil added to tank	0.00
Oil in tank at end	0.00
Oil used(Tank Stick)	0.00
Oil Meter Totalizer Start	0.00
Oil Meter Totalizer End	0.00
Oil Meter Totalizer Used	0.00
Oil Required	0.00

Shingles	
Shingles Moisture(%)	0.0%
Wet Shingles Totalizer Start	0.00
Wet Shingles Totalizer End	0.00
Wet Shingles Totalizer Used	0.00
Dry Shingles Used	0.00
Wet Shingles Required	0.00
Dry Shingles Required	0.00

Lime	
Lime in silo at start	0.00
Lime added to silo	0.00
Lime in silo at end	0.00
Lime used(Tank Stick)	0.00
Lime Totalizer Start	0.00
Lime Totalizer End	0.00
Lime Totalizer Used	0.00
Lime Required	0.00

Filler	
Filler in Silo at start	0.00
Filler added to silo	0.00
Filler in silo at end	0.00
Filler used(Tank Stick)	0.00
Filler Totalizer Start	0.00
Filler Totalizer End	0.00
Filler Totalizer Used	0.00
Filler Required	0.00

Fiber	
Fiber Lbs/Bag	40.0
Fiber in Hopper at Start(lbs)	0.0
Fiber in Hopper at End(lbs)	0.0
Fiber Bag count at start	0.0
Fiber Bag count at end	0.0
Fiber Bags used	0.0
Fiber used(lbs)	0.0
Fiber used(tons)	0.000
Fiber Totalizer Start(lbs)	0.0
Fiber Totalizer end(lbs)	0.0
Fiber Totalizer Used(lbs)	0.0
Fiber Required(lbs)	0.0
Fiber Required(Tons)	0.000

Dust	
Mix Design Dust Required	0.0%
Dust Required	0.00
Dust Totalizer Start	0.00
Dust Totalizer End	0.00
Dust Totalizer Used	0.00
Deviation	NA

* Pipe Line Net.. When applicable, enter the mix weight in the Drum, Slat, etc. Otherwise enter 0.

Engineering Units Calculator

	Density	*Select:*
Material Specific Gravity(@70°F):	1.0	
Material Density(Lb/Gal):	1.0	

Tons to Lbs	0.000 Ton	***enter Density first *** Gallons to Lbs	0.0 Gal.	***enter Density first *** Gallons to Tons	0.0 Gal.
	0.0 Lb.		0.0 Lb.		0.000 Ton
Lbs to Tons	0.0 Lb.	***enter Density first *** Lbs to Gallons	0.0 Lb.	***enter Density first *** Tons to Gallons	0.0 Ton
	0.000 Ton		0.000 Gal.		0.0 Gal.

For Registered Participant use and Workshop promotion purposes only.

For Ez-Flo Scale users and promotion purposes only.

Not for Redistribution.

Spot Check Results

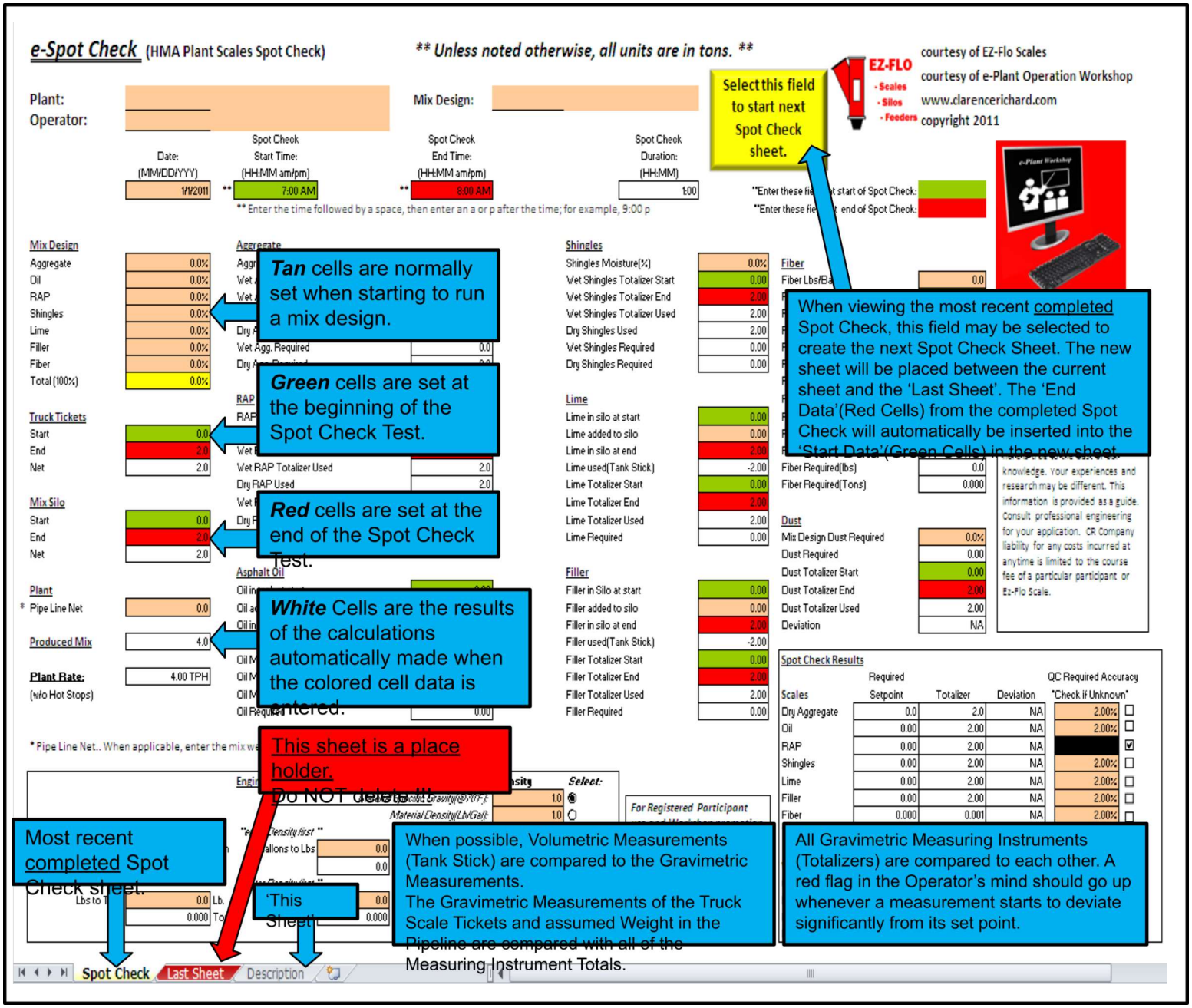
Scales	Design Required	Totalizer	Actual Mix %	Actual/Design Deviation	QC Required Accuracy √ if Unknown
Dry Aggregate	0.0	0.0	NA	NA	2.00%
Oil	0.00	0.00	NA	NA	2.00%
RAP	0.00	0.00	NA	NA	
Shingles	0.00	0.00	NA	NA	2.00%
Lime	0.00	0.00	NA	NA	2.00%
Filler	0.00	0.00	NA	NA	2.00%
Fiber	0.000	0.000	NA	NA	2.00%
Total	0.000	0.000			

Volumetric	Required	Tank Stick	Actual Mix %	Actual/Design Deviation	
Oil	0.00	0.00	NA	NA	2.00%
Lime	0.00	0.00	NA	NA	2.00%
Filler	0.00	0.00	NA	NA	2.00%
Fiber	0.000	0.000	NA	NA	2.00%

Volume/Scale Act. Wt./Scale	Scale Accuracy	Required Accuracy	Old Span	New Span
Oil	NA	2.00%		NA
Lime	NA	2.00%		NA
Filler	NA	2.00%		NA
Fiber	NA	2.00%		NA

Notes:

Spot Check #1
Spot Check #2
Spot Check #3
Spot Check #4
Spot Check #5
Spot Check #6
Spot Check #7
Spot Check #8
Spot Check #9
Spot Check #10
Spot Check #11
Spot Check #12


e-Spot Check (HMA Plant Scales Spot Check)
** Unless noted otherwise, all units are in tons. **
courtesy of EZ-Flo Scales
courtesy of e-Plant Operation Workshop
www.clarencerichard.com
copyright 2011
Plant:
Operator:
Mix Design:
Select this field to start next Spot Check sheet.
Tan cells are normally set when starting to run a mix design.
Green cells are set at the beginning of the Spot Check Test.
Red cells are set at the end of the Spot Check Test.
White Cells are the results of the calculations automatically made when the colored cell data is entered.
When viewing the most recent completed Spot Check, this field may be selected to create the next Spot Check Sheet. The new sheet will be placed between the current sheet and the 'Last Sheet'. The 'End Data'(Red Cells) from the completed Spot Check will automatically be inserted into the 'Start Data'(Green Cells) in the new sheet.
This sheet is a place holder.
Do NOT delete!!
Most recent completed Spot Check sheet.
'This Sheet'
When possible, Volumetric Measurements (Tank Stick) are compared to the Gravimetric Measurements.
The Gravimetric Measurements of the Truck Scale Tickets and assumed Weight in the Pipeline are compared with all of the Measuring Instrument Totals.
All Gravimetric Measuring Instruments (Totalizers) are compared to each other. A red flag in the Operator's mind should go up whenever a measurement starts to deviate significantly from its set point.
Spot Check
Last Sheet
Description

e-Flo Scale 1-Point Calculator

Date:	
Test Manager:	
Plant Location:	
Plant Number:	
Scale Name:	
Material Weighed:	
Ref. Scale Type:	
Ref. Scale Resolution:	

Regarding Columns:

Elapsed Time/Feeder Speed (Sec or %): Optional entry for reference.
Target Rate (TPH or LB/Min): Optional entry for reference.
* **Scale Totalizer** (Lb, Ton, etc): *Required entry*, scale totalizer may read in tons, pounds, etc.
* **Reference Scale Gross** (Lb, Ton, etc): *Required entry*, same units as C.
* **Reference Scale Tare** (Lb, Ton, etc): *Required entry*, same units as C.
Reference Scale Net (Lb, Ton, etc): *Automatically Calculated*, Calibration Scale Net = D – E.
DSP # Multiplier: *Automatically Calculated* from F & C, Span # Multiplier = F / C.
Totalizer Error %: *Automatically Calculated* from G, Error % = (1-G) x 100.
* **Existing DSP #:** *Required entry.*
New INP #: *Automatically Calculated* from G & I, New INP # = G x I.
required entry

	A	B	C*	D*	E*	F	G	H	I*	J	
						(D-E)	(F/C)	(1-G)x100		(GxI)	
Test #	**Elapsed Time / Feeder Speed** (sec/%)	**Target Rate Hi, Mid,Low** (TPH,Lbs/min)	**Scale Totalizer** (Lb,Ton,etc)	**Reference Scale Gross** (Lb,Ton,etc)	**Reference Scale Tare** (Lb,Ton,etc)	**Reference Scale Net** (Lb,Ton,etc)	**DSP # Multiplier**	**Totalizer Error %**	**Existing DSP #**	**New DSP #**	**COMMENTS**
1	30%	12	9.059	15.040	11.750	3.290	0.363	63.68%			bogus test.. Wrong program entered
2	30%	12	5.544	15.690	11.770	3.920	0.707	29.29%	13.000	9.192	Target was 12 TPH but we got 12 TP
3	30%	12	6.210	16.150	11.780	4.370	0.704	29.63%	13.000	9.148	Target was 12 TPH but we got 12 TPH
4	15%	6	3.580	14.250	11.780	2.470	0.690	31.01%	13.000	8.969	Target was 6 TPH but we got 7 TPH
5	15%	6	4.153	14.610	11.780	2.830	0.681	31.86%	13.000	8.859	Target was 6 TPH but we got 7 TPH
6	22%	9	5.079	16.830	11.770	5.060	0.996	0.37%	8.859	8.826	Target was 9 TPH but we got 9.6 TPH
7											
8											
9											
10											

** See Sheet 3 for additional test entries ***

equired Entr
eference Ent

Courtesy of EZ-Flo Scales • 952-939-6000• www.ez-flo.us

e-Flo Scale 1-Point Calculator

Date:	
Test Manager:	
Plant Location:	
Plant Number:	
Scale Name:	
Material Weighed:	
Ref. Scale Type:	
Ref. Scale Resolution:	

Test #	Elapsed Time / Feeder Speed	Target Rate Hi,Mid,Low	Scale Totalizer	Reference Scale Gross	Reference Scale Tare	Reference Scale Net	DSP # Multiplier	Totalizer Error %	Existing DSP #	New DSP #	COMMENTS
	(sec/%)	TPH,Lbs/min	(Lb,Ton,etc)	(Lb,Ton,etc)	(Lb,Ton,etc)	(Lb,Ton,etc)					
1			5.544	15.690	11.770	3.920	0.707	29.29%			
2											
3											
4											
5											
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7											
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21											
22											
23											
24											
25											

e-Flo Scale 1-Point Calculator

Date:	
Test Manager:	
Plant Location:	
Plant Number:	
Scale Name:	
Material Weighed:	
Ref. Scale Type:	
Ref. Scale Resolution:	

Regarding Columns:

Elapsed Time/Feeder Speed (Sec or %): Optional entry for reference.
Target Rate (TPH or LB/Min): Optional entry for reference.
* **Scale Totalizer** (Lb, Ton, etc): *Required entry*, scale totalizer may read in tons, pounds, etc.
* **Reference Scale Gross** (Lb, Ton, etc): *Required entry*, same units as C.
* **Reference Scale Tare** (Lb, Ton, etc): *Required entry*, same units as C.
Reference Scale Net (Lb, Ton, etc): *Automatically Calculated*, Calibration Scale Net = D – E.
DSP # Multiplier: *Automatically Calculated* from F & C, Span # Multiplier = F / C.
Totalizer Error %: *Automatically Calculated* from G, Error % = (1-G) x 100.
* **Existing DSP #:** *Required entry.*
New INP #: *Automatically Calculated* from G & I, New INP # = G x I.
required entry

	A	B	C*	D*	E*	F	G	H	I*	J	
						(D-E)	(F/C)	(1-G)x100		(GxI)	
Test #	**Elapsed Time / Feeder Speed** (sec/%)	**Target Rate Hi, Mid,Low** (TPH,Lbs/min)	**Scale Totalizer** (Lb,Ton,etc)	**Reference Scale Gross** (Lb,Ton,etc)	**Reference Scale Tare** (Lb,Ton,etc)	**Reference Scale Net** (Lb,Ton,etc)	**DSP # Multiplier**	**Totalizer Error %**	**Existing DSP #**	**New DSP #**	**COMMENTS**
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

** See Sheet 3 for additional test entries ***

equired Entr
eference Ent

e-Flo Scale 1-Point Calculator

Date:	
Test Manager:	
Plant Location:	
Plant Number:	
Scale Name:	
Material Weighed:	
Ref. Scale Type:	
Ref. Scale Resolution:	

Test #	Elapsed Time / Feeder Speed	Target Rate Hi,Mid,Low	Scale Totalizer	Reference Scale Gross	Reference Scale Tare	Reference Scale Net	DSP # Multiplier	Totalizer Error %	Existing DSP #	New DSP #	COMMENTS
	(sec/%)	TPH,Lbs/min	(Lb,Ton,etc)	(Lb,Ton,etc)	(Lb,Ton,etc)	(Lb,Ton,etc)					
1											
2											
3											
4											
5											
6											
7											
8											
9											
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Sample Written

Program For

Confined Space

provided as a public service by

OSHCON

Occupational Safety and Health Consultation Program

Texas Department of Insurance, Division of Workers' Compensation

Publication No.
HS02-042A(01-06) Revised
01/27/06

1910.146

Confined Space Program

The following confined space program is provided only as a guide to assist employers and employees in complying with the requirements of OSHA's Confined Space Standard, 29 CFR 1910.146, as well as to provide other helpful information. It is not intended to supersede the requirements of the standard. An employer should review the standard for particular requirements that are applicable to their individual situation, and make adjustments to this program that are specific to their company. An employer will need to add information relevant to their particular facility in order to develop an effective, comprehensive program.

1910.146 Confined Space Program Table of Contents

Confined Space
Program For
Company Name

I. OBJECTIVE

The purpose of ***Company Name's*** Confined Space Program is to set procedures that will ensure workers safe entry into confined spaces and permit-required confined spaces to perform routine tasks associated with their employment. This procedure is designed to provide the minimum safety requirements in accordance with the Occupational Safety and Health Administration's (OSHA) Confined Space Standard, 1910.146.

II. BACKGROUND

A confined space is defined as any location that has limited openings for entry and egress, is not intended for continuous employee occupancy, and is so enclosed that natural ventilation may not reduce air contaminants to levels below the threshold limit value (TLV). Examples of confined spaces include: manholes, stacks, pipes, storage tanks, trailers, tank cars, pits, sumps, hoppers, and bins. Entry into confined spaces without proper precautions could result in injury, impairment, or death due to:

A. an atmosphere that is flammable or explosive;
B. lack of sufficient oxygen to support life;
C. contact with or inhalation of toxic materials; or
D. general safety or work area hazards such as steam or high pressure materials.

III. ASSIGNMENT OF RESPONSIBILITY

A. Employer

In administering this Confined Space Program, ***Company Name*** will:

1. Monitor the effectiveness of the program.
2. Provide atmospheric testing and equipment as needed.
3. Provide personal protective equipment as needed.
4. Provide training to affected employees and supervisors.
5. Provide technical assistance as needed.
6. Preview and update the program on at least an annual basis or as needed.

B. Program Manager

Responsible Person is responsible for managing the Confined Space Program, and shall:

1. Ensure that a list of confined spaces at all ***Company Name*** worksites is maintained.
2. Ensure that canceled permits are reviewed for lessons learned.
3. Ensure training of personnel is conducted and documented.
4. Coordinate with outside responders.
5. Ensure that equipment is in compliance with standards.
6. Ensure that the ***Responsible Person*** in charge of confined space work shall:

a. Ensure requirements for entry have been completed before entry is authorized.
b. Ensure confined space monitoring is performed by personnel qualified and trained in confined space entry procedures.
c. Ensure a list of monitoring equipment and personnel qualified to operate the equipment is maintained by the Safety and Occupational Health Office.
d. Ensure that the rescue team has simulated a rescue in a confined space within the past twelve (12) months.
e. Know the hazards that may be faced during entry, including the mode (how the contaminant gets into the body), signs or symptoms, and consequences of exposure.
f. Fill out a permit.
g. Determine the entry requirements.
h. Require a permit review and signature from the authorized Entry Supervisor.
i. Notify all involved employees of the permit requirements.
j. Post the permit in a conspicuous location near the job.
k. Renew the permit or have it reissued as needed (a new permit is required every shift).
l. Determine the number of Attendants required to perform the work.
m. Ensure all Attendant(s) know how to communicate with the entrants and how to obtain assistance.
n. Post any required barriers and signs.
o. Remain alert to changing conditions that might affect the conditions of the permits (i.e., require additional atmospheric monitoring or changes in personal protective equipment).
p. Change and reissue the permit, or issue a new permit as necessary.

q. Ensure periodic atmospheric monitoring is done according to permit requirements.
r. Ensure that personnel doing the work and all support personnel adhere to permit requirements.
s. Ensure the permit is canceled with the work is done.
t. Ensure the confined space is safely closed and all workers are cleared from the area.

C. Entry Supervisors

Responsible Person(s) shall serve as the Entry Supervisor(s), and shall be qualified and authorized to approved confined space entry permits. The Entry Supervisor(s) shall be responsible for:

1. Determining if conditions are acceptable for entry.
2. Authorizing entry and overseeing entry operations.
3. Terminating entry procedures as required.
4. Serving as an Attendant, as long as the person is trained and equipped appropriately for that role.
5. Ensuring measures are in place to keep unauthorized personnel clear of the area.
6. Checking the work at least twice a shift to verify and document permit requirements are being observed (more frequent checks shall be made if operations or conditions are anticipated that could affect permit requirements).
7. Ensuring that necessary information on chemical hazards is kept at the worksite for the employees or rescue team.
8. Ensuring a rescue team is available and instructed in their rescue duties (i.e., an onsite team or a prearranged outside rescue service).
9. Ensuring the rescue team members have current certification in first aid and cardiopulmonary resuscitation (CPR).

D. Attendants

Responsible Person(s) shall function as an Attendant(s) and shall be stationed outside of the confined workspace. The Attendant(s) shall:

1. Be knowledgeable of, and be able to recognize potential confined space hazards.
2. Maintain a sign-in/sign-out log with a count of all persons in the confined space, and ensure all entrants sign in and out.

3. Monitor surrounding activities to ensure the safety of personnel.
4. Maintain effective and continuous communication with personnel during confined space entry, work, and exit.
5. Order personnel to evacuate the confined space if he/she:

a. observes a condition which is not allowed on the entry permit;
b. notices the entrants acting strangely, possibly as a result of exposure to hazardous substances;
c. notices a situation outside the confined space which could endanger personnel;
d. notices a hazard within the confined space that has not been previously recognized or taken into consideration;

e. must leave his/her work station; or
f. must focus attention on the rescue of personnel in some other confined space that he/she is monitoring.

6. Immediately summon the Rescue Team if crew rescue becomes necessary.
7. Keep unauthorized persons out of the confined space, order them out, or notify authorized personnel of an unauthorized entry.

E. Rescue Team

The Rescue Team members shall:

1. Complete a training drill using mannequins or personnel in a simulation of the confined space prior to the issuance of an entry permit for any confined space and at least annually thereafter.
2. Respond immediately to rescue calls from the Attendant or any other person recognizing a need for rescue from the confined space.
3. In addition to emergency response training, receive the same training as that required of the authorized entrants.
4. Have current certification in first aid and CPR.

F. Entrants/Affected Employees

Employees who are granted permission to enter a confined space shall:

1. Read and observe the entry permit requirements.
2. Remain alert to the hazards that could be encountered while in the confined space.

3. Properly use the personal protective equipment that is required by the permit.
4. Immediately exit the confined space when:

a. they are ordered to do so by an authorized person;
b. they notice or recognize signs or symptoms of exposure;
c. a prohibited condition exists; or
d. the automatic alarm system sounds.

5. Alert Attendant(s) when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.

d. TRAINING

Company Name shall provide training so that all employees whose work is regulated by this Confined Space Program acquire the understanding, knowledge, and skills necessary for the safe performance of their duties in confined spaces.

A. Training Frequency

Responsible Person shall provide training to each affected employee:

1. before the employee is first assigned duties within a confined space;
2. before there is a change in assigned duties;
3. when there is a change in permit space operations that presents a hazard for which an employee has not been trained; and
4. when ***Company Name*** has reason to believe that there are deviations from the confined space entry procedures required in this program, or that there are inadequacies in the employee's knowledge or use of these procedures.

The training shall establish employee proficiency in the duties required in this program, and shall introduce new or revised procedures, as necessary, for compliance with this program.

B. General Training

All employees who will enter confined spaces shall be trained in entry procedures. Personnel responsible for supervising, planning, entering, or

participating in confined space entry and rescue shall be adequately trained in their functional duties prior to any confined space entry. Training shall include:

1. Explanation of the general hazards associated with confined spaces.
2. Discussion of specific confined space hazards associated with the facility, location, or operation.
3. Reason for, proper use, and limitations of personal protective equipment and other safety equipment required for entry into confined spaces.
4. Explanation of permits and other procedural requirements for conducting a confined space entry.
5. A clear understanding of what conditions would prohibit entry.
6. Procedures for responding to emergencies.
7. Duties and responsibilities of the confined space entry team.
8. Description of how to recognize symptoms of overexposure to probable air contaminants in themselves and co-workers, and method(s) for alerting the Attendant(s).

Refresher training shall be conducted as needed to maintain employee competence in entry procedures and precautions.

C. Specific Training

1. Training for atmospheric monitoring personnel shall include proper use of monitoring instruments, including instruction on the following:

a. proper use of the equipment;
b. calibration of equipment;
c. sampling strategies and techniques; and
d. exposure limits (PELs, TLVs, LELs, UELs, etc.).

2. Training for Attendants shall include the following:

a. procedures for summoning rescue or other emergency services; and
b. proper utilization of equipment used for communicating with entry and emergency/rescue personnel.

3. Training for Emergency Response Personnel shall include:

a. rescue plan and procedures developed for each type of confined space that is anticipated to be encountered;
b. use of emergency rescue equipment;
c. first aid and CPR techniques; and
d. work location and confined space configuration to minimize response time.

D. Verification of Training

Periodic assessment of the effectiveness of employee training shall be conducted by ***Responsible Person***. Training sessions shall be repeated as often as necessary to maintain an acceptable level of personnel competence.

V. IDENTIFICATION OF HAZARDS AND EVALUATION OF CONFINED SPACES

A. Survey

Responsible Person shall ensure a survey of the worksite is conducted to identify confined spaces. This survey can be partially completed from initial and continuing site characterizations, as well as other available data (i.e., blueprints and job safety analyses). The purpose of the survey is to develop an inventory of those locations and/or equipment at ***Company Name*** that meet the definition of a confined space. This information shall be communicated to personnel, and appropriate confined space procedures shall be followed prior to entry. The initial surveys shall include air monitoring to determine the air quality in the confined spaces. The potential for the following situations shall be evaluated by ***Responsible Person***:

1. flammable or explosive potential;
2. oxygen deficiency; and
3. presence of toxic and corrosive material.

B. Hazard Reevaluation

The ***Responsible Person*** shall identify and reevaluate hazards based on possible changes in activities or other physical or environmental conditions that could adversely affect work. A master inventory of confined spaces shall be maintained.

Any change in designation of a confined space will be routed to all affected personnel by ***Responsible Person***.

C. Pre-Entry Hazard Assessment

A hazard assessment shall be completed by ***Responsible Person(s)*** prior to any entry into a confined space. The hazard assessment should identify:

1. the sequence of work to be performed in the confined space;
2. the specific hazards known or anticipated; and
3. the control measures to be implemented to eliminate or reduce each of the hazards to an acceptable level.

No entry shall be permitted until the hazard assessment has been reviewed and discussed by all persons engaged in the activity. Personnel who are to enter confined spaces shall be informed of known or potential hazards associated with said confined spaces.

D. Hazard Controls

Hazard controls shall be instituted to address changes in the work processes and/or working environment. Hazard controls must be able to either control the health hazards by eliminating the responsible agents, reduce health hazards below harmful levels, or prevent the contaminants from coming into contact with the workers.

The following order of precedence shall be followed in reducing confined space risks.

1. Engineering Controls

Engineering controls are those controls that eliminate or reduce the hazard through implementation of sound engineering practices.

Ventilation is one of the most common engineering controls used in confined spaces. When ventilation is used to remove atmospheric

contaminants from a confined space, the space shall be ventilated until the atmosphere is within the acceptable ranges. Ventilation shall be maintained during the occupancy if there is a potential for the atmospheric conditions to move out of the acceptable range. When ventilation is not possible or feasible, alternate protective measures or

methods to remove air contaminants and protect occupants shall be determined by ***Responsible Person*** prior to authorizing entry. When conditions necessitate and can accommodate continuous forced air ventilation, the following precautions shall be followed:

a. Employees shall not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.
b. Forced air ventilation shall be directed so as to ventilate the immediate areas where an employee is or will be present within the space.
c. Continuous ventilation shall be maintained until all employees have left the space.
d. Air supply or forced air ventilation shall originate from a clean source.

2. Work Practice (Administrative) Controls

Work practice (administrative) controls are those controls which eliminate or reduce the hazard through changes in the work practices (i.e., rotating workers, reducing the amount of worker exposure, and housekeeping).

3. Personal Protective Equipment (PPE)

If the hazard cannot be eliminated or reduced to a safe level through engineering and/or work practice controls, PPE should be used. ***Responsible Person(s)*** shall determine the appropriate PPE needed by all personnel entering the confined space, including rescue teams. PPE that meets the specifications of applicable standards shall be selected in accordance with the requirements of the job to be performed.

VI. ENTRY PERMITS

The Confined Space Entry Permit is the most essential tool for assuring safety during entry in confined spaces with known hazards, or with unknown or potentially hazardous atmospheres. The entry permit process guides the supervisor and workers through a systematic evaluation of the space to be entered. The permit should be used to establish appropriate conditions. Before each entry into a confined space, an entry permit will be completed by ***Responsible Person***. The ***Responsible Person*** will then communicate the contents of the permit to all employees involved in the operation, and post the permit

conspicuously near the work location. A standard entry permit shall be used for all entries.

A. Key Elements of Entry Permits

A standard entry permit shall contain the following items:

1. Space to be entered.
2. Purpose of entry.
3. Date and authorized duration of the entry permit.
4. Name of authorized entrants within the permit space.
5. Means of identifying authorized entrants inside the permit space (i.e., rosters or tracking systems).
6. Name(s) of personnel serving as Attendant(s) for the permit duration.
7. Name of individual serving as Entry Supervisor, with a space for the signature or initials of the Entry Supervisor who originally authorized the entry.
8. Hazards of the permit space to be entered.
9. Measures used to isolate the permit space and to eliminate or control permit space hazards before entry (i.e., lockout/tagout of equipment and procedures for purging, ventilating, and flushing permit spaces).
10. Acceptable entry conditions.
11. Results of initial and periodic tests performed, accompanied by the names or initials of the testers and the date(s) when the tests were performed.
12. Rescue and emergency services that can be summoned, and the means of contacting those services (i.e., equipment to use, phone numbers to call).
13. Communication procedures used by authorized entrants and Attendant(s) to maintain contact during the entry.
14. Equipment to be provided for compliance with this Confined Space Program (i.e., PPE, testing, communications, alarm systems, and rescue).
15. Other information necessary for the circumstances of the particular confined space that will help ensure employee safety.
16. Additional permits, such as for hot work, that have been issued to authorize work on the permit space.

B. Permit Scope and Duration

A permit is only valid for one shift. For a permit to be renewed, the following conditions shall be met before each reentry into the confined space:

1. Atmospheric testing shall be conducted and the results should be within acceptable limits. If atmospheric test results are not within acceptable limits, precautions to protect entrants against the hazards should be addressed on the permit and should be in place.
2. Responsible Person shall verify that all precautions and other measures called for on the permit are still in effect.
3. Only operations or work originally approved on the permit shall be conducted in the confined space.

A new permit shall be issued, or the original permit will be reissued if possible, whenever changing work conditions or work activities introduce new hazards into the confined space. ***Responsible Person*** shall retain each canceled entry permit for at least one (1) year to facilitate the review of the Confined Space Entry Program. Any problems encountered during an entry operation shall be noted on the respective permit(s) so that appropriate revisions to the confined space permit program can be made.

VII. ENTRY PROCEDURES

When entry into a confined space is necessary, either the Entry Supervisor or ***Responsible Person*** may initiate entry procedures, including the completion of a confined space entry permit. Entry into a confined space shall follow the standard entry procedure below.

A. Prior to Entry

The entire confined space entry permit shall be completed before a standard entry. Entry shall be allowed only when all requirements of the permit are met and it is reviewed and signed by an Entry Supervisor. The following conditions must be met prior to standard entry:

1. Affected personnel shall be trained to establish proficiency in the duties that will be performed within the confined space.
2. The internal atmosphere within the confined space shall be tested by ***Responsible Person*** with a calibrated, direct-reading instrument.
3. Personnel shall be provided with necessary PPE as determined by the Entry Supervisor.
4. Atmospheric monitoring shall take place during the entry. If a hazardous atmosphere is detected during entry:

a. personnel within the confined space shall be evacuated by the Attendant(s) or Entry Supervisor until the space can be evaluated

by ***Responsible Person*** to determine how the hazardous atmosphere developed; and
b. controls shall be put in place to protect employees before reentry.

B. Opening a Confined Space

Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed. When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent anyone from falling through the opening. This barrier or cover shall protect each employee working in the space from foreign objects entering the space. If it is in a traffic area, adequate barriers shall be erected.

C. Atmospheric Testing

Atmospheric test data is required prior to entry into a confined space. Atmospheric testing is required for two distinct purposes: (1) evaluation of the hazards of the permit space, and (2) verification that acceptable conditions exist for entry into that space. If a person must go into the space to obtain the needed data, then Standard Confined Space Entry Procedures shall be followed. Before entry into a confined space, ***Responsible Person*** shall conduct testing for hazardous atmospheres. The internal atmosphere shall be tested with a calibrated, direct-reading instrument for oxygen, flammable gases and vapors, and potential toxic air contaminants, in that order.

Testing equipment used in specialty areas shall be listed or approved for use in such areas by ***Responsible Person***. All testing equipment shall be approved by a nationally recognized laboratory, such as Underwriters Laboratories or Factory Mutual Systems.

1. Evaluation Testing

The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity. The analysis shall identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space. Evaluation and interpretation of these data and development of the entry procedure should involve a

technically qualified professional (i.e., consultant, certified industrial hygienist, registered safety engineer, or certified safety professional).

2. Verification Testing

A confined space that may contain a hazardous atmosphere shall be tested for residues of all identified or suspected contaminants. The evaluation testing should be conducted with specified equipment to determine that residual concentrations at the time or testing and entry are within acceptable limits. Results of testing shall be recorded by the person performing the tests on the permit. The atmosphere shall be periodically retested (frequency to be determined by ***Responsible Person***) to verify that atmospheric conditions remain within acceptable entry parameters.

3. Acceptable Limits

The atmosphere of the confined spaces shall be considered to be within acceptable limits when the following conditions are maintained:

a. oxygen: 19.5 percent to 23.5 percent;
b. flammability: less than 10 percent of the Lower Flammable Limit (LFL); and
c. toxicity: less than recognized American Conference of Governmental Industrial Hygienists (ACGIH) exposure limits or other published exposure levels [i.e., OSHA Permissible Exposure Limits (PELs) or National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs)].

D. Isolation and Lockout/Tagout Safeguards

All energy sources that are potentially hazardous to confined space entrants shall be secured, relieved, disconnected, and/or restrained before personnel are permitted to enter the confined space. Equipment systems or processes shall be locked out and/or tagged out as required by the ***Company Name*** Lockout/Tagout Program [which complies with OSHA's 29 CFR 1910-147 and American National Standards Institute (ANSI) Z244.1-1982, Lockout/Tagout of Energy Sources] prior to permitting entry into the confined space. In confined spaces where complete isolation is not possible, ***Responsible Person*** shall evaluate the situation and make provisions for as rigorous an isolation as practical. Special precautions shall be taken when entering double-walled, jacketed, or internally

insulated confined spaces that may discharge hazardous material through the vessel's internal wall.

Where there is a need to test, position, or activate equipment by temporarily removing the lock or tag or both, a procedure shall be developed and implemented to control hazards to the occupants. Any removal of locks, tags, or other protective measures shall be done in accordance with the ***Company Name*** Lockout/Tagout Program.

E. Ingress/Egress Safeguards

Means for safe entry and exit shall be provided for confined spaces. Each entry and exit points shall be evaluated by ***Responsible Person*** to determine the most effective methods and equipment that will enable employees to safely enter and exit the confined space.

Appropriate retrieval equipment or methods shall be used whenever a person enters a confined space. Use of retrieval equipment may be waived by the ***Responsible Person(s)*** if use of the equipment increases the overall risks of entry or does not contribute to the rescue. A mechanical device shall be available to retrieve personnel from vertical confined spaces greater than five (5) feet in depth.

F. Warning Signs and Symbols

All confined spaces that could be inadvertently entered shall have signs identifying them as confined spaces. Signs shall be maintained in a legible condition. The signs shall contain a warning that a permit is required before entry. Accesses to all confined spaces shall be prominently marked.

VIII. EMERGENCY RESPONSE

A. Emergency Response Plan

Responsible Person shall maintain a written plan of action that has provisions for conducting a timely rescue of individuals within a confined space, should an emergency arise. The written plan shall be kept onsite where the confined space work is being conducted. All affected personnel shall be trained on the Emergency Response Plan.

B. Retrieval Systems and Methods of Non-Entry Rescue

Retrieval systems shall be available and ready when an authorized person enters a permit space, unless such equipment increases the overall risk of entry, or the

equipment would not contribute to the rescue of the entrant. Retrieval systems shall have a chest or full-body harness and a retrieval line attached at the center of the back near shoulder level or above the head. If harnesses are not feasible, or would create a greater hazard, wristlets may be used in lieu of the harness. The retrieval line shall be firmly fastened outside the space so that rescue can begin as soon as anyone is aware that retrieval is necessary. A mechanical device shall be available to retrieve personnel from vertical confined spaces more than five (5) feet deep.

ATTACHMENT

Sample Process Duty Roster

Process: Tank Steam/Wash Rack	
Entry Supervisor	**Entrants**

1. Upon receipt of a tank for cleaning, do a visible check for product. If product is visible in the tank, then the tank will be refused. 2. Complete and attach certification and danger tag to tank. 3. Provide confined space entry permit for the tank. 4. Verify that entrants have proper training and knowledge of known hazards, including the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure.	1. Purge tanks with cold water prior to steam cleaning. 2. Obtain the confined space entry permit and authorized signature. 3. Complete a safe entry checklist prior to entering the confined space. 4. Fill out and attach the caution tag after tank is purged and cleaned. 5. Know space hazards, including information on the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure. 6. Use the correct personal protective equipment (PPE) properly. 7. Maintain communication with standby person to enable them to monitor entrant's actions and alert the entrant to evacuate if necessary. 8. Exit from permit space as soon as possible: when ordered to by authorized persons; when entrant notices or recognizes the signs or symptoms of exposure; when a prohibited condition exists; and/or when the automatic alarm system sounds. 9. Alert the standby person when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.
Process: Tank Maintenance	
Entry Supervisor	**Entrants**

1. Upon receipt of a tank for maintenance, do a visible check for product. If product is visible in the tank, then the tank will be refused. 2. Complete and attach certification and danger tag to tank. 3. Provide confined space entry permit for the tank. 4. Verify that entrants have proper training and knowledge of known hazards, including the mode of exposure (how it gets into the body), signs or symptoms, and the results of exposure.	1. Prior to moving any tank into the maintenance bay, ensure tank has been cleaned and/or purged per attached caution tag, test atmosphere, and record results on hot tag. (Tank will not be moved into bay until the atmosphere has been tested and is determined to be within acceptable limits.) 2. In bay, if work will require confined space entry, obtain confined space entry permit from the Service Writer. 3. Obtain the confined space entry permit and the authorized signatures. 4. Complete the safe entry checklist prior to confined space entry. 5. Know space hazards, including information on the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure. 6. Use the correct personal protective equipment (PPE) properly. 7. Maintain communication with standby person to enable them to monitor the entrant's actions and alert the entrant to evacuate if necessary. 8. Exit from permit space as soon as possible: when ordered to by authorized persons; when entrant notices or recognizes signs or symptoms of exposure; when a prohibited condition exists; and/or when the automatic alarm system sounds. 9. Alert the standby person when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.

A. Date of Entry		B. Location	
C. Time Issued		D. Expiration Date	
E. Employee Assigned to Enter			
F. Person In Charge		Position	
G. Description of known hazards present in confined space			

	Required		Completed	
	Yes	No	Yes	No
H. Atmospheric test before and during				
1. Oxygen (19.5% to 23%)				
2. Hydrogen Sulfide gas (below 10ppm)				
3. Explosive gases (less than 10% LEL)				
I. Designated person performing testing				
J. Protective equipment for entry and rescue				
1. Harness and lifeline on person entering and tied off or secured				
2. Worker wearing monitor				
3. Worker wearing proper respirator protection				
4. SCBA (5min or more) with worker				
5. Spare harness and lifeline with observer				
6. Spare SCBA (15min or more) with observer				
7. Ventilation Equipment				
K. Description of any additional hazards that may be expected to be generated by the entrance activities in the space and action taken to correct condition				
L. Special work practices to be followed				
1. Communication signals reviewed				
2. Emergency procedures understood				
M. Ventilate before and during				

Personnel involved in this entry have received instructions on safety procedures and hazards of this job and the permit is complete

_____

Signature of Person in Charge

_____

Signature of Person(s) assigned to enter

Process: Tank Maintenance	
Entry Supervisor	**Entrants**
1. Upon receipt of a tank for maintenance, do a visible check for product. If product is visible in the tank, then the tank will be refused. 2. Complete and attach certification and danger tag to tank. 3. Provide confined space entry permit for the tank. 4. Verify that entrants have proper training and knowledge of known hazards, including the mode of exposure (how it gets into the body), signs or symptoms, and the results of exposure.	1. Prior to moving any tank into the maintenance bay, ensure tank has been cleaned and/or purged per attached caution tag, test atmosphere, and record results on hot tag. (Tank will not be moved into bay until the atmosphere has been tested and is determined to be within acceptable limits.) 2. In bay, if work will require confined space entry, obtain confined space entry permit from the Service Writer. 3. Obtain the confined space entry permit and the authorized signatures. 4. Complete the safe entry checklist prior to confined space entry. 5. Know space hazards, including information on the mode of exposure (how it gets into the body), signs or symptoms, and results of exposure. 6. Use the correct personal protective equipment (PPE) properly. 7. Maintain communication with standby person to enable them to monitor the entrant's actions and alert the entrant to evacuate if necessary. 8. Exit from permit space as soon as possible: when ordered to by authorized persons; when entrant notices or recognizes signs or symptoms of exposure; when a prohibited condition exists; and/or when the automatic alarm system sounds. 9. Alert the standby person when a prohibited condition exists and/or when warning signs or symptoms of exposure exist.

**** Written Energy Control Procedure for Equipment Lockout Tagout****
**** Written Procedure for working in Confined Space****

Company:
Location:
Date:
Equipment:
Task:
Project Manager:
Emergency Response Instructions:

Emergency Response Telephone Numbers:
Fire Department: Ambulance: Supervisor:

Select all that apply

X	Procedure Category	Suggested Equipment/Permits/Training	⇩	⇩
☐	*Safety Tools*	Permit		
☐		Buddy System		
☐		Coveralls		
☐		Eye/Ear Protection		
☐		Radio		
☐		SCBA		
☐		Respirator		
☐		Air Quality Monitor		
☐		Harness with line		
☐		Scaffold		
☐		Fall Protection		
☐		ARC Flash PPE		
☐				
☐				
☐	*Permitted Confined Space*	High Temperature Stress		
☐		Air Quality		
☐		Venting or Exhaust Fan locked on		
☐		Damper position locked		
☐		Oxygen Depletion, Welding		
☐				
☐				
☐				
☐	*ARC Flash Prevent & Protect*	ARC Flash training up to date and verified		
☐		Verify correct ARC Flash PPE available		
☐		Electrical LOTO verified		
☐				

X	Lockout Category		Suggested Lockouts Specify Order ⇨	Lock	Un-Lock
☐	***Electrical***	1	Baghouse Drags, Motor Circuit Breaker		
☐		2	Baghouse Augers, Motor Circuit Breaker		
☐		3	Baghouse Airlocks, Motor Circuit Breaker		
☐		4	Baghouse Pulsing Control		
☐		5	Burner		
☐		6	Air Compressor		
☐		7	Air Blower		
☐		8	Locking hasp on Motor Control Panel doors		
☐		9	Lockout main circuit breaker		
☐		10	Lock Control Room		
☐		11			
☐		12			
☐		13			
☐		14			
☐		15			
☐		16			
☐	***Gravity***	1	Pulse bags down		
☐		2			
☐		3			
☐	***Pneumatic***	1	Secure Exit Doors Open		
☐		2	Bleed Manifold to Pulse Valves/Compartment Doors		
☐	***Mechanical***	1			
☐		2			
☐		3			
☐	***Hydraulic***	1			
☐		2			
☐	***Thermal***	1	Lockout Manual Fuel Valve (Gas), Bleed Gas Lines		
☐		2	Lockout Pump (Fuel Oil and LP), Bleed Fuel Lines		

Procedure Explanation and Additional Comments:

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**** Written Energy Control Procedure for Equipment Lockout Tagout****
**** Written Procedure for working in Confined Space****

Company:
Location:
Date:
Equipment:
Task:
Project Manager:
Emergency Response Instructions:

Emergency Response Telephone Numbers:
Fire Department: Ambulance: Supervisor:

Select all that apply

X	Procedure Category	Suggested Equipment/Permits/Training	⇩	⇩
☐	*Safety Tools*			
☐				
☐				
☐				
☐				
☐				
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☐				
☐	*Permitted Confined Space*			
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐	*ARC Flash Prevent & Protect*			
☐				
☐				
☐				

X	Lockout Category		Suggested Lockouts Specify Order ⇨	Lock	Un-Lock
☐	***Electrical***	1			
☐		2			
☐		3			
☐		4			
☐		5			
☐		6			
☐		7			
☐		8			
☐		9			
☐		10			
☐		11			
☐		12			
☐		13			
☐		14			
☐		15			
☐		16			
☐	***Gravity***	1			
☐		2			
☐		3			
☐	***Pneumatic***	1			
☐		2			
☐	***Mechanical***	1			
☐		2			
☐		3			
☐	***Hydraulic***	1			
☐		2			
☐	***Thermal***	1			
☐		2			

Procedure Explanation and Additional Comments:

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**** Written Energy Control Procedure for Equipment Lockout Tagout****
**** Written Procedure for working in Confined Space****

Company: Anywhere Paving
Location: Earth
Date: Feb 30th 19 Never

Equipment: Belt on Scale
Task: Resplice
Project Managr: Superman
Emergency Response Instruction : Call 911 1st then owner

Emergency Response Telephone Numbers:
Fire Department:911 Ambulance:911 Supervisor: 800-555-5497

Select all that apply

X	Procedure Category	Suggested Equipment/Permits/Training	⇩	⇩
☐	*Safety Tools*			
☐	Safety Googles			
☐	Gloves			
☐	Hardhats			
☐	Safety Boots			
☐	Padlocks			
☐				
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☐				
☐				
☐	*Permitted Confined Space*			
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☐	*ARC Flash Prevent & Protect*			
☐				
☐				
☐				

X	Lockout Category		Suggested Lockouts Specify Order ⇨	Lock	Un-Lock
☐	***Electrical***	1	incline scale belt		
☐		2	slinger belt		
☐		3	feeder belt collecting belt		
☐		4	scalping screen		
☐		5			
☐		6			
☐		7			
☐		8			
☐		9			
☐		10			
☐		11			
☐		12			
☐		13			
☐		14			
☐		15			
☐		16			
☐	***Gravity***	1	Lock out gravity takeup		
☐		2			
☐		3			
☐	***Pneumatic***	1	scale belt test wieghts		
☐		2			
☐	***Mechanical***	1			
☐		2			
☐		3			
☐	***Hydraulic***	1			
☐		2			
☐	***Thermal***	1			
☐		2			

Procedure Explanation and Additional Comments:

☐	Geather belt splice tools		
☐	Lockout takeup after all el lockout done TEST to make sure lockouts work!		
☐	Pickbelt up on wind gaurd and put plywood under it to work		
☐	Splice belt		
☐	pickup belt splice tools		
☐	return belt to run position		
☐	put take up back on belt		
☐			
☐			
☐			
☐			

**** Written Energy Control Procedure for Equipment Lockout Tagout****
**** Written Procedure for working in Confined Space****

Company:
Location:
Date:
Equipment:
Task:
Project Manager:
Emergency Response Instructions:

Emergency Response Telephone Numbers:
Fire Department: Ambulance: Supervisor:

Select all that apply

X	Procedure Category	Suggested Equipment/Permits/Training	⇩	⇩
☐	*Safety Tools*	Permit		
☐		Buddy System		
☐		Coveralls		
☐		Eye/Ear Protection		
☐		Radio		
☐		SCBA		
☐		Respirator		
☐		Air Quality Monitor		
☐		Harness with line		
☐		Scaffold		
☐		Fall Protection		
☐		ARC Flash PPE		
☐				
☐				
☐	*Permitted Confined Space*	High Temperature Stress		
☐		Air Quality		
☐		Venting or Exhaust Fan locked on		
☐		Damper position locked		
☐		Oxygen Depletion, Welding		
☐				
☐				
☐				
☐	*ARC Flash Prevent & Protect*	ARC Flash training up to date and verified		
☐		Verify correct ARC Flash PPE available		
☐		Electrical LOTO verified		
☐				

X	Lockout Category		Suggested Lockouts Specify Order ⇨	Lock	Un-Lock
☐	***Electrical***	1	Baghouse Drags, Motor Circuit Breaker		
☐		2	Baghouse Augers, Motor Circuit Breaker		
☐		3	Baghouse Airlocks, Motor Circuit Breaker		
☐		4	Baghouse Pulsing Control		
☐		5	Burner		
☐		6	Air Compressor		
☐		7	Air Blower		
☐		8	Locking hasp on Motor Control Panel doors		
☐		9	Lockout main circuit breaker		
☐		10	Lock Control Room		
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☐		13			
☐		14			
☐		15			
☐		16			
☐	***Gravity***	1	Pulse bags down		
☐		2			
☐		3			
☐	***Pneumatic***	1	Secure Exit Doors Open		
☐		2	Bleed Manifold to Pulse Valves/Compartment Doors		
☐	***Mechanical***	1			
☐		2			
☐		3			
☐	***Hydraulic***	1			
☐		2			
☐	***Thermal***	1	Lockout Manual Fuel Valve (Gas), Bleed Gas Lines		
☐		2	Lockout Pump (Fuel Oil and LP), Bleed Fuel Lines		

Procedure Explanation and Additional Comments:

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