ENGEL INDUSTRIE'S
HIGH SPEED STUD LINE

INSTALLATION, OPERATION & MAINTENANCE MANUAL

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TRADEMARK NOTICES

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HIGH SPEED STUD LINE

1. INTRODUCTION

The Engel high speed stud line produces a variety of steel studs and tracks produced with galvanized mild steel from 20 to 26 gauge material, for the construction industry. This line is also equipped with a set of forming rolls used to produce the furring channel. A third set of rolls is also available as an option to produce a 90° stiffener angle.

The high speed line runs at 150 feet per minute and is equipped with a freestanding hydraulic system and a buffered pneumatic system. The entire processor line consists of a decoiler, feed tables, straightener, flying notcher, flying shear, and rollformer.

Figure 1-1 High Speed Stud Line

Several stud and tracks sizes are available, depending upon strip width:

	WIDTH	STRIP WIDTH
STUD OUTSIDE *****Stud material widths add 2.75" to desired outside width.	2.500"	5.250"
	3.625"	6.375"
	6.000"	8.750"
TRACK OUTSIDE ******Track material widths add 2.11" to desired outside width.	2.500"	4.610"
	3.625"	5.735"
	6.000"	8.110"
FURRING CHANNEL	2.750"	4.359"

Machine dimensions are approximately 16' x 6' plus de-coiling and loop area. The overall, length is approximately 28' to 26' depending on de-coiler and loop area.

A. INSTALLATION

In selecting a location for the line, consider these factors:

- Working weight (including oil tank filled to capacity)in relation to the building structure for proper support
- Access to the selected location where the machine will be installed
- An adequate area to allow sufficient working space around the machine (a clearance of at least 3 feet or 914 mm) for proper ventilation and maintenance.

Some thought should also be given to availability of the required power source (refer to the electrical drawing shipped with the machine or in the back of the manual). The machine should also be located away from grinding machines, sanding machines, spray painting areas and other sources of contamination if practical.

Answers to questions regarding site preparation and other technical assistance is available free of charge via telephone between the hours of 8 AM and 4:30 PM CST Monday through Friday by calling the Customer Service Department at 314-638-0100.

(1) Unpacking The Machine

When the machine arrives, inspect it carefully before accepting the shipment. It is important to note any damage on the Bill of Lading or other shipping documents so that a claim can be filed with the carrier.

Pay special attention to the control console, because it contains delicate electronic devices. Check for physical damage to the switches and the components inside. If anything looks damaged, notify both the carrier (to file a claim) and our Customer Service Department (to order replacement parts). It is important to notify the factory promptly so the new parts arrive before the machine is installed, as it may not be possible to start up and run the machine without them.

Normal procedures should be used to unpack the machine. Remove any covering, steel strapping or skids that may be present. Remove all wooden blocks (used as spacers to prevent movement of the machine parts during shipment). After inspection and unpacking, prepare to move the machine into position, using the floor layout drawing in the back of this manual. This can be done with a fork truck or overhead crane. Next, set the decoiler into position. Once the equipment is in position, fill the hydraulic tank with Mobile Dte 25 hydraulic oil (or equivalent) and make the necessary electrical connections between the units. Then bring in the required power source to the main control console. When doing the electrical hookups, refer to the electrical drawings supplied with the equipment if necessary.

To safely operate this machinery, all personal must read and understand the safety section of this manual. Study and follow the safety precautions in this section, which are intended to prevent injury to you and your fellow workers. However, they cannot cover all possible situations. Therefore, consider the consequences of your actions before executing any procedure or operation.

B. SAFETY

(1) Safety Precautions (Before Starting The Machine)

- Protect yourself. Wear safety glasses and leather gloves while handling the material. Do not wear loose clothing, neckties, or jewelry. If long sleeves must be worn, avoid cuffs and buttons.

- Keep your work area clean. Remove all scrap, oil spills, rags, tools, and any other loose items that could cause you to slip, trip, or fall.
- Make sure that hydraulic pressures are at specified levels before operating the machine.
- Be alert for loose, worn, or broken parts. Do not attempt to operate the machine with such parts present, or if the machine is making unusual noises or actions.
- Be sure that this manual is kept near the machine so the operator can refer to it when necessary. If you have not already done so, study the manual before operating the machine.
- Be aware of the location of the POWER OFF push-button as well as the Emergency Stop push-button and use them to stop the machine in emergencies.

(2) Safety Precautions (While Operating The Machine)

- Be alert when operating the machine.
- Only one person should control the machine. Never allow anyone to operate the controls while you are working on the machine.
- Remove all Power and tag and lock it out any time someone is working on or repairing the machine.
- Keep your arms and hands away from the internal workings of the machine when starting, running, or stopping the machine.
- Never leave the work area while the machine is running.
- Use good quality metal coils free of damaged or mashed ends.
- Continually observe the punching, shearing, and rollforming of the metal and monitor the machine. If any unusual condition develops, immediately stop the machine and investigate.
- Do not work on any moving device without first powering down the machine and taking every safety precaution.
- When cleaning the machine, or any components, do not use toxic or flammable substances. Do not perform any cleaning while the machine is running. Never override or disable any safety switch or safety interlock.
- Use proper size wrenches and tools. Do not use adjustable crescent wrenches or worn wrenches. A slipping wrench can cause a serious injury. Replace worn nuts, bolts, screws, etc., being sure they are of equivalent quality of those being replaced.
- Use caution when using an air hose to clean in and around the machine. Air pressure may drive dirt and small chips into bearing surfaces or cause bodily injury.

2. SYSTEM OVERVIEW

A. DECOILER

The M-6000-EXM24-HB Decoiler is the standard model typically purchased with the High Speed Stud Line. This is optional because it's always possible that you, the customer, will already have a decoiler that will be sufficient or you may require a decoiler with more capacity. If a different type decoiler is ordered, refer to the decoiler section toward the back of this manual or to the manual supplied with the decoiler from the manufacturer.

Figure 2-1 Decoiler Assembly

The standard M-6000-EXM24-HB has a capacity for 6000LB (2722kg) coils with a maximum coil outside diameter of 72 inches (1829mm). The coil inside diameter can be from 18 inches (457mm) to 22 inches (559mm).

(1) Electrical & Hydraulic Controls

The control panel for the M-6000-EXM24-HB is located on the backside of the Decoiler. In addition, a single manually actuated valve is located below the electrical panel, which is used to control the expansion and contraction of the mandrel.

Refer to the Controls section of this manual for a complete list and details of the electrical controls.

(a) Hydraulic Controls

The M-6000-EXM24-HB Decoiler is equipped with its own hydraulic unit. A single, manually operated valve is used to control the expansion and retraction of the decoilers' arms.

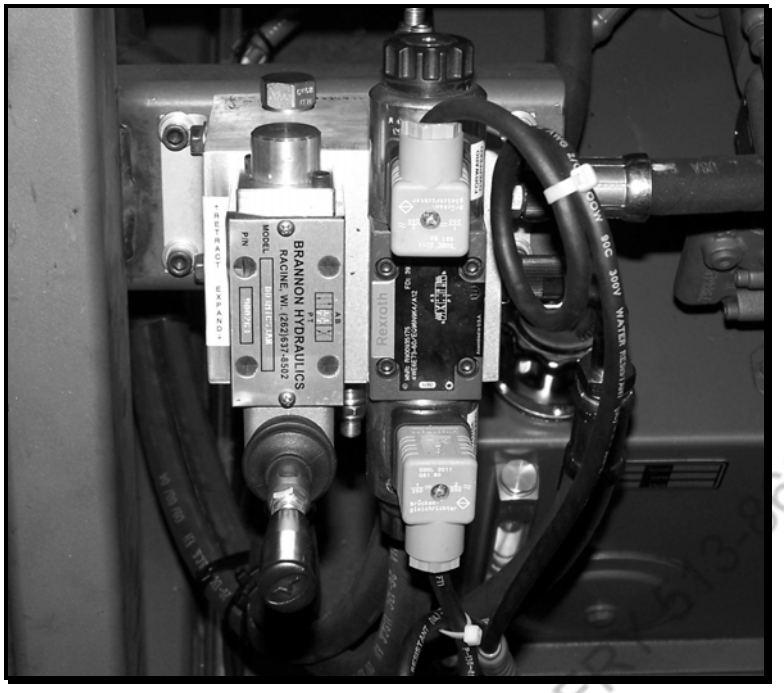


Figure 2-2 Decoiler Mandrel Control Valve

To utilize this valve, the decoilers' hydraulic unit must be activated. To expand the arms, raise up on the handle and to contract press down on the handle.

(2) Coil Loading

Before a coil can be loaded, ensure the coil is properly strapped for movement to the Decoiler and banded to prevent clock springing.

1. First, apply power to the decoilers' hydraulic unit and completely retract the arms with the Expand/Contract valve.
2. Then rotate the expansion arms, with the Forward or Reverse switches, to position them for easy loading.
3. With the leading end of the coil so the material will payoff the top, carefully slide the coil onto the mandrel until it touches the back-up plate.
4. Next, expand the arms into the inside of the coil until the coil is securely held.
5. Then, remove the banding from the coil, feed the leading edge under the payoff arm and begin the threading process into the processor.
6. Once the strip is securely held by the processor, place the Decoiler into Auto mode, to enable the loop to be controlled by the Decoiler.

⚠ CAUTION
Ensure proper eye, hand and foot protection is worn when handling any type of material.

B. PROCESSOR

The processor section of the M-200-FSA High Speed Stud machine consists of entry feed guides, straightener section, hole die, drive rolls, shear cutoff die and exit feed guides.

A pneumatic reserve tank is located at the entrance end of the processor, which supplies a buffered reserve of air for the hole die and cutoff die travel cylinders. The hydraulic system is used to power the hole and cutoff dies, along with the processor drive system.

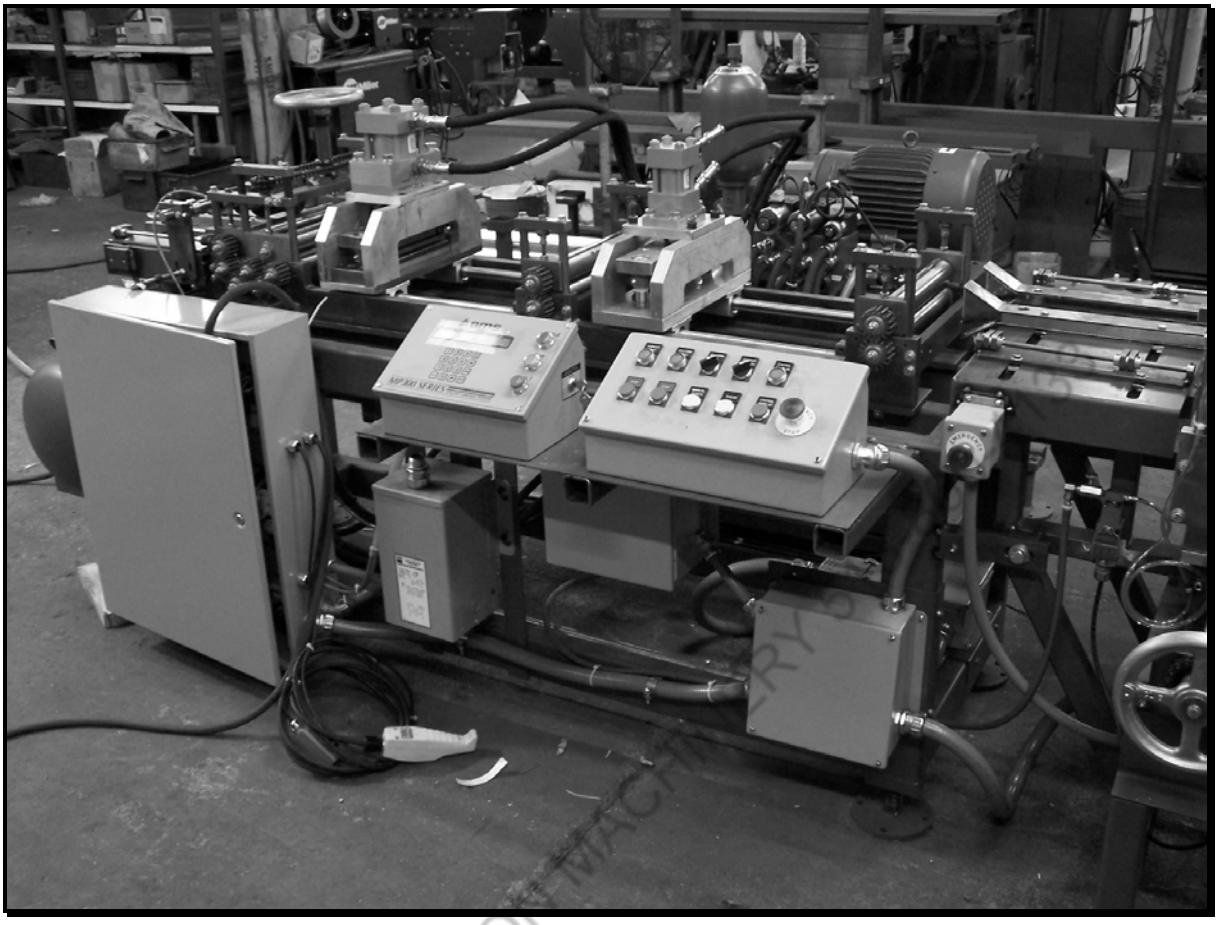


Figure 2-3 Processor Assembly *(Guards removed for clarity)*

(1) Entry Feed Guides

Two steel guides are located at the entrance end of the processor. Both guides are adjustable and is setup using the flip over setup stops. Each guide has two sets of setup stops for the different material widths.

The guides should be as tight as possible without causing the metal to bind. If the guides are too loose, the metal may not track accurately through the machine. If the guides are too tight, a drag is placed on the material, which may cause it to slip in the pinch or feed rolls.

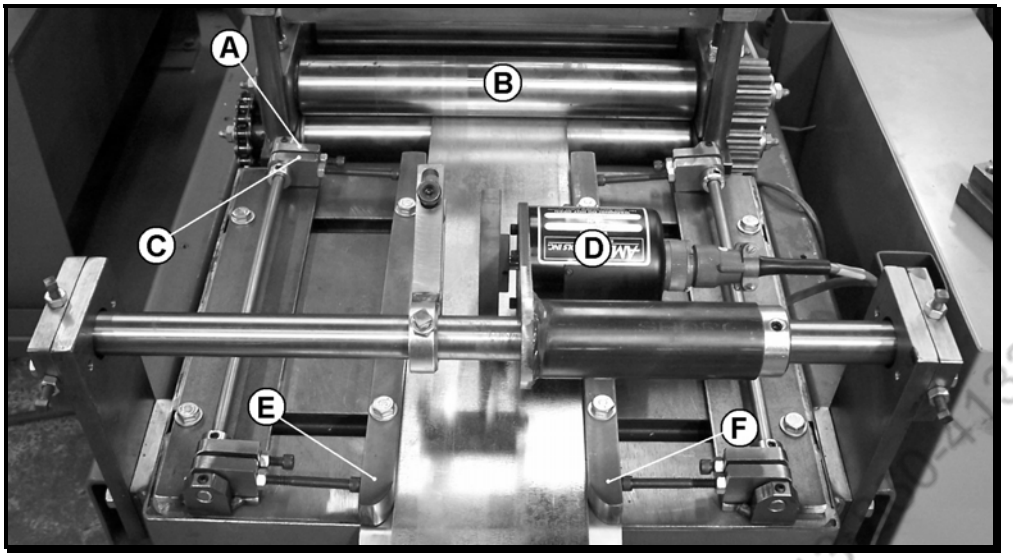


Figure 2-4 Feed Table Components

A	Wide material locator	**D**	Encoder
B	Entry pinch rolls	**E**	Left feed guide
C	Narrow material locator	**F**	Right feed guide

(a) Guide Changeover

When you change material widths, the guides must be setup to ensure the material tracks properly through the processor.

1. Ensure no material is in the processor and ALL power sources are shutoff and locked out.
2. Loosen the lock bolts (Item **B**) on both feed guides.
3. Flip the desired setup stops (4 stops) (Items **A**) into position and flip the others outward.
4. Slide each feed guide until they touch both setup stops.

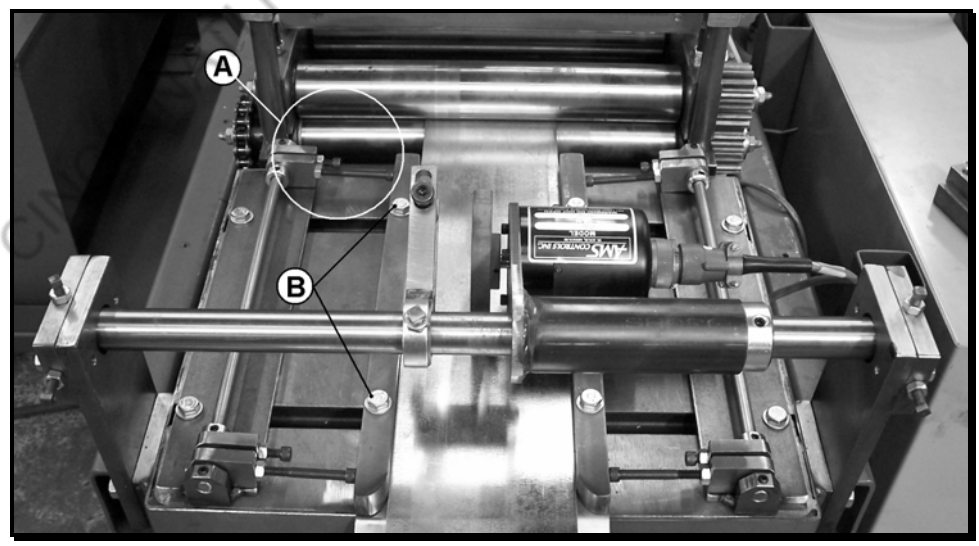


Figure 2-5 Feed Guide Changeover

5. While holding the feed guide against the stop, tighten the lock bolts.
6. Once the strip is slid between the feed guides, ensure the material tracks through the guides without binding or slop is noted. If the material is too tight or too loose, adjust both stops on one guide to ensure proper tracking of the strip.

(2) Straighter Section

Located just past the entry feed table (Item **C**) and the first set of pinch rolls (Item **E**), is a Straightening Roll (Item **D**) used to remove coil set from the material being processed. The Straightener is NOT designed to correct coil defects (such as: edge wave or camber).

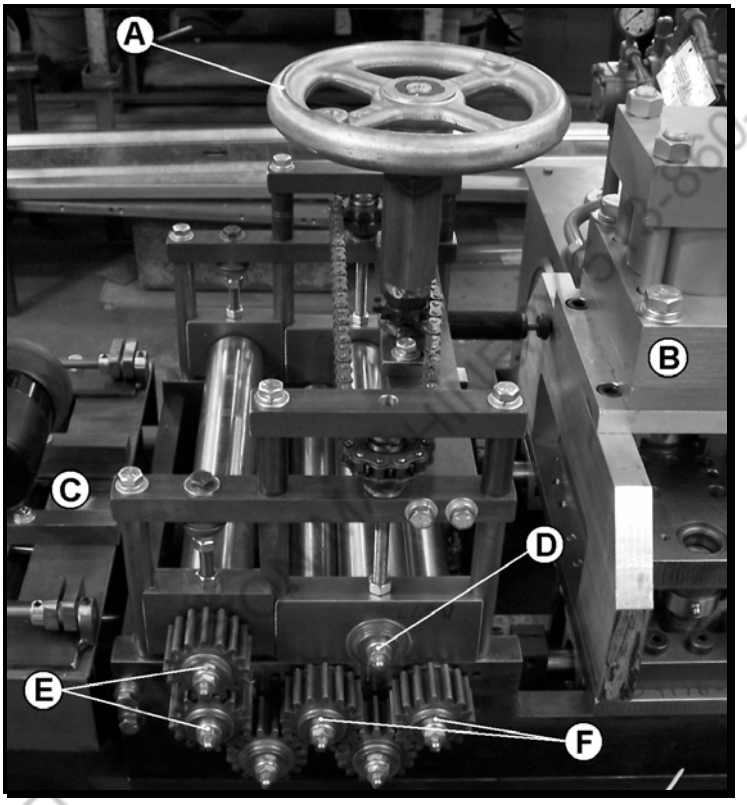


Figure 2-6 Straightener Section

The Straightener section consists of two powered drive rolls (Item **F**), and one independently adjustable non-powered straightening roll (Item **D**), used to correct coil set. This roll is adjusted up and down by a single hand-wheel (Item **A**). Once the material is straightened, the leading edge enters the Hole Punch die (Item **B**).

(3) Flying Hole Die

The Flying Hole Die is located between the Straightening section and the second set of pinch rolls. The hole die rides on two travel shafts and is positioned with a pneumatic cylinder and the die stroke is hydraulically actuated.

⚠ NOTE:
To prevent premature wear on the tooling, ensure the dies do NOT double punch over a previously punched area.

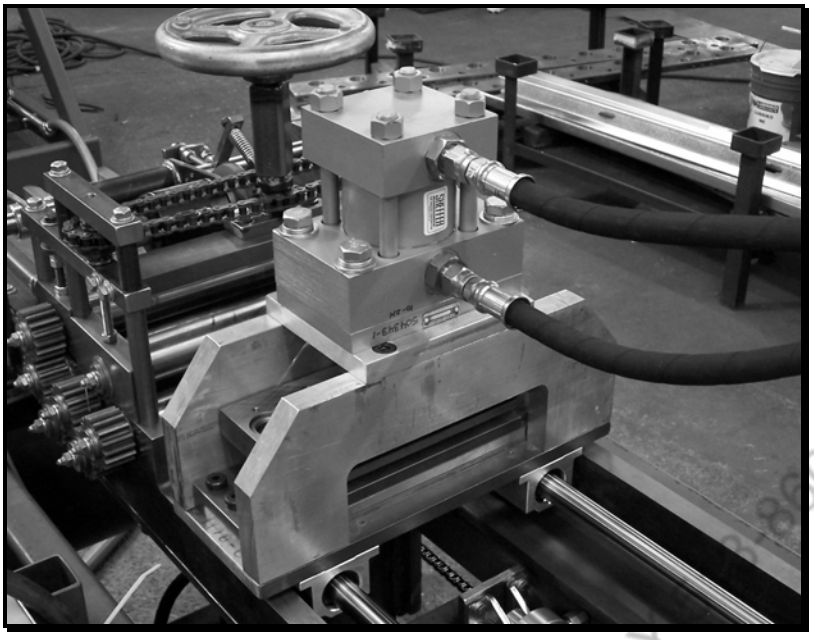
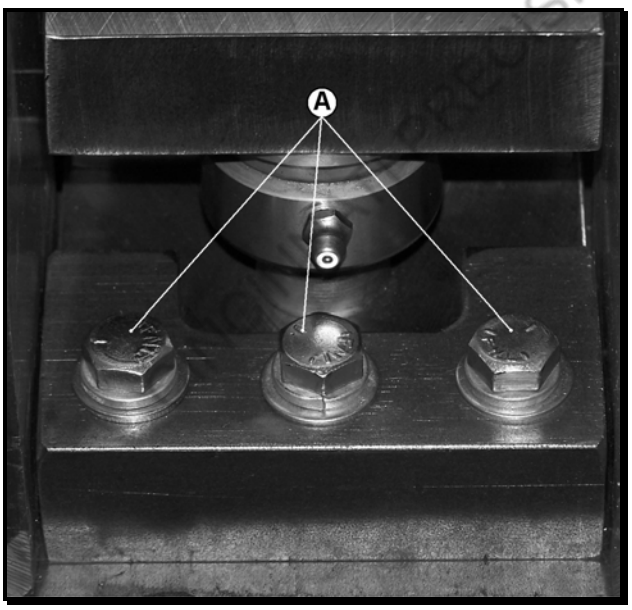


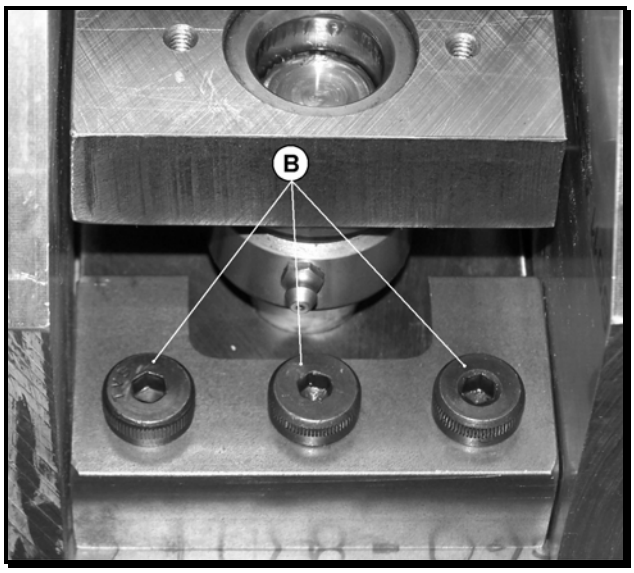
Figure 2-7 Hole Die Assembly

(a) Die Changeover

The Engel High Speed Stud machine is equipped with two access hole dies. The following is the recommended procedure for removing and installing a hole die.

1. *Ensure ALL power sources are shutoff and locked out*.
2. Remove processor guard to access hole die.
3. *Remove* mounting bolts (Item **A**) and *loosen* the shoulder bolts (Item **B**) on the opposite side.





4. Slide the die onto stable work bench.
5. Carefully slide new die facing the correct direction.
6. Tap the die firmly into place and secure with mounting bolts.

(4) Cutoff Die Assembly

The Cutoff Die Assembly is located between the second and third set of pinch rolls. The hole die rides on two travel shafts and is positioned with a pneumatic cylinder and the die stroke is hydraulically actuated.

> ⚠ **NOTE:**
> To prevent premature wear on the tooling, ensure the dies do NOT double punch over a previously punched area.

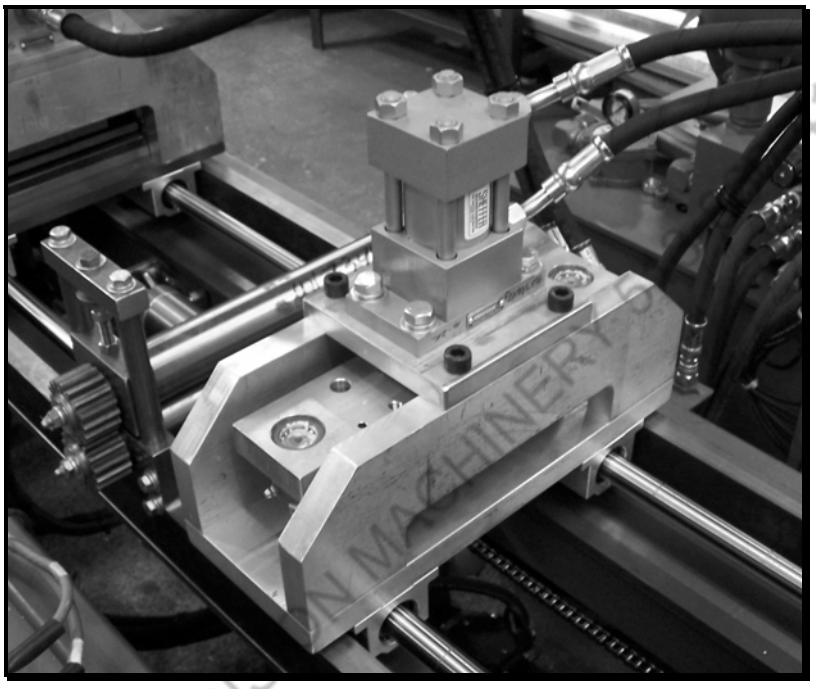


Figure 2-8 Cutoff Die Assembly

(5) Drive Rolls

The High Speed Stud Line has three sets of powered drive rolls throughout the line. The top roll is directly above the bottom roll and is held in contact with the bottom roll by spring washer pressure. The function of the drive rolls is to firmly grip the material between the top and bottom rolls while feeding the material through the machine.

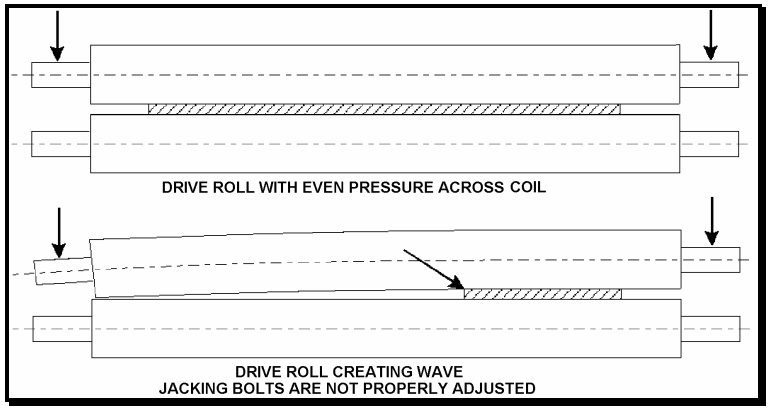


Figure 2-9 Typical Drive Rolls

Because of this strong hold down pressure being on the outside of the material edge, you may see stretching of the edge or what you will see is a wavy edge. To eliminate this condition, jacking bolts are provided under the roll supports on the ends of the top drive roll. These jacking bolts are adjusted down to lift the top roll, up. In this way, the top rolls are not allowed to exert their full force on the edge of the material, but enough pressure is exerted to hold the material. If the spring washer pressure on the end of the rolls were lessened, it could eliminate edge waving, but would also decrease the pressure holding the material and could allow the material to slip.

(a) Jacking Bolt Adjustment

1. Back the material out from between the rolls.
2. Loosen the lock nut (Item **B**) on each of the Jacking Bolts.
3. With a feeler gauge, raise or lower each side with the adjustment bolt (Item **A**) to obtain a gap of approximately .050 on the outboard ends of the rolls, which sets the gap in the center of the roll at approximately .015.

⚠ NOTE:
The preferred pre-gap is .005 less than the material thickness processing.

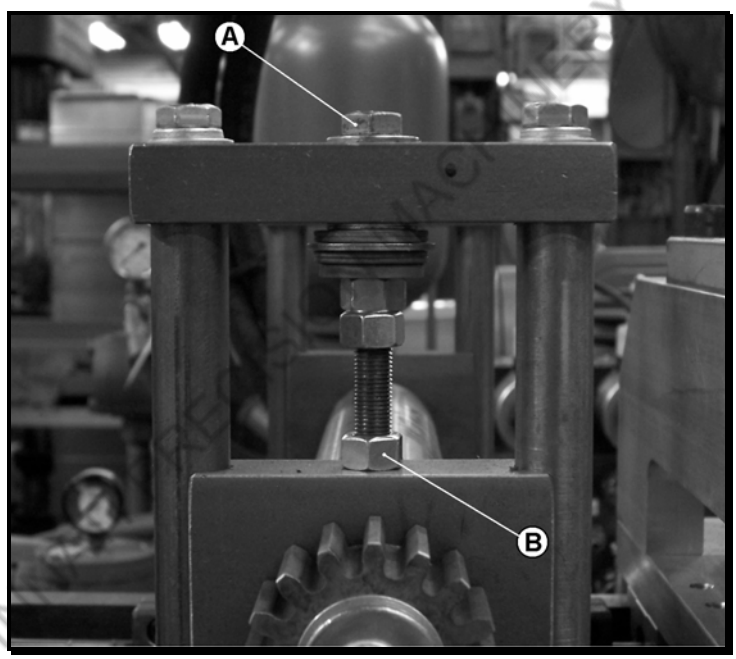


Figure 2-10 Jacking Bolt Adjustment

4. Tighten both lock nuts (Item **B**), and recheck gap to ensure the gap did not change while tightening the lock nuts.
5. If edge wave is present, the gap may need to be readjusted as needed. The exact amount of gap will have to be determined on a trial and error basis.

(6) Pneumatic System

The High Speed Stud Machine utilizes a buffered air system, to ensure adequate air is available during operation. The tank that contains the reserve air is located at the entrance end of the processor that feeds two regulators.

The regulators are used to control the travel pressure for the Hole Die (Item **A**) and Cutoff Die (Item **B**). The Hole regulator is set at approximately **30 PSI** and the Cutoff Die is set at approximately **40 PSI**.

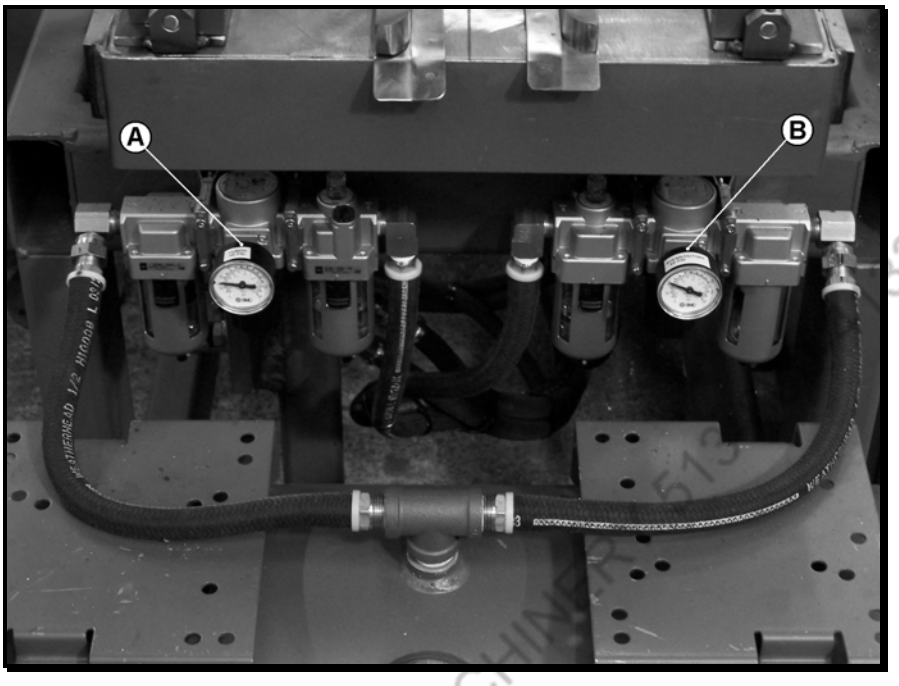


Figure 2-11 Pneumatic Components

The minimum air pressure required feeding the buffer tank is **70-90 PSI**. Failure to maintain adequate air pressure may cause inconsistent travel pressures, which leads to inaccurate parts.

(7) Hydraulic System

The High Speed Stud Line is equipped with a free standing hydraulic system, which is used to power the drive system of the processor and the die cylinders. Refer to the manufactures operation and maintenance manual for detailed information regarding this unit in the back of this manual.

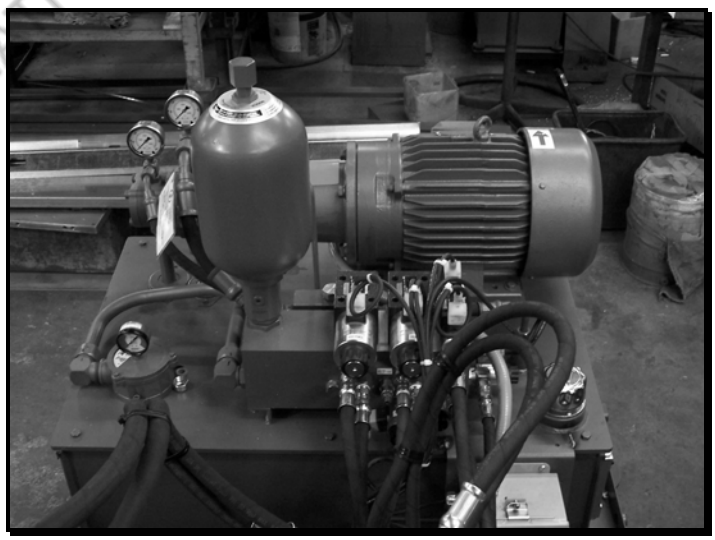


Figure 2-12 Hydraulic System

C. ROLLFORMER

The High Speed Stud machine utilizes a twelve station rollformer with two sets of forming rolls. One set is used for the production of studs and channels. The second is used for the production of furring channels. An optional set of rolls are available to produce a 90° stiffener angle. For more information regarding this option, please contact the Engel sales office.

A single set of rolls are used to produce a variety of studs and channels. The rolls are positioned with a hand wheel located on top of the forming rolls. To position the forming rolls from stud/channel rolls to the furring channel rolls, a hand wheel located on the side of the rollformer.

The forming rolls were factory pre-gapped and should require little or no adjustment. The pre-gap settings allow the production of various gauges, without any resetting roll gap.

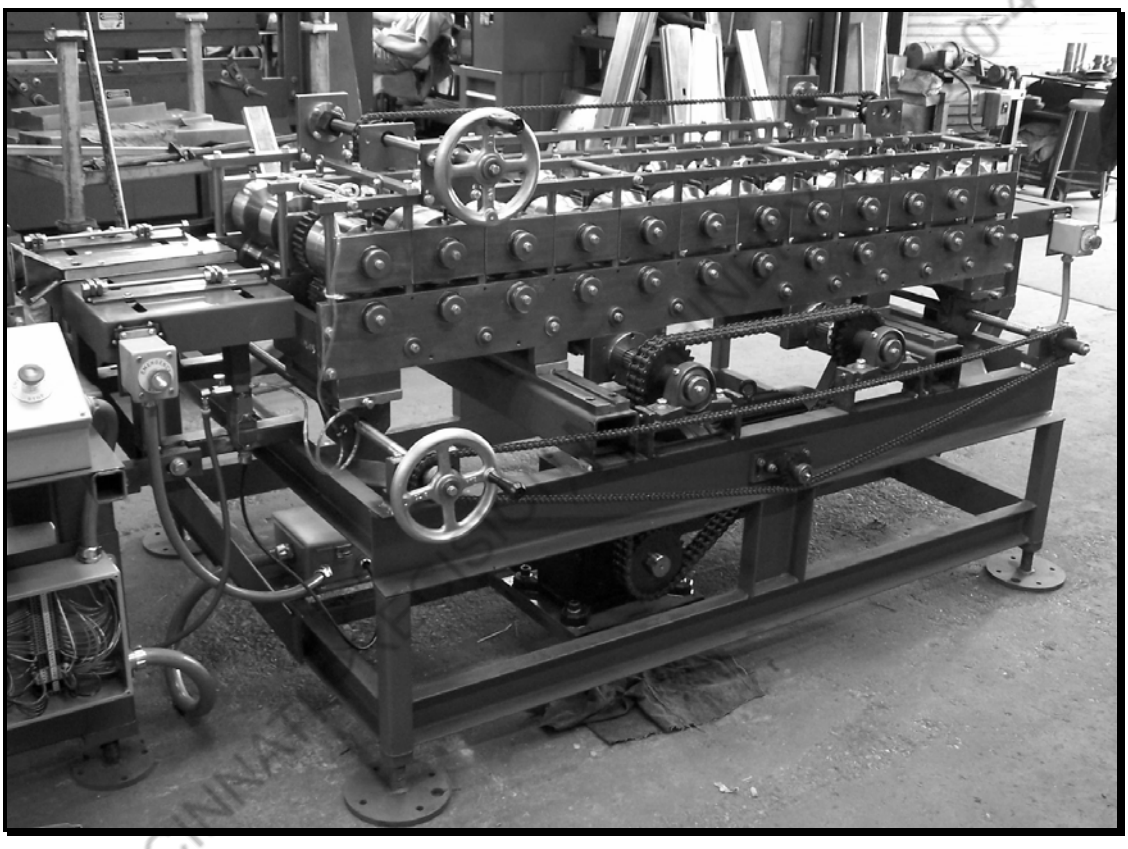


Figure 2-13 Rollformer Assembly

(1) Entry Feed Guides

Two steel guides are located at the entrance end of the rollformer. Both guides are adjustable and is setup using the flip over setup stops. Each guide has two sets of setup stops for the different material widths.

The guides should be as tight as possible without causing the metal to bind. If the guides are too loose, the metal may not track accurately through the machine. If the guides are too tight, a drag is placed on the material, which may cause it to slip in the pinch or feed rolls.

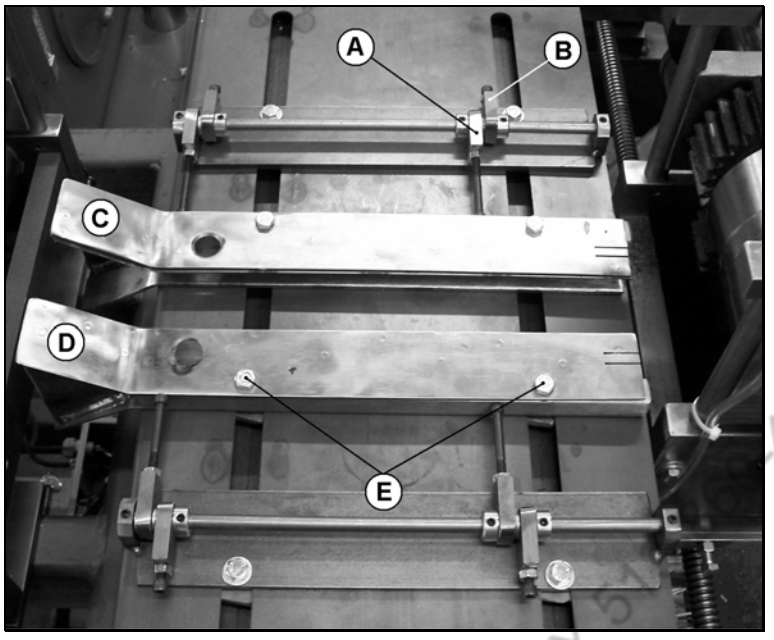


Figure 2-14 Rollformer Feed Table Components

A	Narrow material locator	**C**	Left feed guide
B	Wide material locator	**D**	Right feed guide
		E	Lock nuts

(a) Guide Changeover

When you change material widths, the guides must be setup to ensure the material tracks properly through the processor.

1. Ensure no material is in the processor and ALL power sources are shutoff and locked out.
2. Loosen the lock bolts (Item **E**) on both feed guides.
3. Flip the desired setup stops (4 stops) (Items **A OR B**) into position and flip the others outward.
4. Slide each feed guide (Items **C** & **D**) until they touch both setup stops.
5. While holding the feed guide against the stop, tighten the lock bolts.
6. Once the strip is slid between the feed guides, ensure the material tracks through the guides without binding or slop is noted. If the material is too tight or too loose, adjust both stops on one guide to ensure proper tracking of the strip.

(2) Stud/Channel Profile Adjustment

The forming rolls were factory pre-gapped and should require little or no adjustment. The pre-gap settings allow the production of various gauges, without any resetting roll gap.

The final three stations are used to create the final 90° leg profile of the studs and channels. Stations 10 and 12 are factory set at .035 and station 11 is pre-gapped at .025.

⚠ NOTE:
IF you change the roll gap on either the stud rolls or the furring rolls, the opposite set of rolls gap will change.

(a) Adjusting Roll Gap

The following is the recommended adjustment procedure.

1. Ensure ALL power sources are shutoff and locked out.

⚠ DANGER:
NEVER perform maintenance or make any adjustments without removing power from any power source and locking out that source. SAFETY IS ALWAYS FIRST!!!!!!

2. With the hand wheel, spread the stud/channel rolls to their widest width.
3. *Using a feeler gauge, check the clearances of both the stud/channel rolls and the furring rolls on **both** surfaces of the roll and document.*

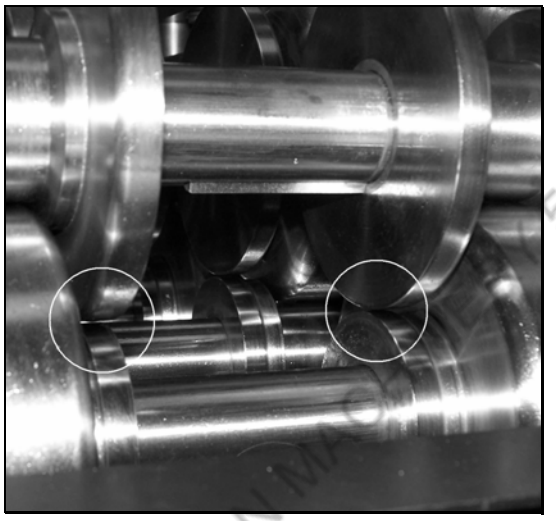


Figure 2-15 Setting Roll Gap

4. Loosen ALL three locknuts (**B**) on the upper forming roll mounting blocks.

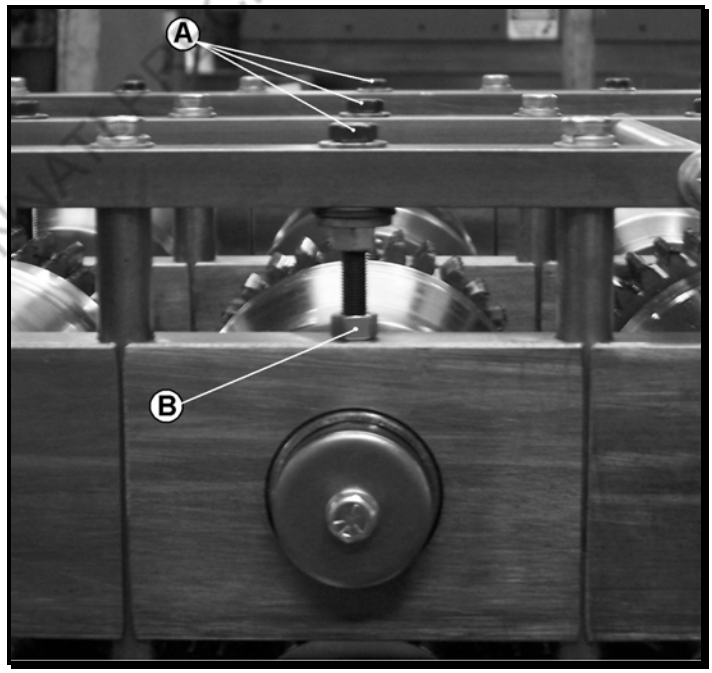


Figure 2-16 Roll Gap Adjustment

5. With a feeler gauge, raise or lower the upper forming roll shaft with the adjustment bolt (Item **A**), until the desired adjustment is obtained. IE, if a.002 gap was added to the stud/channel rolls, the furring roll gap must increase by the same amount, or an excessive load may be placed on the upper shaft.
6. This may take several adjustments to achieve the desired results.
7. Once the adjustment has been made, confirm gap, and then retighten all locknuts (**B**).

(3) Adjustment Hand Wheels

Two hand wheels are used for adjusting the High Speed Rollformer. One hand wheel (Item **B**) is used to move the forming rolls into position and the other (Item **A**) is used to set the width of part to be produced in the stud/channel rolls.

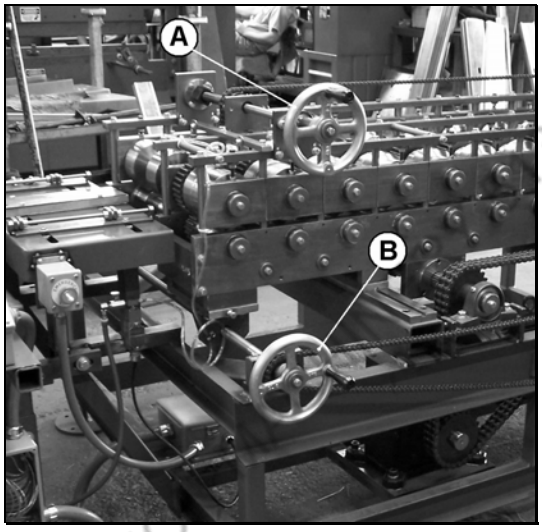


Figure 2-17 Rollformer Adjustment Hand Wheels

(4) Double Sheet Detector

A double sheet detector is located at the entrance end of the rollformer above the upper forming roll. This detector prevents two pieces of material from entering the rollformer and jamming up the rolls. As two parts enter the rollformer, the first roll is deflected up, which triggers a pneumatic valve shutting down the roll drive of the rollformer.

Figure 2-18 Double Sheet Detector

(5) Part Straightener

Located on the exit end of the Rollformer is an inclined plate that can be raised or lowered to remove down bow in the parts. If down bow is present raise the downstream end of the straightener with the setscrews.

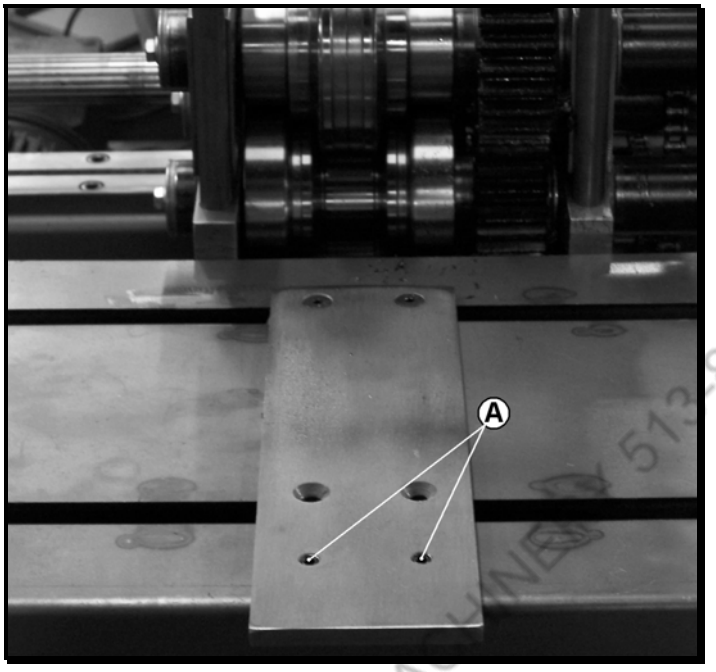


Figure 2-19 Part Straightener

(6) Resetting Rolls To Factory Settings

As described earlier, the roll gaps were set at the factory and should require little or no adjustments. To reset the roll gap to factory standards, follow the recommended procedure.

1. Ensure ALL power sources are shutoff and locked out.

⚠ DANGER:
NEVER perform maintenance or make any adjustments without removing power from any power source and locking out that source. SAFETY IS ALWAYS FIRST!!!!!!

2. With the hand wheel, spread the stud/channel rolls to their widest width.
3. Starting with the first set of rolls, loosen the lock nuts and adjust the stud/channel rolls to .035 and the furring rolls to .005.
4. Repeat this process on stations 2 thru 10.
5. Station 11 is set to .025 for the stud/channel roll and the furring rolls are set to .010.
6. Station 12 is set to the same gap as 1 thru 10.

3. SYSTEM CONTROLS

This section describes the operational controls for the processing line. The operator control console together with the computer control system provides a centralized location for the operator to direct operations.

All operators should be familiar with the contents of this section, and have a thorough understanding of the procedures and operating principals covered.

Once the preparation set-up has been accomplished, the System Control Console is utilized for system operation and the production run.

A. EMERGENCY STOP SWITCHES

The system's **EMERGENCY STOP** (**E-STOP**) switches are located around the unit and are placed to be within practical reach should an emergency situation occur requiring the immediate shut-down of the system.

Each switch is of the "slap" design, meaning that when the switch is in the "pulled-out" position, the system is functional. When the switch is pressed in, it stays in that position, immediately activating all system brakes and stopping all motors in the line. The emergency switch(es) must be in the *pulled-out* position for the system to operate. When an emergency switch has been activated, the CONTROL POWER ON lamp will turn off.

> ⚠ **NOTE**
> All Emergency Stop Switches must be in the pulled-out *(deactivated)* position for system operation.

B. OPERATOR CONTROL CONSOLE

The System Control Console is utilized to select the production run computer program to be utilized, input the program operational parameters, and to engage and control the overall system during the production run. It consists of the system computer, along with the various mechanical switches and indicator lamps required for overall system control and condition warning.

C. DECOILER CONTROL SWITCH PANEL

The Decoiler switch panel is located on the backside of the unit. From this panel, the operator can control all functions of the decoiler. *To utilize the Decoilers controls, the Control Power must be ON at the Processor control console.*

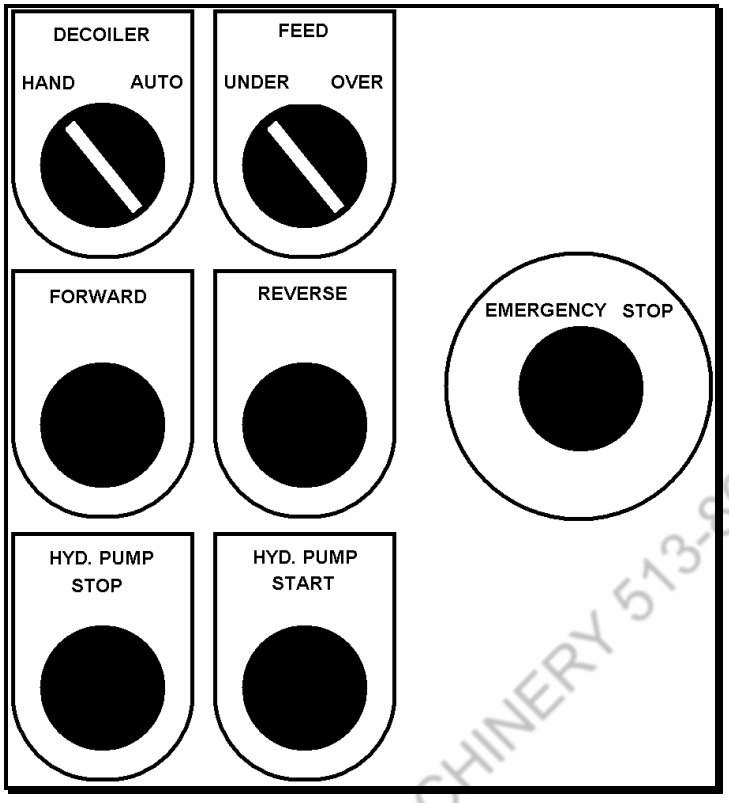


Figure 3-1 Decoiler Control Switches

(1) DECOILER *(HAND/AUTO)*

A two-position selector switch used to switch the drive system from Hand mode to Auto mode. In Hand mode, the drive system is controlled by the Forward/Reverse switches and in Auto mode, the drive system is controlled by the payoff arm.

(2) FORWARD

A **black** pushbutton switch used to jog the mandrel in the Forward direction, depending upon which direction the FEED selector switch is set.

(3) HYD. PUMP STOP

A **red** pushbutton switch used to deactivate the hydraulic motor. Once this switch is depressed and the hydraulic unit will de-energize.

(4) FEED *(UNDER/OVER)*

A two-position selector switch used to determine the direction of material payoff from the Decoiler. In the Under Mode, the leading edge of the material will payoff from under the mandrel. In the Over Mode the leading edge of the material will payoff over the top of the mandrel which is the *recommended payoff position*.

(5) REVERSE

A **black** pushbutton switch used to jog the mandrel in the Reverse direction, depending upon which direction the FEED selector switch is set.

(6) HYD. PUMP START

A **green** pushbutton switch used to activate the Decoiler hydraulic system. This will allow the operator to utilize the manual controls of the Decoiler.

(7) E-STOP

Refers to an emergency stop condition. A push switch, which when pushed in, initiates an emergency stop condition. To reset the emergency stop condition, the CONTROL POWER ON switch must be pressed after resetting *(pulling out)* any E-STOP switch that may have been pressed.

⚠ NOTICE

It will always be necessary to clear whatever caused the E-STOP before a reset can work properly with the CONTROL POWER ON switch. This may mean clearing an interlock open condition or pulling an E-STOP push button back out.

D. SYSTEM CONTROL CONSOLE SWITCH PANEL

The System Control Console Switch Panel contains the various mechanical switches and indicator lamps required for overall system control and condition warning. Controls and lamps for individual subsystem operation are grouped in vertical rows.

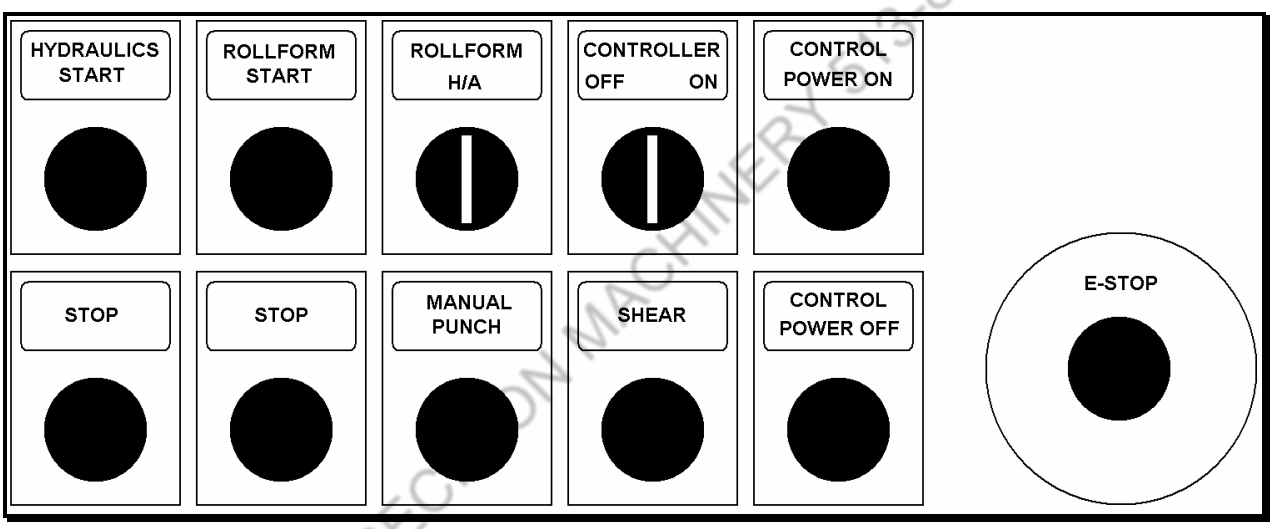


Figure 3-2 Processor Control Switches

(1) HYDRAULICS START

A **green** pushbutton switch used to activate the hydraulic motor. Once this switch is depressed and the hydraulic unit is energized, the switch will illuminate.

(2) STOP *(HYDRAULICS)*

A **red** pushbutton switch used to deactivate the hydraulic motor.

(3) ROLLFORM START

A **green** pushbutton switch used to activate the Rollformers' electric drive system. Once this switch is depressed and the drive system is energized, the switch will illuminate.

⚠ DANGER

ENSURE ALL PERSONAL ARE CLEAR OF THE LINE WHEN ACTIVATING THE ROLLFORMER START SWITCH WITH THE ROLLFORM SWITCH IN AUTO.
SERIOUS INJURY OR DEATH MAY RESULT.

(4) STOP *(ROLLFORM)*

A **red** pushbutton switch used to deactivate the Rollformer drive motor.

(5) ROLLFORM *(HAND/AUTO)*

A two-position selector switch used to switch the drive system from Hand mode to Auto mode. In Hand mode, the Rollformer drive system is controlled by the hand held jog pendent and in Auto mode, the drive system runs continuously.

(6) MANUAL PUNCH

A **yellow** pushbutton switch used to fire the Hole Punch die for test purposes only. To utilize this switch, the Hydraulic system must have powered applied to it.

(7) CONTROLLER *(OFF/ON)*

A two-position selector switch used to turn on and off the AMS® computer controller.

(8) MANUAL SHEAR

A **yellow** pushbutton switch used to fire the Shear Cutoff die for test purposes only. To utilize this switch the Hydraulic system must have power applied to it.

(9) CONTROL POWER ON

A **green** pushbutton switch used to apply power to the control panel. To utilize this switch the shutoff valve to the air supply tank must be open to ensure adequate air pressure. Once this switch is depressed and the control panel is energized, the switch will illuminate.

(10) CONTROL POWER OFF

A **red** pushbutton switch used to shut off power to the control panel. Depressing this switch will deactivate the processor and rollformer drive.

(11) E-STOP

Refers to an emergency stop condition. A push switch, which when pushed in, initiates an emergency stop condition. To reset the emergency stop condition, the CONTROL POWER ON switch must be pressed after resetting *(pulling out)* any E-STOP switch that may have been pressed.

⚠ NOTICE

It will always be necessary to clear whatever caused the E-STOP before a reset can work properly with the CONTROL POWER ON switch. This may mean clearing an interlock open condition or pulling an E-STOP push button back out.

(12) ROLLFORMER JOG PENDENT *(Item **A**)*

A handheld controller used to jog the rollformer rolls in the Forward direction only. To utilize this switch, the Rollformer Start pushbutton must be activated and the Rollformer H/A must be in the H (Hand) position.

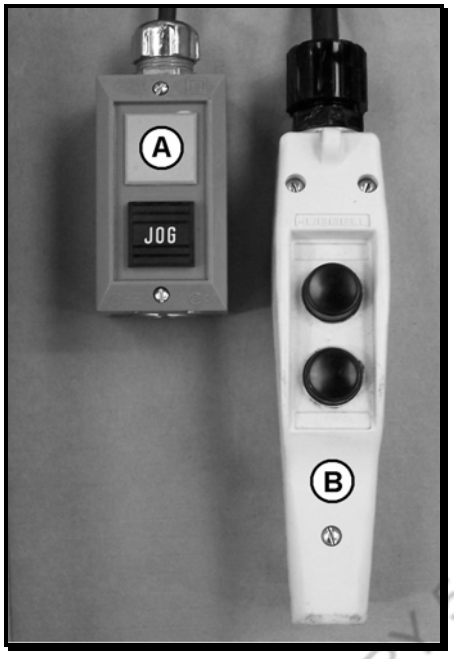


Figure 3-3 Jog Pendents

(13) PROCESSOR JOG PENDENT *(Item **B**)*

A handheld controller used to jog the processor rolls forward or reverse, depending upon the direction selected. To utilize this switch, the Hydraulic system must be activated.

E. COMPUTER CONTROL

Together with the control console switches, the AMS® Computer Control System provides the means to coordinate the operations of the processing line. For information regarding the AMS® Control system, refer to the Vendor Information section of this manual.

4. OPERATION

A. HIGH SPEED STUD LINE--SAFETY PRECAUTIONS

Before operating this equipment, read this entire manual. Study and follow the safety precautions in this section and in the rest of this manual. These safety precautions are intended to prevent injury to you and your fellow workers. They cannot, however, cover all possible situations. Therefore, consider the consequences of your actions before executing any procedure or operation.

The following precautions must be followed when working with or being in the area of individual machines.

1. When setting up or threading, operate in the "HAND" or “MANUAL” mode only.
2. The operator must be sure that all persons are at a safe distance from the moving equipment when jogging or running.
3. Never position yourself between the strand of material and a piece of equipment.
4. Never place hands, arms or body near the pinch rolls or at other "PINCH", "SQUEEZE" or "SHEAR" points.
5. Exercise extreme care when manually threading material into or through the equipment.
6. Ensure all safeguards are operative and in place. Never bypass safety devices.
7. Never reach into the die areas or roller areas of the machine AT ANY TIME *(Whether or not the machine is running)* without extreme caution.

B. POWERING UP THE LINE

When powering up the processing line by switching the **CONTROLLER** selector switch to the **ON** position, the computer will perform a self test sequence, the equipment is held in an E-STOP condition by a watch dog monitor. When the computer has completed its internal testing and is ready to proceed, a signal is sent to the watch dog monitor, which then enables the system. The system will stay in an E-STOP condition until cleared by the operator. To clear the E-STOP condition, press the **CONTROL POWER ON** switch.

1. At the control panel, depress the Processor **HYDRAULICS START** switch to apply power to the hydraulics power unit.

C. LINE SETUP PROCEDURES

⚠ NOTE

It is assumed that the feed table has been squared, and that the shear blade clearance is correct for the material being processed, and that the Drive Rolls are properly adjusted for the material thickness being used. If these setup procedures must be accomplished, refer to the Maintenance Section of this manual.

(1) Loading A Coil *(Optional)*

Once a coil has been loaded onto the decoiler mandrel, make sure that it is pushed tight against the backing plate and that it will uncoil from the top. While the coil is still supported with the loading mechanism (fork lift, etc.) expand the arms on the mandrel until all three expansion arms are tight against the coil.

The mandrel is then rotated slightly by using the Decoiler Forward Jog push button, checked to ensure that the mandrel is evenly, and tightly expanded. Coil retainers are

then placed on the mandrel arms and tightened to prevent the coil from "walking" away from the backing plate.

(2) Threading The Processor

1. Using the decoiler jog switch, jog enough excess material from the decoiler to reach the shear cutoff die.
2. Before the material can be jogged into the pinch rolls, the feed guides need to be set to the width of material to be processed.
3. The leading edge of the coil is fed through the feed table section at the entrance end of the Processor.
4. After the material is flattened in the straightener section, continue to jog the leading edge until it is located just past the shear cutoff die.

⚠ NOTE

Coil width can vary from one end of the coil to the other. The operator should check the material in the Feed Table from time to time while the coil is running to ensure that the coil width has not increased enough to cause binding in the Feed Table.

5. Place the decoiler into **AUTO** from the Decoiler control panel, the material will pay off the mandrel as necessary to feed the Processor.
6. To reset the Computer Control encoder to zero, create a crop cut, activate the **Cycle** pushbutton on the AMS® control panel.
7. Now that you have good material to the cutoff die, the Processor can set up to process parts automatically by use of the computer control.

(3) Set Up Rollformer

Before material can be formed by the rollformer, the entry guides must be set for the material to be processed. Then set the width of the stud/track station and place them inline with the processor. If producing furring channels, ensure the furring channel rolls are online with the processor.

(4) Running A Job

Once the material has been loaded on the Decoiler, and threaded into the processor line, you are ready to proceed. Refer to the AMS® manual for additional information.

(a) Entering A Part

Before a part can be processed, its quantities must be listed on the MAIN screen where it is selected as the active job.

1. Press the **PGM** key on the keypad.
2. Enter the **Job Number** with the numerical keys on the keypad and then press **ENT**.
3. Enter the **Part Length** with the numerical keys on the keypad and then press **ENT**.
4. In **Options**, enter the desired punch option.
5. Once the punch option is selected, enter the location of the **first** punch.
6. Next, enter the desired **spacing** between the punches.
7. Then, enter the minimum distance (**Limit**) which no punch is allowed.

(b) Processing

With a valid job entered as an active job on the Main Screen, the following is an outline to running a batch.

1. Ensure the Rollformer is in **AUTO** mode and the rolls are turning.
2. Activate the **RUN** button to initiate the batch.

⚠WARNING

Ensure the Decoiler and Rollformer are in AUTO mode, before placing the Processor into AUTO, or serious damage will occur to the equipment.

(5) Interrupt a Production Run

To interrupt or stop a production run, pressing either of the following push-buttons or controls will stop the run:

(a) Normal Procedure

At the Main Control Console, activate the **HALT** button. To return back to Auto, press the **RUN** button.

(b) Emergency Procedure

Press in any E. Stop emergency switch.

⚠WARNING

Should a hazardous situation occur, depress any EMERGENCY STOP (E STOP) slap switch to immediately stop the production line.

5. MAINTENANCE

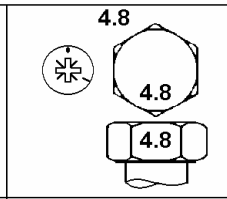
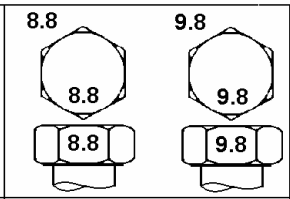
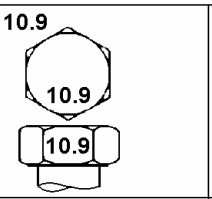
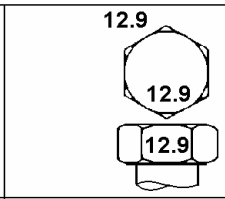
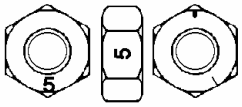
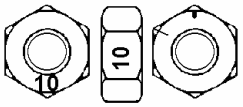
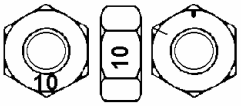
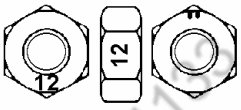
A. TORQUE VALUES FOR GENERAL ASSEMBLY

The torque chart value *(Table 1 and 2)* is provided for reference when performing general assembly of various components. These values should be used only if torque values are not otherwise specified for a particular assembly. Refer to the associated assembly drawings for assemblies or other component assemblies that may require special torque specifications.

The following conditions must be observed when using the general assembly torque values:

- Joints are assumed to be metal and rigid. Do use these values where gaskets or compressed material may be damaged by over-torquing.
- During disassembly, note bolt head markings and always reassemble the same hardware or equivalent new hardware in the correct locations.
- As a general rule, when reusing previously removed hardware, apply the minimum values from the table.
- Reduce the table values by 20% when assembling plated hardware or phosphate coated hardware.
- Reduce table values by 30% when molykote, white lead, or similar mixtures are used to lubricate threads.
- Reduce the table values by 35% when torquing jam nut *(thin nuts)*.
- Special use column values in the table are for capscrews in gray iron castings when thread length engagement is at least 1.5 times the capscrew diameter.

Table 5-1. Metric Bolt And Cap Screw Torque Values

Property Class and Head Markings				
Property Class and Nut Markings				

size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated*		Dry*		Lubricated*		Dry*		Lubricated*		Dry*		Lubricated*		Dry*	
	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	220	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

** "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

Table 5-2. Unified Inch Bolt And Cap Screw Torque Values

SAE Grade and Head Markings	NO MARK	1 or 2[b]	5 5.1 5.2	8 8.2
SAE Grade and Nut Markings	NO MARK	2	5	8

size	Grade 1				Grade 2[b]				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated*		Dry*		Lubricated*		Dry*		Lubricated*		Dry*		Lubricated*		Dry*	
	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft	N-m	Lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	215	160	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	470	300	510	375	470	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

** "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

[b] Grade 2 applies for hex cap screws (not hex bolts) up to 152mm (6 in.) long. Grade 1 applies to hex hex cap screws over 152 mm (6 in.) long, and for all other types of bolts and screws of any length.

B. SERVICING

(1) Lubricant Recommendations / Specifications

To ensure that the system is kept in a correct operating condition, it must be inspected and maintained on a regular basis. Proper cleaning and/or replacement of filters, the periodic lubrication of bearings, bushings, chains and other moving friction and wear generating points will prevent damage to or failure of the unit, and provide optimum performance.

Table 3 lists the types of lubricants used to maintain the processing line. The **LUBE TYPE** code on the left side of the table is utilized to identify the lubricant used in the text of this manual.

Table 5-3. Recommended Lubrication Products

Lube Type	Description	Recommended Products
A	CHAIN OIL	**WAY LUBRICANT 220**
B	MULTI-PURPOSE LUBE	**LUBRIKO M6** MARFAX MULTI-PURPOSE #2 (TEXACO) MULTI-PURPOSE #2 GREASE (AMACO) MOBILITH AW #2 (MOBIL)
C	GEARBOX OIL	**SYNTHETIC OIL 634 (MOBILE)** VAN GUARD CYLINDER OIL 680 (TEXACO) CYLINDER OIL 680 (AMACO)
D	HYDRAULIC OIL	**DTE #25 MOBILE (NON-HYPOID)** RANDO HYD AW46 HYDRAULIC OIL (TEXACO) AW-68 HYDRAULIC OIL (AMACO)
E	GEAR GREASE	**ENLUBE S-CHEM 10M-2**

(2) Lubrication, General Requirements

Table 5 shows some of the lubrication points on the system. The maintenance technician must become familiar with all the lubrication points located throughout the line. Chain drives, rack and pinion locations, dies, rollers, hand wheels, and those points where metal-to-metal contact of movable surfaces are located must be adequately lubricated. The lubrication schedule shown in Table 4 was developed as a "general" application. The actual lubrication requirements for the line and for individual points will be determined by usage requirements. These requirements will be based on line setup, usage, and equipment environment.

During lubrication procedures, a preventative maintenance inspection should also be conducted. Check the machine visually for loose nuts, bolts, parts out of adjustment, etc. Correct all deficiencies while they are small, and before they become operational problems.

Certain parts of the machine are left unpainted to aid in the movement of the slide assembly when changing dies, etc. Keep these areas clean and coated with light grease.

(3) Lubrication Schedule

The lubrication schedule shown in Table 4 was developed as a "general" application. The actual lubrication requirements for the line and for individual points will be determined by usage requirements. These requirements will be based on line setup, usage, and equipment environment.

1. Do not over-lubricate.

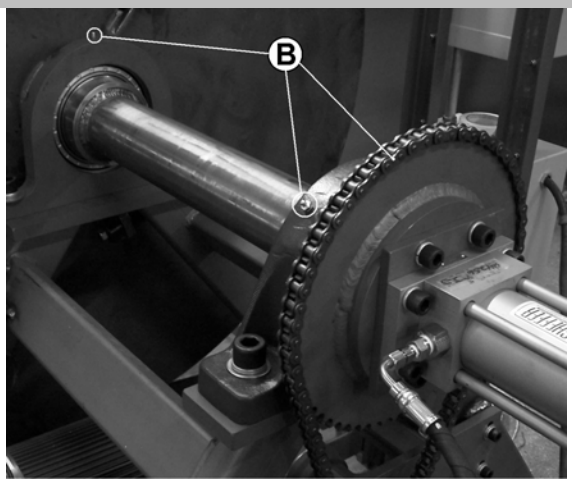
2. When using a low pressure grease gun, lubricate only to the point of grease starting to come out of the edges of the seals, etc., of the item being lubricated.
3. Do not over lubricate chains. Chain drives should not be lubricated to the point that oil is "flung" off during operation.
4. Ensure that proximity sensor heads are kept clean and free of lubricant. Dirty sensor heads will affect system operation.
5. *NOT ALL lubrication points are shown in "System Lubrication Points" photos, ensure ALL points are identified and properly lubricated.*

Table 5-4. Lubrication Schedule

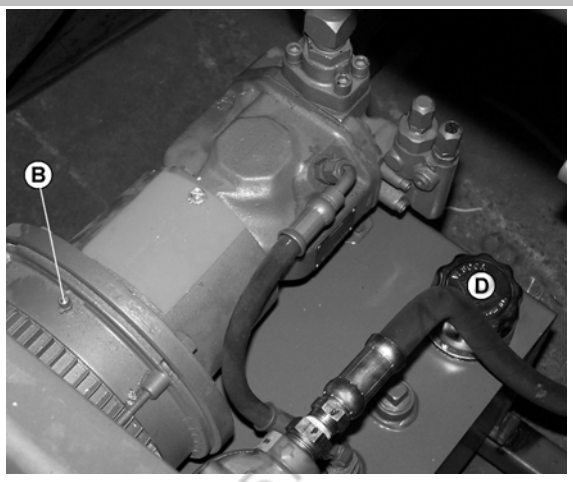
Procedure	Lube Type	Weekly	Monthly	6 Months	12 Months
DECOILER					
Mandrel Slides	**B**	**X**			
Mandrel Support Bearings	**B**		**X**		
PROCESSOR					
Change Hydraulic Fluid Filter	**PER MFG'S RECOMMENDATION**				
Drain and Replace Hydraulic Fluid	**D**	**PER MFG'S RECOMMENDATION**			
Roller Bearings	**B**			**X**	
Drive Chains	**A**	**X**			
Rack and Pinion Gears	**E**		**X**		
Hand wheels	**C**			**X**	
Slides and Remote Fittings	**C**		**X**		
ROLLFORMER					
Shaft Support Bearings	**B**			**X**	
Ball Screws	**C**			**X**	
Gears	**E**		**X**		
Roll Bearings	**B**			**X**	

Table 5-5. System Lubrication Points

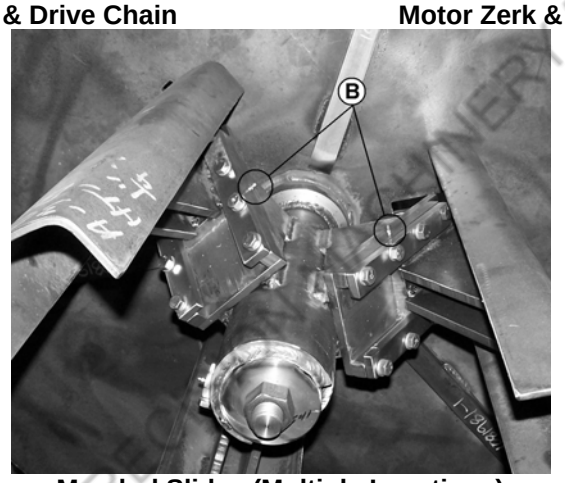
DECOILER



Support Bearings & Drive Chain

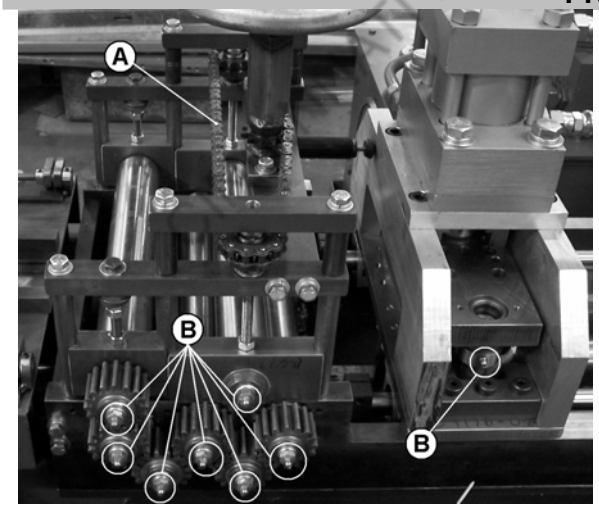


Motor Zerk & Hydraulic Reservoir

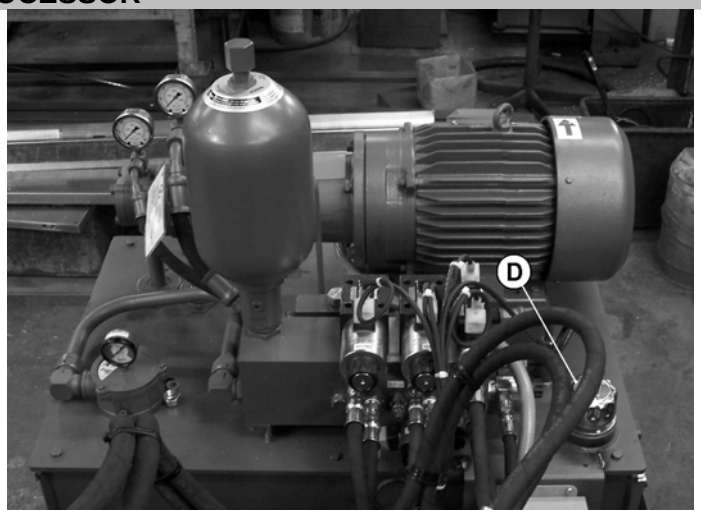


Mandrel Slides (Multiple Locations)

PROCESSOR



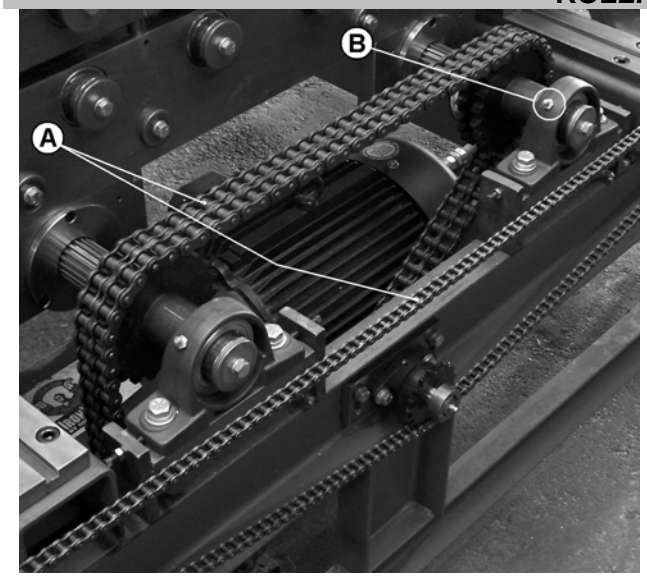
Roll Bearings, Die Posts & Sync Chain



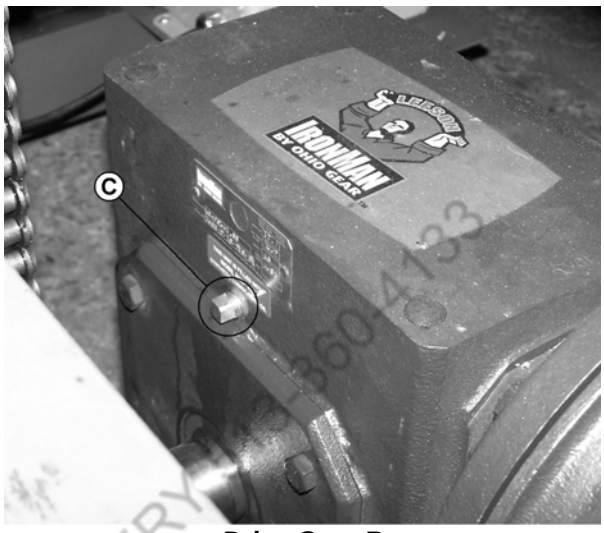
Hydraulic Reservoir

Table 5-5. System Lubrication Points

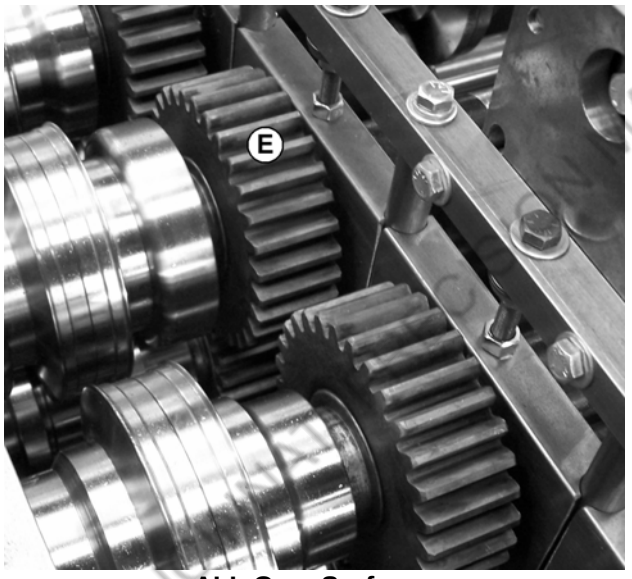
ROLLFORMER



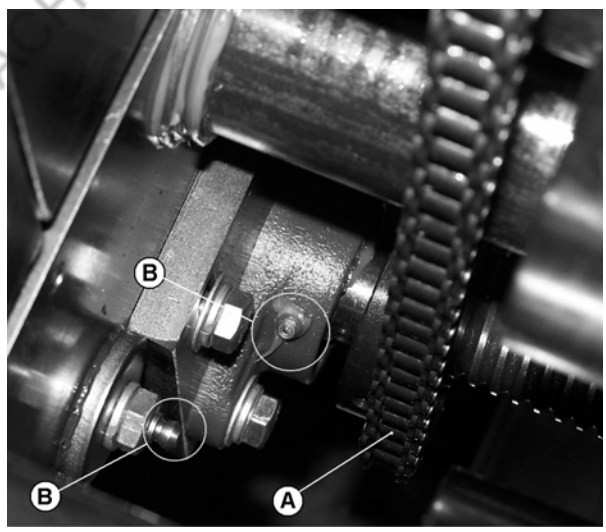
Support Bearings & ALL Drive Chains



Drive Gear Box
Located on Frame Base.



ALL Gear Surfaces



Sync Chains, Support Bearings & Roll Bearings

⚠ NOTICE
NOT ALL lubrication points are shown in "System Lubrication Points" photos, ensure ALL points are identified and properly lubricated

C. PREVENTIVE MAINTENANCE

A periodic inspection schedule should be established and maintained. A suggested inspection/check schedule is provided in Table 5. The criteria listed meet the minimum requirements necessary to ensure safe reliable service under normal operating conditions. It should be modified as required to meet varying operating and environmental conditions.

Table 5-6. Inspection Schedules

Procedure	As Req'd	Weekly	Monthly	6 Months	12 Months
GENERAL MAINTENANCE					
Chains, sprockets, idler pulleys and guide surfaces: Inspect for excessive wear, looseness. Repair/replace as required			X		
Motor Brushes: Inspect for burnt surface, chipped or damaged condition. Replace as required. Semi-annually or every 2000 operating hours, whichever comes first.				X	
Conveyor Belts: Inspect for cuts, chaffs, splits or cracks. Replace as required.		X			
HYDRAULIC UNIT					
Check Accumulator Pre-Charge Pressure					X
Clean Pump Suction Strain and Flex Magnet				X	
Monitor Hydraulic Fluid Temperature	X				
Check for Hydraulic Fluid Leaks		X			

(1) Daily Maintenance

Check the machine visually for loose nuts or bolts, parts out of adjustment, etc. Correct problems while they are small.

(2) Monthly Maintenance

Check all drive chains and rack and pinions for proper tension. Tighten as necessary. Grease all fittings and wipe off excess grease.

(3) Semi-Annual Maintenance

Change the hydraulic oil filter element.

D. UNDERSTANDING HYDRAULIC SYSTEMS

This section provides the user with an overview of safety precautions to follow when performing hydraulic tests and maintenance on the production line. An overview of various components and their application is provided in a general format, along with guidance in using the Engel Industries hydraulic diagrams and parts listing.

Depending on your equipment line, some of the components discussed in this section may or may not apply to your application. The intent is to provide the reader with a system overview and understanding to aid in the hydraulic maintenance and troubleshooting of their equipment line.

It is expected that all maintenance personnel are qualified technicians, familiar with the maintenance concepts required for the system, and are thoroughly familiar with coil processing line operations. It is also expected and required that maintenance personnel follow all cautions and warnings listed within this manual, and all industry coil handling procedures when working with equipment of this nature.

(1) Hydraulic Schematic Symbol Interpretation

The hydraulic schematic represents the hydraulic system in the same manner that an electrical schematic represents the electrical system. Instead of current flowing, we have the flow of hydraulic fluid. Both systems utilize a working "pressure" through system components, to accomplish a desired task.

As with the electrical schematic, the hydraulic schematic utilizes symbols to represent the actual components. Recognizing the individual symbols and understanding the represented component's function will allow the technician to accurately follow the fluid flow through the system, understand what is happening at each device, and therefore readily identify the problem when a mechanical component fault occurs. When troubleshooting an electrically controlled hydraulic system, ***always eliminate the electrical system as the first step in troubleshooting***. Ensure that all electrical controlled devices are operating, having the proper power connections and good grounds or return leads.

⚠ WARNING

Escaping hydraulic fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles that eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks, DO NOT use your hands.

⚠ WARNING

Oils and other petroleum products can readily be absorbed through the skin and into the blood stream. Wash immediately after coming into contact with these products.

⚠ WARNING

Follow electrical, hydraulic and pneumatic lockout procedures as described in the LOCKOUT section of this manual before performing any of the maintenance procedures. Use a lockout device and/or tag *(not supplied by IPI)* as a safety precaution during maintenance procedures.

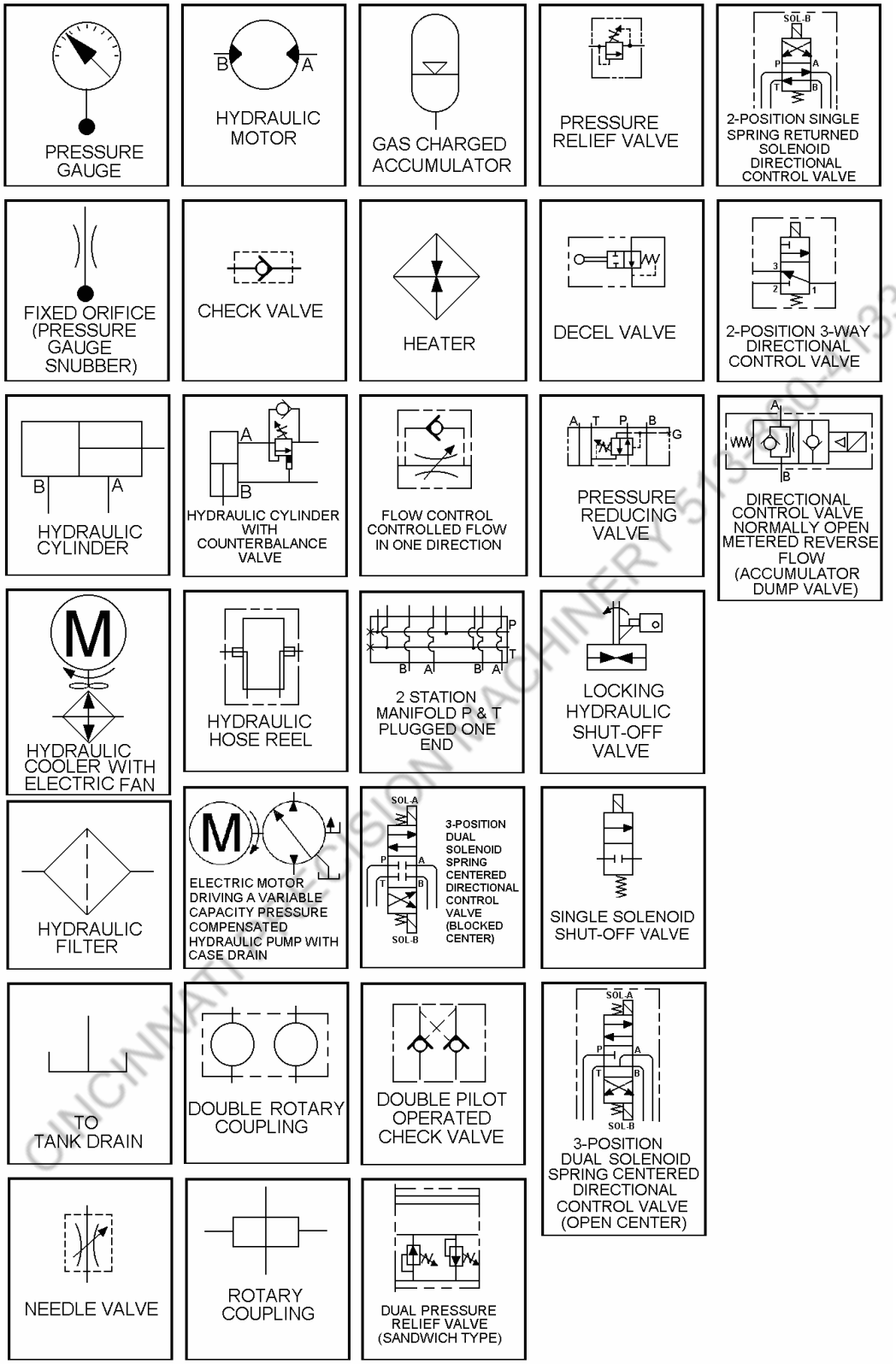
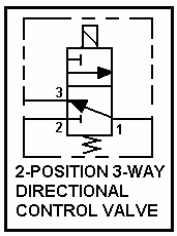
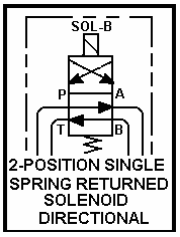


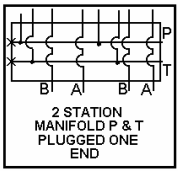
Figure 5-1 Hydraulic Drawing Symbols

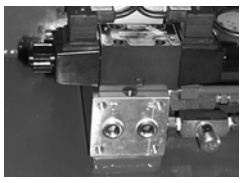


2-Position 3-Way Directional Control Valve: This valve, when deactivated, provides a fluid path from port 1 through the valve to port 3. When activated, the path between ports 1 and 3 are closed, and a path from port 1 through the valve to port 2 is opened. This valve could be used to control the in and out stroke of a cylinder.

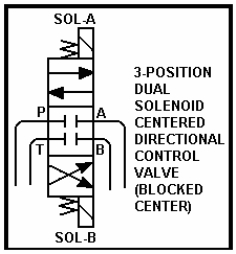


2-Position Single Spring Returned Solenoid Directional Valve: This is an electrical activated solenoid valve that normally *(deactivated)* passes the fluid flow from the P to A ports to the using device, and back on the B to T port to the reservoir. When activated, this valve swaps the ports, changing the flow from P to B out to the using device, and back on A to T to the reservoir. This valve could be used to control the Extend / Retract functions of a cylinder.

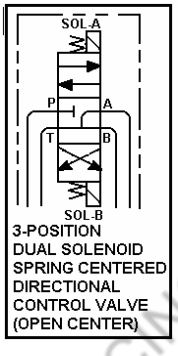




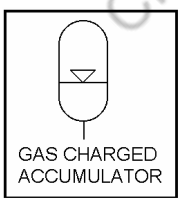
2-Station Manifold *(P & T plugged one end)*: A manifold is a drilled passage block with ports for both the pressure and return fluid used to mount control valves. Additional manifolds may be plumbed from one end of the block, or the P & T ports at that end of the block may be plugged when not used.



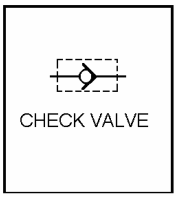
3-Position Dual Solenoid Centered Directional Control Valve *(Blocked center)*: This control valve provides no path for fluid flow in the deactivated position. In the "A" solenoid activated position, it provides a straight through flow for fluid *(P to A and B to T)*. In the "B" solenoid activated position, it provides a crossed path for fluid *(P to B and A to T)*.

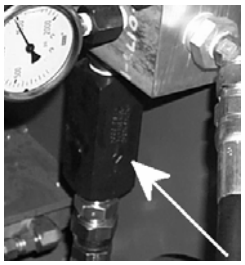


3-Position Dual Solenoid Spring Centered Directional Control Valve *(Open Center)*: On this valve in the deactivated position the pressure port is blocked off, with the A and B ports flowing freely to the reservoir. With the "A" solenoid activated, the valve provides a straight through path from P to A and B to T. With the "B" solenoid activated, the paths are reversed with the flow being from P to B, and A to T.

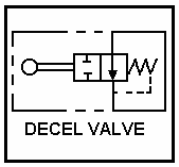


Accumulator: An accumulator is a two section tank, with the sections separated by a diaphragm. One section is charged with a gas to a predetermined pressure. The other section is connected to the hydraulic system. The hydraulic pressure works against the diaphragm, with the diaphragm exerting pressure against the fluid in an attempt to maintain a constant hydraulic pressure. An accumulator is also used for extra fluid capacity when several operations are occurring simultaneously.

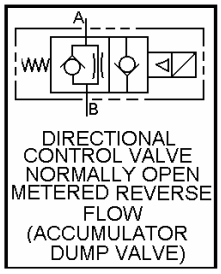




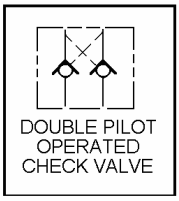
Check Valve: A check valve can be compared to a diode in an electrical circuit, it allows fluid to pass in one direction only *(in the direction of the arrow scribed on the side of the valve)*. The check valve will also trap pressure on its output side, not allowing it to bleed back through the valve on deactivated systems. In the check valve symbol, the un-blocked path is against the arrow toward the ball.

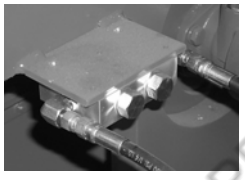


Decel Valve: A mechanically actuated valve that restricts fluid flow proportional to the valve position. IPI's normal application for this type of valve is as a variable speed valve connected to the "dancer" arm of an decoiler. The dancer arm rides the coil "loop," and as the loop shortens and the arm is raised, the valve is opened allowing more fluid to pass, thereby increasing the rate of decoiler spindle rotation to increase the loop.

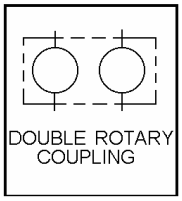


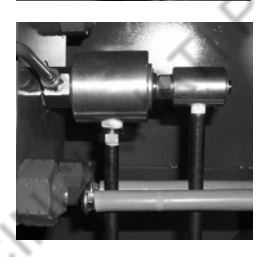
Directional Control Valve, Normally Open Metered Reverse Flow *(Accumulator Dump Valve)*: An electrically activated valve which in the deactivated position allows unrestricted fluid flow from ports A to B, and an adjustable rate of flow between ports B to A. When activated this valve allows fluid flow only from port B to A, unrestricted.



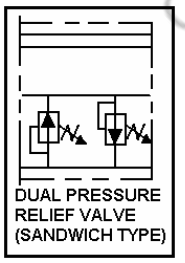


Double Pilot Operated Check Valve: A pilot operated check valve is utilized to stop line leakage back flow and to prevent unintentional cylinder movement. Pressure must be applied on one line to unlock the check valve on the other line.

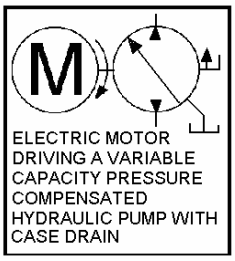


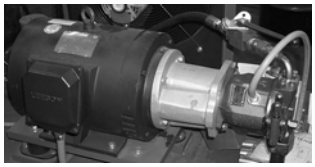


Double Rotary Coupling: Rotating couplings are used to connect hydraulic fluid lines to a rotating cylinder. IPI's normal application is to the rotating spindle cylinder on the decoiler.

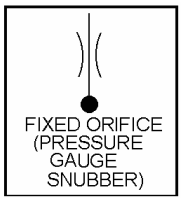


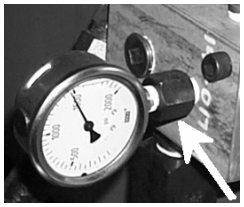
Dual Pressure Relief Valve *(Sandwich type)*: A mechanically adjusted valve which is set to pass hydraulic fluid up to a certain pressure, and route excess pressure out a secondary port. The dual pressure relief valve, limits the pressure between lines, dumping excess pressure to the opposite line. This configuration will maintain the same pressure in both lines.



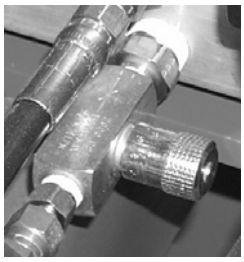


Electric Motor Driving a Variable Capacity Pressure Compensated Hydraulic Pump with Case Drain: An electric motor driven hydraulic pump, with the pump having a return port to the reservoir. Excess pressure or fluid flow is dumped back to the reservoir.

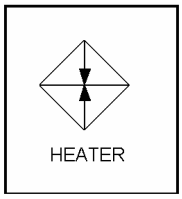




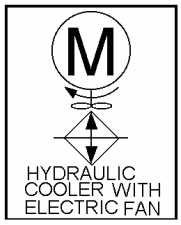
Fixed Orifice *(Pressure Gauge Snubber)*: A fitting with a very small orifice that tends to dampen out sudden pressure variations. The snubber eliminates needle bounce on pressure gauges.

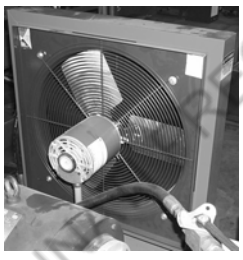


Flow Control Valve *(Controlled Flow in one direction)*: A combination check valve and needle valve. Hydraulic fluid flow in one direction (blocked by the check valve) is controlled by the needle valve setting. Fluid flow in the opposite direction is passed by the check valve and is unaffected by the needle valve.

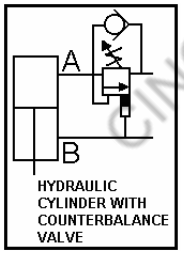


Heater: An electrically powered element heater used to maintain oil reservoir temperature within the correct operating range during cold weather.

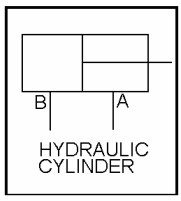




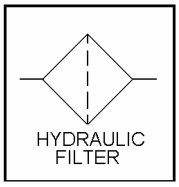
Hydraulic Cooler With Electric Fan: A radiator type core through which the hydraulic fluid flows. A radiator fan, normally thermostatically controlled, provides the required cooling air movement through the core.



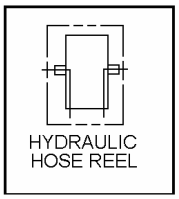
Hydraulic Cylinder With Counterbalance Valve: A hydraulic cylinder with an attached valve unit which controls the rate of flow from/to one cylinder port based on the rate of flow applied to the other cylinder port.



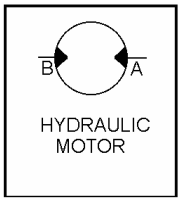
Hydraulic Cylinder: A piston work device which is driven into its anchored casing, or out of the anchored casing, by hydraulic fluid entering and leaving the two control ports.

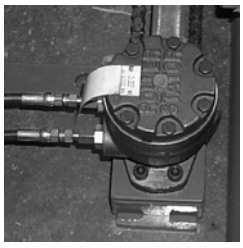


Hydraulic Filter: A device used to filter impurities and foreign matter from the hydraulic fluid. A filer may utilize a fine mesh screen or a fiber core for the filtration process. Most fiber core filters utilized for hydraulic fluid are a minimum of 10 micron.

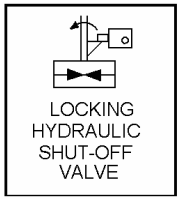


Hydraulic Hose Reel: A spring-loaded reel, used to pay out and automatically recoil hydraulic lines that feed a movable device. Normally utilized by IPI with coil cars.

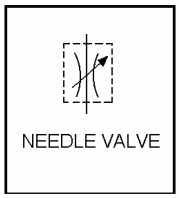




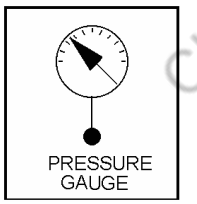
Hydraulic Motor: A hydraulic motor is an impeller driven device, with impeller rotation provided by the passage of hydraulic fluid. The higher the hydraulic pressure, the greater the flow, and the faster the motor rotation (depending on motor load). Two ports are provided on the hydraulic motor. Motor direction of rotation is normally controlled by which port has the "pressure" applied, and which port is the "return."



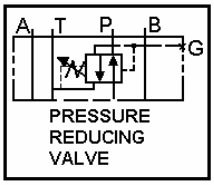
Locking Hydraulic Shut-Off Valve: A manually operated valve used to close off the pressure line from the hydraulic pump. This valve is lockable in the "closed" position for maintenance operations to prevent the valve been inadvertently turned on, injuring personnel or damaging equipment.



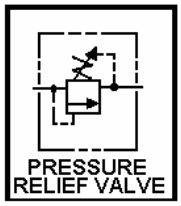
Needle Valve: This is a manually adjustable flow control that puts a restriction in the fluid line. This restriction affects the flow in either direction.



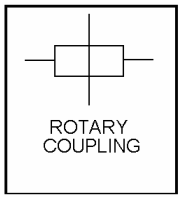
Pressure Gauge: The pressure gauge contains a device to translate the pressure within a system to the mechanical movement of a needle on a predetermined scale. The critical points of system pressure are leaving the pump *(system pressure)*, and after pressure reducing devices. The hydraulic schematic will call out the required pressure at any gauge.

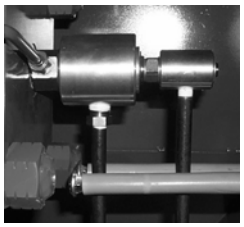


Pressure Reducing Valve: A mechanically adjusted valve which is set to pass hydraulic fluid up to a certain pressure, and route excess pressure out a secondary port, normally back to the reservoir.

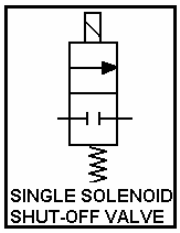


Pressure Relief Valve: A normally closed valve preset to open at a predetermined pressure and provide a passage from the pressure system to the return system, maintaining system pressure at the safe, predetermined value. A manual activating knob is provided for removing the pressure trapped within the pressure side. This is normally activated prior to disassembling hydraulic lines or valves for maintenance.

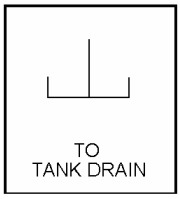


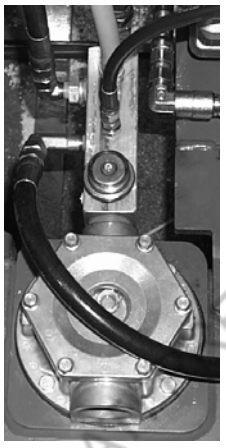


Rotary Coupling: Rotating couplings are used to connect hydraulic fluid lines to a rotating cylinder. IPI's normal application is to the rotating spindle cylinder on the decoiler.



Single Solenoid Shut-Off Valve: This valve can be compared to a switch, in the deactivated position fluid flow is blocked. In the activated position, fluid may flow in either direction.





Tank Drain: This symbol represents the return of the hydraulic fluid to the reservoir. Mechanically this return is normally through a manifold and a return screen filter.

⚠ WARNING

Always determine the hydraulic oil level and fill the reservoir to the proper level with all hydraulic actuating cylinders fully retracted. Failure to follow this procedure may cause over filling with possible damage to the tank when the system is operated.

⚠ CAUTION

Do not mix hydraulic oils of different specifications. The oils may not be compatible and could result in damage to the hydraulic system components.

⚠ CAUTION

Hydraulic system pressure relief valves should only be adjusted by a qualified hydraulics mechanic. A relief valve set at too high a pressure may cause system damage and component failure. A relief valve set at too low a pressure may cause faulty system operation.

(2) Hydraulic System Maintenance

(a) Contamination

Contamination is the prime enemy of machines that incorporate hydraulic systems. Contaminants in a hydraulic system may be solids, liquids, or gasses. Solids *(grit, dust, and metal particles)* pose the greatest problem since they are the most common and the most damaging.

Contaminants may be external or generated. External contaminants may enter a system while it is disassembled for repairs or through improperly serviced breathers. Lint is a common problem, introduced during cleaning and maintenance. Generated contamination results from existing contamination breeding new contamination. For example, tiny grit may score off particles within the system, which in turn grind off more. Uncontrolled, contamination WILL multiply rapidly.

The quality components used in IPI hydraulic systems will operate for years without trouble, if kept free of contamination. If not, a variety of ills can result. Dirty oil can cause a pump to wear quickly, valves to stick, or internal leakage, degrading machine accuracy and capacity.

(b) Maintaining Good Filtration

Many of the dirt particles that are harmful to expensive machinery are too small to see, so just because the hydraulic fluid or a component looks clean doesn't necessarily mean that it is clean. Good filtration guidelines include:

- Drain and replace hydraulic oil and put in a new filter every six months. The filter should be changed more often if the indicator on the tank goes into the red *(if applicable)*.
- Maintain a stock of filters for emergency use. If it is necessary to open the system for repair, replace the filter.
- A complete change of fluid and filter is advised in case of gross fluid contamination. Replace only with Mobile DTE25, a heavy-duty oil with anti-wear additives, treated to avoid rust and oxidation. If this fluid is not available, contact the factory for recommendations.

(c) Accumulator

An accumulator provides the means of storing a buffered reserve of pressure in the hydraulic system. The instant a load is applied, for example, a hydraulic cylinder is actuated, the system responds by pumping an increased amount of fluid to drive the operation. During the period between an initial demand of a load and the time it takes for the system to respond, the amount of available hydraulic force being generated momentarily falls below the demand. In an effort to accommodate the demands placed on a hydraulic system, many of the Engel processing lines utilize a gas charged type of accumulator.

A gas charged accumulator should be pre-charged at ambient *(room)* temperature while empty of hydraulic fluid.

The accumulator pre-charge pressure for your system is noted on your hydraulic schematic. The hydraulic schematic drawing is located in the assembly drawing section of this manual.

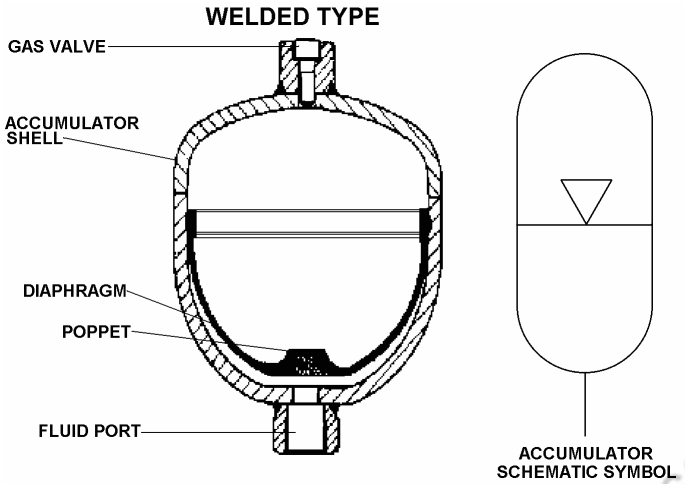


Figure 5-2 Accumulator

1. Maintenance

The following is a suggested periodic maintenance checklist. As pointed out in this section, a poorly maintained hydraulic power system will result in inefficient operation, excessive wear, and avoidable downtime.

- **Initial Setup:** Ensure the accumulator is pre-charged to the pressure specified on the hydraulic schematic. This pressure should be rechecked at least once during the first week of operation.
- **After First Month:** Change hydraulic fluid filter.
- **After First 3 Months:** The accumulator pre-charge pressure should be checked and recharged if required. If the pressure is correct, it should be checked at least once a year.
- **Daily:** Monitor the hydraulic fluid temperature. If the hydraulic tank is not equipped with a thermometer it is suggested that a stick-on type of thermometer be attached.
- **Weekly:** Check for hydraulic fluid leaks.
- **Semiannual:** Drain and replace the hydraulic fluid, clean the pump suction strainer, clean the flexible magnet attached to the suction strainer, and install a new filter.
- **Annually:** Check the accumulator pre-charge pressure and recharge if necessary.

(d) Troubleshooting

Many of the failures in a hydraulic system show similar symptoms; a gradual or sudden loss of high pressure, resulting in loss of power or speed in the cylinders. In fact, the cylinders may stall under light loads or may not move at all. Often the loss of power is accompanied by an increase in pump noise, especially as the pump tries to build up pressure.

Any major component - pump, relief valve, directional valve, or cylinder could be at fault. In a sophisticated system other components could also be at fault, but this would require the services of an experienced technician. By following an organized step-by-step testing procedure in the order given below, the problem can be traced to a general area, then, if necessary, each component in that area can be tested or replaced.

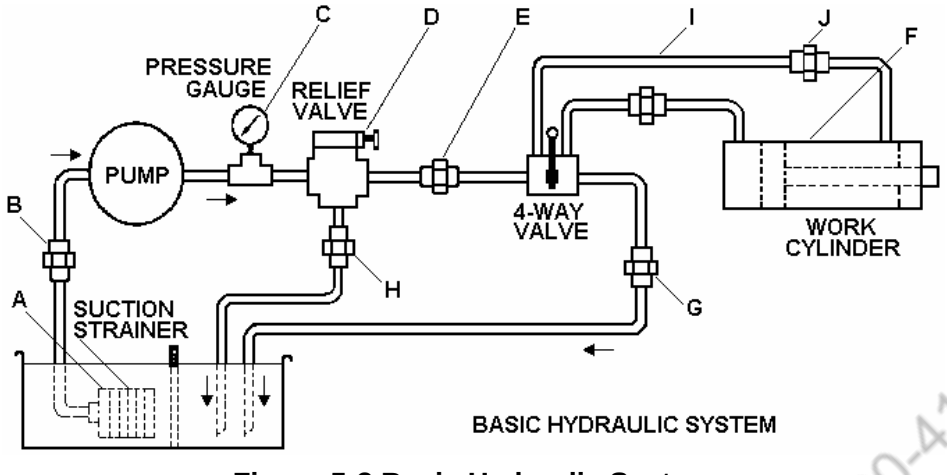


Figure 5-3 Basic Hydraulic System

1. STEP 1 - Pump Suction Strainer

Probably the field trouble encountered most often is cavitation of the hydraulic pump inlet caused by restriction due to a dirt buildup on the suction strainer. This can happen on a new as well as on an older system. It produces the symptoms described above, increased pump noise, loss of high pressure and/or speed.

If the strainer is not located in the pump suction line, it will be found immersed below the oil level in the reservoir, as at Point A. Some operators of hydraulic equipment never give the equipment any attention or maintenance until it fails. Under these conditions, sooner or later, the suction strainer will probably become sufficiently restricted to cause a breakdown of the whole system and damage to the pump.

The suction strainer should be removed for inspection and should be cleaned before reinstallation. Wire mesh strainers can best be cleaned with an air hose, blowing from the inside out. They can also be washed in a solvent that is compatible with the reservoir fluid. Kerosene may be used for strainers operating in petroleum base hydraulic oil. The strainer should be cleaned even though it may not appear to be dirty. Some clogging materials cannot be seen except by close inspection. If there are holes in the mesh or if there is mechanical damage, the strainer should be replaced.

When reinstalling the strainer, inspect all joints, as at Point B for possible air leaks, particularly at union joints. There must be no air leaks in the suction line. Check the reservoir oil level to be sure it covers the top of the strainer by at least 3" at minimum oil level with all cylinders extended. If it does not cover to this depth there is danger of a vortex forming which may allow air to enter the system when the pump is running.

2. STEP 2

If cleaning the pump suction strainer does not correct the trouble, isolate the pump and relief valve from the rest of the circuit by disconnecting at Point E so that only the pump, relief valve, and pressure gauge remain in the pump circuit. Cap or plug both ends of the plumbing that was disconnected. The pump is now deadheaded into the relief valve. If full pressure can be developed, obviously the pump and relief valve are operating correctly, and the trouble is to

be found further down the line. If full pressure cannot be developed in this test, continue with Step 3.

3. STEP 3

If high pressure cannot be obtained in Step 2 by running the pump against the relief valve, further testing must be conducted to see whether the fault lies in the pump or in the relief valve. Proceed as follows:

If possible, disconnect the reservoir return line from the relief valve at Point H. Attach a short length of hose to the relief valve outlet. Hold the open end of this hose over the reservoir filler opening so the rate of oil flow can be observed. Start the pump and run the relief valve adjustment up and down while observing the flow through the hose. If the pump is bad, there will probably be a full stream of oil when the relief adjustment is backed off, but this flow will diminish or stop as the adjustment is increased. If a flow meter is available the flow can be measured and compared with the pump catalog rating.

If a flow meter is not available, the rate of flow on small pumps can be measured by discharging the hose into a bucket, while timing with the second-hand of a watch. For example, if a volume of 10 gallons is collected in 15 seconds, the pumping rate is 40 GPM, etc.

If the gauge pressure does not rise above a low valve, say 100 PSI, and if the volume of flow does not substantially decrease as the relief valve adjustment is tightened, the relief valve is probably at fault, and should be cleaned or replaced as instructed in Step 5.

If the oil flow substantially decreases as the relief valve adjustment is tightened, and if only a low or moderate pressure can be developed, this indicates trouble in the pump. Proceed to Step 4.

Alternate Test Method for Pumps with a Case Drain Line:

1. Remove the case drain line from the reservoir return manifold and put the end of the line in a bucket.
2. Start the pump and run for one minute (timed). Verify the amount of oil in the bucket.
3. If the oil in the bucket from the case drain line is less than 10% of the pump capacity, the pump is functioning properly. If the oil in the bucket from the case drain line is more than 10% of the pump capacity, the pump internal leakage is too high and the pump must be rebuilt or replaced.

4. STEP 4 - Pump

If a full stream of oil is not obtained in Step 3, or if the stream diminishes as the relief valve adjustment is tightened, the pump is probably at fault. Assuming that the suction strainer has already been cleaned and the inlet plumbing has been examined for air leaks, as in Step 1, the oil is slipping across the pumping elements inside the pump. This can mean a worn-out pump, or too high an oil temperature. High slippage in the pump will cause the pump to run considerably hotter than the oil reservoir temperature. In normal operation, with a good pump, the pump case will probably run about 20 degrees (F) above the reservoir temperature. If the temperature is greater than this, excess slippage caused by wear may be the cause.

Check also for slipping belts, sheared shaft pin or key, broken shaft, broken coupling, or loosened set screw.

5. STEP 5 - Relief Valve

If the test of Step 3 has indicated the trouble to be in the relief valve, D, the quickest remedy is to replace the valve with another one known to be good. The faulty valve may later be disassembled for inspection and cleaning. Pilot-operated relief valves have small orifices that may be blocked with accumulations of dirt. Blow out all passages with an air hose and run a small wire through the orifices. Check also for free movement of the spool. In a relief valve with pipe thread connections in the body, the spool may bind if pipe fittings are over-tightened. If possible, test the spool for bind before unscrewing threaded connections from the body, or screw in fittings tightly during inspection of the valve.

6. STEP 6 - Cylinder

If the pump will deliver full pressure when operating across the relief valve in Step 2, both pump and relief valve may be considered good, and the trouble is further downstream. The cylinder should be tested first for worn-out or defective packing, by the method described in the following paragraphs.

7. STEP 7 - Directional Control Valve

If the cylinder has been tested (Step 6) and found to have reasonably tight piston seals, the 4-way valve should be checked next. Although it does not often happen, an excessively worn valve spool can slip enough oil to prevent buildup of maximum pressure. Symptoms of this condition are a loss of cylinder speed together with difficulty in building up to full pressure even with the relief valve adjusted to a high setting. This condition would be more likely to occur with high pressure pumps of low volume output, and would develop gradually over a long period of time. Four-way valves may be tested by the method described in material that follows.

8. STEP 8 - Other Components

Check other components such as bypass flow controls, hydraulic motors, etc. Solenoid 4-way valves of the pilot-operated type with tandem or open center spools may not have sufficient pilot pressure to shift the spool.

E. ASSEMBLY DRAWINGS & ELECTRICAL SCHEMATICS

This Assembly Drawing and Electrical Schematic sections contain drawings and schematics for your processing line equipment. The drawings contain pertinent information for the operation, maintenance, and repair of your equipment. Refer to the drawings when working on the equipment and when ordering replacement parts.

F. ORDERING PARTS

A Parts Order form is provided for your convenience. Photocopy the form for shop use. Fill out all required spaces. Parts orders may be placed by telephone, or may be faxed to Engel Industries.

G. RETURNS

(1) Returning Parts For Repair

Prior to parts being returned for repair, Engel Industries Customer Service must be contacted. A ***Return Material Authorization*** *(RMA)* worksheet must be used. A ***Return Material Authorization*** worksheet is provided in this section for your convenience. Photocopy the worksheet for shop use. Fill out all required spaces. Telephone Engel Industries Customer Service. The following information must be received/provided through Engel Industries Customer Service.

- Name of individual requesting return.
- Component Part Number and Name.
- Cause or indication of component failure.
- Purchase Order number for repair charges and return shipping.

An RMA number will be provided by customer service, log this number on the the RMA worksheet. The statement **RETURN FOR REPAIR** and the **RMA** number ***must be marked on the outside of the shipping carton***. Carefully pack the faulty part for shipping, and include a completed copy of the RMA Worksheet with the part. Return freight charges are paid by the customer.

- Mark the outside of the carton “RETURNED FOR REPAIR,” and the RMA number.

(2) Warranty Returns

When a component covered by warranty fails, it must be returned to Engel Industries for evaluation and processing. A customer provided Purchase Order number is utilized to order a replacement part and cover shipping. Return freight charges are paid by the customer.

The following procedures for warranty returns and service are provided as an operating guide. Special circumstances that require variance from these procedures must be pre-approved by the Engel Warranty Administrator.

- Engel will **not** provide “loaner” parts or components while a warranty claim is being evaluated.
- Engel warrants that new equipment it *manufacturers* shall at the time of shipment, and for a period of one year on parts, be free from defects in material and workmanship. This warranty applies only to machines installed, operated, and maintained in accordance with Engel’s recommendations and quotes for field specifications.

- Warranty claims may be disallowed if it is determined that any claimed defect is a result of misuse, neglect, improper maintenance or repair, alterations, accident or excessive deterioration due to environmental contamination.
- The warranty does not apply to normal wear items such as lamps, switches, belts, drive chains, or electrical connectors. Warranty does not cover normal maintenance items or maintenance functions.
- Engel's obligation under this warranty is limited to repairing or replacing the failed component that Engel's inspection determines to be defective. Warranty claim items must be returned to Engel, freight prepaid, for inspection and warranty determination.
- Purchased parts *(items not manufactured by* Engel*)* are warranted by their vendor or manufacturer. Engel is not liable for this warranty, but will, for the convenience of our customers, process such warranty claims to the vendor.
- Hydraulic cylinders normally will not be returned to Engel. Cylinder leakage is a result of loose packing or bad seals. The tightening of packing or the replacement of seals is a normal maintenance procedure and not a warranty item.
- Assemblies will not be returned to Engel for warranty evaluation or replacement. Only the failed component of the assembly may be returned for warranty. If the customer desires to return an assembly, all labor and parts for repairing the assembly will be at a cost plus basis, with only the failed component will be covered by warranty claim. A repair PO must accompany the repair order.

Prior to parts being returned for warranty exchange or warranty repair, Engel Industries Customer Service must be contacted. An ***RMA number*** provided by the Service Department and a ***Return Material Authorization*** *(RMA)* worksheet must be utilized for returns. An RMA Worksheet is provided for your convenience in this section. Photocopy the worksheet for shop use. Fill out all required spaces. The following information must be entered on the RMA form:

- Customer business name and address.
- Contact telephone and fax number.
- Name of the individual requesting return (customer point of contact).
- Equipment Model and serial number of the top level equipment assembly.
- Line installation date.
- Component description, part number and serial number (if applicable).
- Part failure description. Be specific and describe the problem or failure for which the part is being returned.
- Purchase Order number for the ordered replacement part.
- Warranty Return Parts Authorization Number (RA) provided by Engel Industries .
- Reason for the part return *(warranty, repair or credit)*.

Carefully pack the part for shipping, and include a completed copy of the RMA Worksheet with the part.

Mark "**WARRANTY RETURN**" and the **RMA** number on the outside of the carton.

(a) Warranty Claim Approved

Once the warranty claim has been approved, a **Customer Credit** for the purchase replacement item will be issued against the purchase order under which the customer received their replacement part. Shipping costs are not reimbursed.

A **Warranty Inspection Report** for the item will be completed and mailed/faxed/or emailed to the customer.

(b) Warranty Claim Disapproved.

No credit is issued against the purchase order under which the customer received their replacement part. A **Warranty Inspection Report** is prepared and mailed/faxed/or emailed to the customer. This report requests part disposition from the customer. The part will be held at Engel for 30 days. Within that time frame the customer must select to have the part:

- Repaired *(if practical)* and returned at customer expense *(a repair PO must be issued)*. Customer is charged parts, labor and shipping.
- Returned not repaired, freight/postage collect.
- Scrapped.

If customer direction is not received within the 30 day time frame, the part is scrapped.

(3) Returning Unused Parts For Credit

Unused, undamaged, parts still in their original packaging, which are approved by Engel Industries for credit return, are subject to a 35% restocking fee based on current price lists.

An ***Return Material Authorization*** *(RMA)* number is required for the part return, with the CREDIT box checked. Once received, the part will be inspected for acceptability. If the part is free from defects, and in the original packaging, a customer credit, less the **35% restocking fee**, will be issued to the customer. If the part does not meet restock requirements, a ***Warranty Inspection Report*** will be generated informing the customer of the inspection results and asking his disposition of the part. If disposition is not received within 30 days, the part will be returned to the customer freight collect.

Carefully pack the part(s) for shipping, and include a completed copy of the RMA Worksheet with the part.

Mark "**CREDIT RETURN**" and the **RMA** number on the outside of the carton.

ENGEL INDUSTRIES
8122 Reilly Avenue,
St. Louis, MO 63111 U.S.A.

Telephone (314) 638-0100
Fax (314) 638-6514
Web: www.engelind.com

E-Mail: Gary Paszkiewicz gpaszkiewicz@engelind.com

ENGEL INDUSTRIES

CUSTOMER PARTS ORDER FORM

INSTRUCTIONS

Please fill out the form with the information requested. Use extra sheet if additional parts are required. Fax to Engel Industries and we will process your order.

PARTS ORDER INFORMATION			
Customer Name:			**Purchase Order No.:**
Bill To Address:			**Customer Contact**:
Bill To City, State, Zip:			
Ship To Address (if different than Bill to):			**Telephone No.**:
Ship To City, State, Zip (if different than Bill to):			
Payment Terms:		**Parts Needed By Date:**	
Shipping Information: **Ship VIA: Surface** ☐ **Air** ☐ **Other** ☐ _____	**Freight:** **Prepaid** ☐ **Collect** ☐ **Shipment Insured** ☐		**Call upon arrival?:** ☐ **YES** ☐ **NO** **Telephone No.:**
Qty	**Part No.**	**Description**	**Information Source** (i.e., Drawing No., Manual No., Figure, Item No.)
Special Instructions:			

RETURN MATERIAL AUTHORIZATION (RMA) FORM

CUSTOMER:		**RMA No.** *(from IPI)*: RMA-__ __ __ __ __ __ __	
ADDRESS:		**CUSTOMER POINT OF CONTACT** *(who may we call?)*: **E-mail Address:**	**DATE:** **P.O. No.** *(replacement part ordered)*:
Telephone No.: ( ) ____-_____	**Fax. No.:** ( ) ____-_____	**EQUIPMENT MODEL** *(Duct-O-Matic, Whisper-Loc, etc.)*:	
Returned Part Information **Description:** **Part No.:** **Serial No.:**		**Line Serial No.:** **Reason for Return:** ☐ Warranty ☐ Repair ☐ Credit	**Line Installation Date:**

PART FAILURE DESCRIPTION *(describe reason for return in detail. Insufficient description such as Broke, Doesn't Work, etc., are not acceptable and may delay your warranty claim)*:

RMA approved items must be received by Engel within 15 days of the RMA issue date. Items not received within that time period will not be accepted and will not be considered for warranty coverage.

Note: For commercially purchased parts, Engel acts as an intermediary for the benefit of the customer. Parts are returned to the original vendor or manufacturer for warranty evaluation. Any delays in notifying you of the warranty status for commercial parts is due to the manufacturer's procedures. Notification of status for Engel manufactured components is normally completed within ten business days of receipt.

A written evaluation of your warranty claim will be provided to you. If warranty is denied, the reason will be explained and you will be asked for the disposition of the part. You may have the part returned to you as-is, freight collect; have the part repaired/rebuilt at time/material charge and returned to you; or you may request the part be scrapped. Warranty denied parts will only be held by Engel for 30 days from the date of customer notification. After that date, unless instructed otherwise, the part will be scrapped.

Return Instructions: Place a copy of this completed form with the component being returned. On the outside of the shipping carton, mark the carton PART RETURN, and below this write the RMA number.

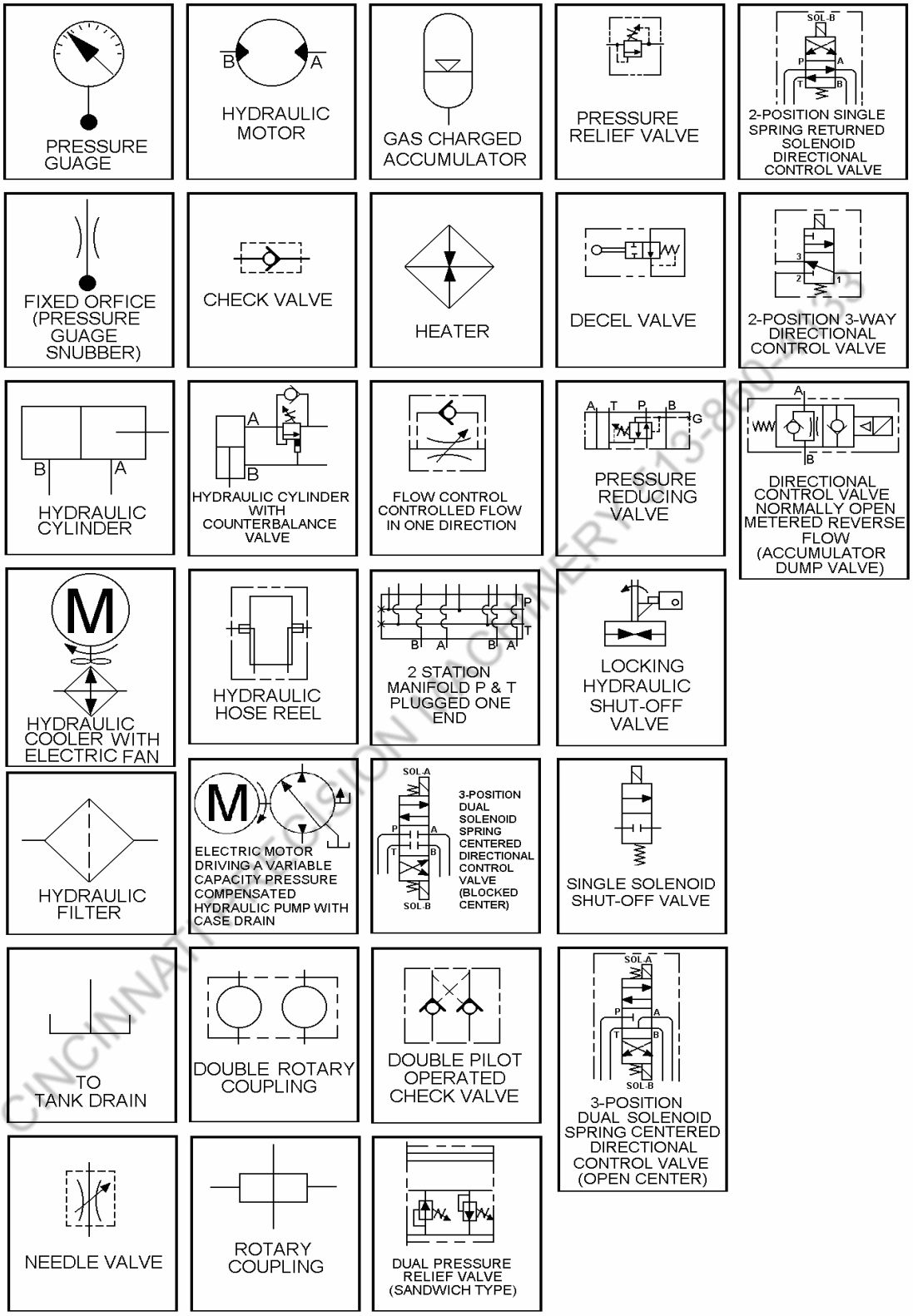
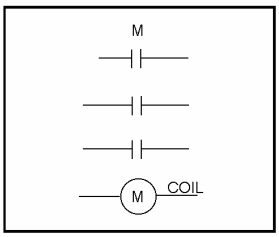


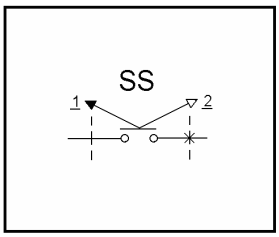
Figure 5-4 Hydraulic Symbols Used On Assembly Drawings

Electrical Drawings



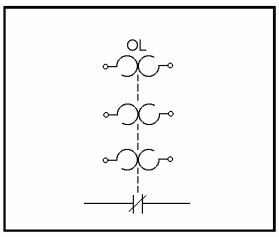
MOTOR CONTACTOR
Three phase type.

NOTE
Unit may have additional contacts.



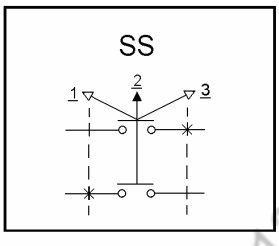
SELECTOR SWITCH
(2 POSITION)

NOTE
Indicates contact closure in switch position 2.



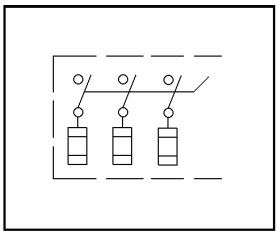
OVERLOAD RELAY

Three phase thermal type with manual reset.



SELECTOR SWITCH
(3 POSITION)

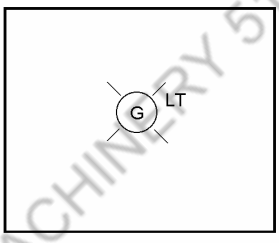
NOTE
X indicates contact closure in switch position.



DISCONNECT SWITCH

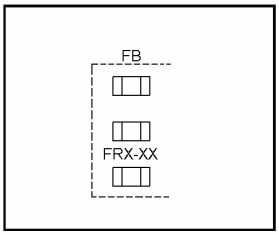
With integral fuse block - three phase type.

NOTE
Specify fuse type and size.



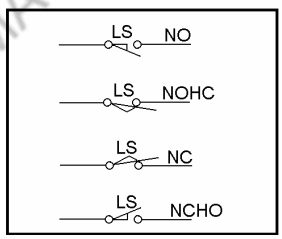
INDICATOR LAMP

NOTE
May be full voltage or transformer type.



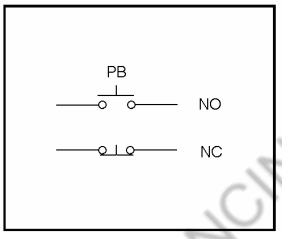
FUSE BLOCK
Three phase type shown.

NOTE
Fuse type and rating to be specified.

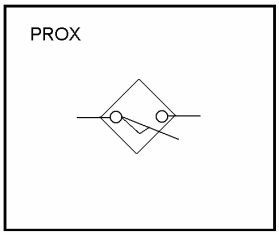


LIMIT SWITCHES

NOTE
May be lever, roller, or push-button activated.

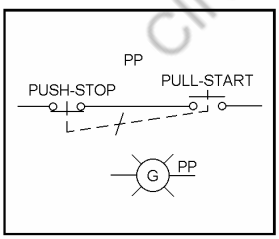


PUSH-BUTTON SWITCH



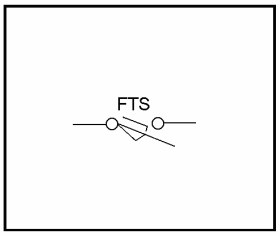
PROXIMITY SWITCH

NOTE
May be AC or DC type



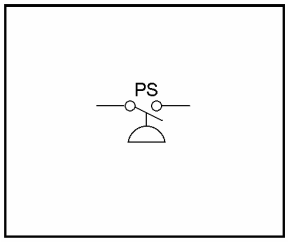
PUSH-PULL SWITCH

With integral lamp.

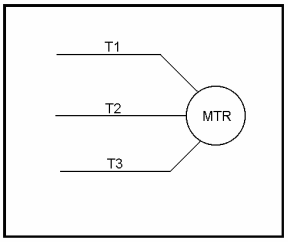


FOOT SWITCH

Figure 5-5 Electrical Symbols Used On Assembly Drawings (Sheet 1 of 2)

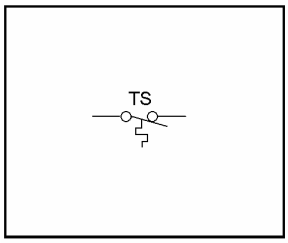


PRESSURE SWITCH



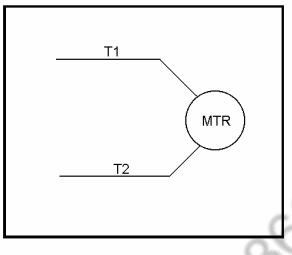
MOTOR

Three phase type.



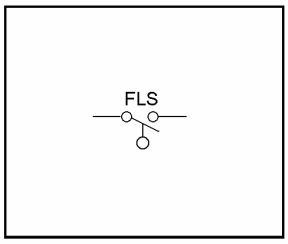
TEMPERATURE SWITCH

NOTE
Operating temperature to be specified.

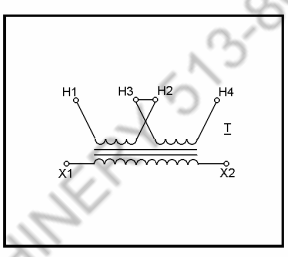


MOTOR CONTACTOR

One phase type.



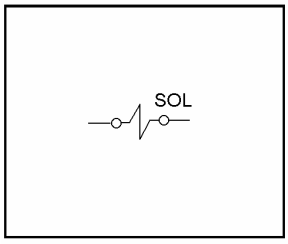
FLOAT SWITCH



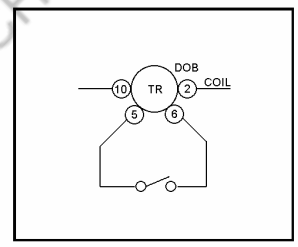
TRANSFORMER

Single phase type with dual voltage primary.

NOTE
Specify primary and secondary voltage.

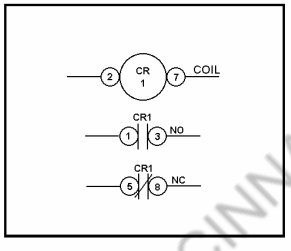


SOLENOID



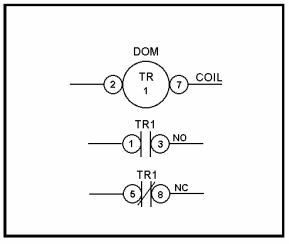
TIMER

Delay on break type. Contact operation is delayed after switch is opened.



CONTROL RELAY

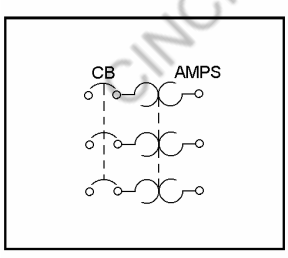
NOTE
Numbers indicate socket terminal numbers.



TIMER

Delay on make type. Contact operation is delayed after power is applied to coil.

NOTE
Numbers indicate socket terminal numbers.



CIRCUIT BREAKER

Three phase thermal type with manual reset.

NOTE
Specify amperage.

Electrical Symbols Used On Assembly Drawings (Sheet 2 of 2)

H. ASSEMBLY & ELECTRICAL DRAWINGS

The Assembly and Electrical drawings are furnished in this section for troubleshooting, parts ordering and component identification. Please use these drawings when replacement parts are required to help speed up the ordering process.

I. OEM (VENDOR INFORMATION)

This section contains several OEM Vendor supplied information. Each document pertains to a specific component on your processing line. This information is very valuable for setup procedures, maintenance procedures and operational procedures.