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21 X 33 Clamp
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Johnson Controls, Inc.
Plastics Machinery Division

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INTRODUCTION

The blow molding method of fabrication is used for the manufacture of hollow articles and containers ranging in size from about 3cc (or a bottle approximately 1/2 inch outside diameter and 1-1/4 inches high) to home heating oil tanks having a volume of hundreds of gallons. Many automotive parts such as heater and air conditioner ducts and underhood reservoirs are also blow molded. Perhaps the most commonly encountered blow molded parts are bottles for detergents, cosmetics, and milk. Blow molding has gained increasing importance in recent years for the production of large containers such as 15, 30, and 55 gallon drums. A recent application involves blow molding of automotive gasoline tanks from plastics to reduce automobile weight and increase gas mileage.

While the process is used mainly for container-type applications, other applications include toys and carrying cases for typewriters, chain saws, portable drills, saber saws and sanders.

The basic principle is used in all of these different applications.

BLOW MOLDING MACHINES

There are only a few basically different blow molding systems, but each has its own particular method of accomplishing the end goal: that of producing a hollow item via air inflation of a tubular parison. The most prominent among the systems are extrusion blow molding and injection blow molding. Another patented system which is being widely used, primarily for polypropylene, is biaxially oriented blow molding.

* Uniloy® is a registered trademark of Johnson Controls, Inc.

PREFACE

This blowmolding machine is the product of:

Johnson Controls, Inc.*
Plastics Machinery Division
P. O. Box 129
Manchester, Michigan 48158, U.S.A.

This manual has been prepared to assist the user in the installation, operation, and maintenance of Uniloy® reciprocating extrusion blow molding machines. Since there are many variations in the system and their use, the manual is intended as a general guide to all installations.

Uniloy® built equipment is dry cycled at the factory to insure completeness and good performance according to our published specifications. Certain parts are then removed for shipment and must be reassembled by the user. The user must also install all necessary utility connections including interconnections between various pieces of equipment.

After all equipment has been located and the utilities connected, a Uniloy® serviceman will come in to make final adjustments and do the actual start-up. Uniloy® does not assume any responsibility for machines not started by a Uniloy® serviceman.

To insure optimum operating results, it is necessary that the following be adhered to:

1. The machine must be properly installed.

2. It should receive proper care and maintenance after being placed in operation. Set up a preventative maintenance program.

3. Instruct your machine operators on the functions, capabilities, and limitations of the equipment.
4. Select good personnel for your maintenance and train them as specialists.

5. Maintain an adequate stock of spare parts.

6. Consult the Uniloy Service Department on any problems your personnel are unable to handle.

WARRANTY

The Seller warrants the Equipment, so far as the same is of its own manufacture, to be free from defects in material and workmanship, when used by the Purchaser under normal conditions for one year after date of shipment from Seller's place of manufacture or 4,000 hours of operation, whichever occurs first. The Seller's obligation under this warranty may, at its option, be discharged by repairing without charge such Equipment or the defective part thereof, F.O.B., Seller's designated point of return or at Seller's option, by furnishing without charge, F.O.B. its place of manufacture, a similar part to replace any of its own manufacture which proves to have been defective. The Seller shall also have the option of requiring the return of the defective material (transportation prepaid) to establish the claim. The Seller's obligation hereunder shall be confined to such repair or replacement and shall be further conditioned upon the Seller's receiving within said warranty period immediate written notice from the Purchaser upon discovery of any such defect.

The warranties and remedies set forth herein constitute the only warranties of Purchaser with respect to the equipment and the Purchaser's only remedies in the event such warranties are breached. They are in lieu of all other warranties, written or oral, statutory, expressed or implied, including without limitation the warranty of merchantability for a particular purpose. This agreement states the entire obligation of the Seller in connection with this transaction and in no event will the Seller have any obligation or liability for damages, including but not limited to indirect, special, or consequential damages such as loss of anticipated profits or other economic loss arising out of or in connection with the use, performance, existence, furnishing or functioning of any item of equipment or services provided for in this agreement.

The warranties herein specified shall not apply if the failure of any purchased item to satisfy such warranty is due to accident, neglect, misuse, improper transportation arranged by Purchaser or its agent, or causes other than ordinary use including operation contrary to Seller's operating instructions or if any person other than Seller's authorized personnel shall modify, adjust, or repair such unit or perform any maintenance service on it. It must be understood that Purchaser assumes full responsibility for the overall effectiveness and efficiency of the operating environment in which the Equipment is to function, as well as responsibility for the cooperation of its personnel.

The warranty obligations of the Seller with respect to Equipment, parts, or accessories not manufactured by the Seller shall in all respects conform and be limited to the warranty extended to the Seller by its supplier.

The press and hydraulic equipment shall not be operated at greater pressure or at higher rate of speed than specified herein, or contrary to operating instruction furnished by the Seller to the Purchaser.

Service calls required on replacements parts are not covered under this warranty.
Limited Liability
The Seller shall not be liable for loss or damage due to delay in manufacture or delivery or due to inability to manufacture or deliver resulting in either case from any cause beyond the Seller's control, including, but not limited to, compliance with any regulations, orders, or instructions of any federal, state or municipal government, or any department or agency thereof, acts of God, acts or omissions of the Purchaser, inability to successfully produce the required parts or products, acts of civil or military authority, fires, strikes, factory shutdowns or alterations, embargoes, war, riot, delays in transportation or other inability due to causes beyond the control of the Seller to obtain necessary labor, manufacturing facilities or materials from the Seller's usual sources. Delays resulting from any such cause shall extend delivery dates correspondingly.

Express Contract of Indemnification
In accepting delivery and installation of this equipment, Purchaser specifically promises that it will not change, alter, or modify the equipment or remove or render inoperable or unsafe any guards, shields, or other safety features of the equipment; or remove, obliterate, or obstruct any warning, caution, or instruction labels; or fail, refuse, or neglect to install any retrofit kits from time to time marketed or provided by Seller to improve personnel safety. Purchaser also specifically agrees that if it breaches any of such promises, or if it is remiss, negligent, or deficient in maintaining the equipment or in hiring and training equipment operators or service personnel, the Purchaser will indemnify and hold harmless Seller from any and all types of actions, suits, claims, or demands, including products liability claims brought by Purchaser's employees, or subrogation claims brought by Purchaser's worker's compensation or health insurance carriers, for injuries or loss arising out of the operation, maintenance, repair, or other use of such equipment. Purchaser specifically agrees that this Express Contract of Indemnification is a condition of sale supported by adequate consideration and was read and understood by the Purchaser before purchasing and accepting delivery and installation of the equipment.

STATEMENT OF POLICY CONCERNING OCCUPATIONAL SAFETY AND HEALTH ACT

The Occupational Safety and Health Act of 1970 (OSHA) places the responsibility upon each employer to provide their employees a place in which to work free from recognized safety and health hazards. Uniloy* interprets OSHA standards as they appear to apply to Uniloy* products. Then we design and build into our products those safety features which we believe are required. It is, indeed, Uniloy's* desire to assist its customers to comply with OSHA. However, since these standards are continually reviewed and revised and are subject to differing interpretations by the officials implementing and enforcing the act, Uniloy* is not in a position to guarantee compliance.

If you desire to incorporate into your Uniloy* equipment additional or substitute health or safety features, Uniloy* will be pleased to discuss the design alternatives with you and to furnish quotations covering them for your consideration.

Because of the fluctuations and the variable interpretation of the OSHA standards and our inability to assure you of compliance therewith, we hereby advise you that Uniloy* assumes no liability for direct or consequential damages which may arise out of any failure of Uniloy* equipment to comply with Occupational Safety and Health Act or any state equivalent thereof.
SAFETY

All precautions have been taken to assure the safety of personnel with your Uniloy® blow molder. The operator must practice safety operating procedures at all times on and around the machine. Warning, Danger, and Safety plaques are placed in conspicuous areas that may be potentially hazardous to personnel.

Uniloy® has built into its blow molder a system of safety devices to help assure safe operation of the machine.

Keep Hands Free of Moving Parts and Pinch Areas Never stick your hand into the feed throat of the extruder or between clamps. If there is an obstruction in the extruder feed throat, use a plastic stick or similar rod (not metal) to break the jam-up.

Keep Guards in Place While Operating Do not remove any guards or leave guards off while machine is in operation. The guards protect the operator from both heat and high voltage. Guards should only be removed when the power to the machine is in the "off" position.

Never Stand In Front of the Head at Start-Up Never stand in front of the head on the start-up of the extruder. A cold slug of material might jam-up in the head adapter and cause the head flange bolt to snap.

Use Gloves on Hot Surfaces Always use insulated gloves to protect yourself from the heat when working with items such as the head, barrel, screw, etc.

Start Machine In Low Speed On start-up, always start machine at minimum speed and bring up to operating speed slowly noting power readings (per ammeter).

All safety devices installed on your blowmolder are intended for protection, health, and welfare of personnel. For no reason should they be removed or the system overridden.

The operator or maintenance personnel should assure themselves of the proper operation of these devices prior to operation of the machine.

Safety instruction plates are fastened in conspicuous areas of the machine. Under no circumstance should these be removed. They must be maintained so that they are easily readable. Operating and maintenance personnel must understand the safety instructions before they are permitted to work on the machine.

Safety Inspection Certain precautions should be taken to insure the safe operation of any blow molding machine. The following listing covers preventative safety procedures which maintain the safe operating conditions of the machine.

WARNING

Do not operate the machine if safety gate and interlocks are not functioning properly.

Inspect all heat instruments for proper control of respective heat zones. This check is important for protection of plant personnel from injury. Loss of heat control in some plastic materials could result in an explosion.

Check tightness of tie rod nuts.

Check all hydraulic pressure lines and fittings for loose joints or loose piping that could result in an oil blow out. Such blow outs could cause direct injury or possibly a fire if they were to come in contact with heater bands.
Check electrical grounding to prevent possibility of an accidental or unauthorized disconnect.

Check all electrical wiring for loose connections or short circuits. Use only fuse size specified on the electrical schematic supplied with the machine.

Before working on screw or head heater bands, pull the main disconnect switch to "off". Failure to pull disconnect could result in electrical shocks.
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MACHINE SPECIFICATIONS
FOR MODEL 400R25, DOUBLE 21 X 33 CLAMP

EXTRUDER

Screw Diameter Inches.................................................................4.00
L/D Ratio..........................................................................................24:1
Compression Ratio..........................................................................3:1
Drive Horsepower...........................................................................125
Drive Type........................................................................................D.C. V.S.
Plasticizing Rate-lbs/hr.....................................................................750
Shot Size-Grams............................................................................HDPE3,500
Shot Cylinder - Bore Stroke/in......................................................10" x 16"
Barrel Cooling Medium....................................................................U-Con Fluid
Hydraulic Pump-Gpm.........................................................................40 Gpm
Hydraulic Reservoir Capacity..........................................................100 Gal.
Maximum Hydraulic System Pressure...........................................1,500 Psi
Electric Power................................................................................285 amps @460 volt

CLAMP (Double 21 x 33 Side Shifting)

Clamp Type........................................................................................Toggle
Platen Size.......................................................................................21" x 33" ea.
Stroke...............................................................................................20"
Shut Height Maximum
  Minimum........................................................................................21", 12"
Tie Bars...........................................................................................6
Side Shifting Stroke.........................................................................5"
Tonnage.............................................................................................90
RESIN HANDLING

The first step in the process is the system by which the plastic resin is fed to the blow-molder. Depending on the type of container to be made, this system may have to supply resin in its natural state or blended with color concentrate. Bleach, detergent, etc., usually require a colored container; whereas, milk, water, juice, etc., use the resin in its natural color. These two systems are described separately in the following sections.

Colored Resin Handling System
This system includes the equipment to store, blend, and convey virgin resin, color concentrate, and reground scrap to the blow molder in the proper proportions. To simplify the explanation, we shall follow the material through the system.

Initially we start with virgin resin and color concentrate. The virgin is stored in a TOTE bin from which it is fed to the duo-screw blender by a material feeder, which is a motor driven vacuum device. The material feeder is mounted on the virgin hopper of the blender and is connected to the TOTE bin by steel tubing. The color concentrate is put into the color hopper of the blender by hand. Color concentrate is used in small enough quantities that it usually is not automated.

The blender is a duo-screw auger type blender which has variable speed adjustments by which the desired proportions may be obtained.

After the virgin and color are blended, they are deposited in a storage area in the base of the unit. From there they are conveyed to the blow molding machine hopper on demand by a material feeder which is mounted on top of the hopper.

If the system is equipped with a Uniloy® bottle finishing line it will also have a scrap reprocessing system. This system collects the scrap flash trimmed from the container and airways it to the scrap grinder. Since the airway is moving a large volume of air in order to entrain the scrap, the scrap grinder is equipped with a cyclone separator. The cyclone allows the air to escape while the scrap settles down into the grinder. If the air was forced directly into the cutting chamber of the grinder, ground plastic and dust would be blown all over the area. It might also create enough back pressure in the airveyor to

COLORED RESIN HANDLING SYSTEM

Item Part Name
A Virgin Tote Bin
B Duo-Screw Blender
C Blended Resin Line to Blow Molder 1-1/4 EMT Tubing
D Blended Resin Storage Bin Suction Ports
E Regrind Tote Bin
F 2" EMT Tubing
G Scrap Return, 10" Duct
H 1-1/4 EMT Tubing
I Material Feeders
J 1-1/4 EMT Tubing
K Regrind Cyclone
L Scrap Separator
M Scrap Grinder
prevent proper conveying and cause plugging in the airveyor duct work.

As plastic scrap enters the grinder it encounters several rotating and fixed blades between which it is sheared over and over again until it is approximately pellet size at which time it may pass through the perforated screen below the cutting chamber. The scrap, which is now called regrind, then falls into a small storage bin that funnels it into an impeller type fan. This fan airveys the regrind through steel tubing to a regrind storage TOTE bin.

Again, since we are airveying, an air dissipating cyclone is mounted on top of the TOTE bin. Several permanent magnets are inserted between this cyclone and the TOTE bin to prevent metal contamination beyond this point. These magnets are accessible through a hinged door and should be cleaned periodically.

This TOTE bin is the major storage area for regrind just as the first TOTE bin was for virgin. From here the regrind is conveyed to the blender by a material feeder in the same manner as the virgin was.

The blender, therefore, mixes the color, virgin, and regrind together in adjustable proportions.

In the case of the large blowmolding operations, a central resin handling system may be employed serving a group of machines. All machines operating on a single system must, naturally, use the same color and type of resin. This type of system, although larger, involves the same general kinds of equipment.

When installing a resin handling system, it must be taken into account that the normal scrap grinder used in such a system will generate more noise than is allowed by the Walsh-Healy Act. The grinder must, therefore, be housed in a room separate from all work areas.

Natural (uncolored) Resin Handling System

This system includes the equipment to store, blend, and convey virgin resin and regrind scrap to the blow molding machine in proper proportions. As before, the following explanation will follow the material as it passes through the system.

The virgin resin is stored in a TOTE bin from which it is fed directly to the blow molding machine hopper by means of a ratio loader, which is a motor driven vacuum device. The ratio loader operates intermittently and is controlled by a level switch in the machine hopper.

If the system is equipped with a Uniloy® bottle finishing line, it will also have a scrap reprocessing system. This system collects the scrap flash trimmed from the container and airveys it to the scrap grinder. Since the airveyor is moving a large volume of air in order to entrain the scrap, the scrap grinder is equipped with a cyclone separator. The cyclone allows the air to escape while the scrap settles down into the grinder. If the air was forced directly into the cutting chamber of the grinder, ground plastic and dust would be blown all over the area. It might also create enough back pressure in the airveyor to prevent proper conveying and cause plugging in the airveyor duct work.

As plastic scrap enters the grinder, it encounters several rotating and fixed blades between which is is sheared over and over again until it is approximately pellet size at which time it may pass through the perforated screen below the cutting chamber. The scrap, which is now called regrind, then falls into a small storage bin that funnels it into an impeller type fan. This fan airveys the regrind through steel tubing into a regrind storage TOTE bin.
Again, since we are airveying, an air dissipating cyclone is mounted on top of the TOTE bin. Several permanent magnets are inserted between this cyclone and the TOTE bin to prevent metal contamination beyond this point. These magnets are accessible through a hinged door and should be cleaned periodically.

This TOTE bin is a major storage area for regrind just as the first TOTE bin was for virgin resin. From here the regrind is conveyed to the blow molding machine hopper in the same manner as the virgin resin was.

The ratio loader, therefore, conveys both virgin and regrind to the machine hopper. It is not a blender in the strict sense, but it will deliver the two materials in variable proportions and satisfactorily mixed.

In the case of large blow molding machine operations, a central resin handling system may be employed serving a group of machines. This type of system, although larger, involves the same general kinds of equipment.

NATURAL (UNCOLORED) RESIN HANDLING SYSTEM

Item Part Name

A  Virgin Line to Blow Molder1-1/4 EMT Tubing
B  Regrind Line to Blow Molder1-1/4 Tubing
C  Regrind Tote Bin
D  Scrap Return
E  Virgin Tote Bin
F  Regrind Cyclone
G  2" EMT Tubing
H  Scrap Separator
I  Scrap Grinder

When installing a resin handling system, it must be taken into account that the normal scrap grinder used in such a system will generate more noise than is allowed by the Walsh-Healy Act. The grinder must, therefore, be housed in a room separate from all work areas.
THE EXTRUDER

The extruder is the heart of the blow molder. It is where the resin pellets are heated, melted, and mixed into a mass of molten plastic, forced into the extrusion head then extruded in the form of a parison to be blown into its final shape within the mold. It is composed of several sections which are described herein.

Hopper
This is a conical shaped holder for the resin handling system. It is generally mounted on top of a magnetic separator on the feed throat of the barrel. The hopper is equipped with a plexiglass window for observation of the material level within the hopper. It also has a side discharge port used for color changes or resin changes.

Magnetic Separator
Between the hopper and the feed throat mounting is a magnetic separator for the removal of any stray metallic particles that may get in the resin from the regrind resin material or into the regular resin. This should be cleaned at the start of every day’s operation.

Barrel/Screw Assembly
This is the plastic producing part of the blow molder. The barrel is a hollow seamless steel heavy walled tube. It has an “Xalloy” lining for wear-resistance. The barrel has a side opening at one end for the feed throat to mount on.

Screw
The screw which is continuously rotating is made of stainless steel. It has auger-like flights that have been treated with stellite and ground. These are for the conveying of the plastic resin through the barrel and presents a tough wear resistant surface.

The design of the screw divides its length into four zones. They are Feed, Transition, Metering I, and Metering II. Each zone affects the pitch of the screw flights and root diameter of the flights. The root diameter of the screw becomes smaller as it progresses through the zones toward the tip.

As plastic resin pellets enter the feed section they are transported forward by the flights. As the pellets enter the transition zone they are pressed against the heated wall of the barrel.

EXTRUDER BARREL

Item
A. Hopper
B. Magnetic Separator
C. Feed Throat
D. Heater/Cooler Bands
E. Barrel
F. Screw
G. Barrel Support
H. Screw Key
Here they are melted into a molten mass, not only by heat generated from the heater bands but also by the friction created by compression of the pellets. The material is converted continuously into melted plastic as it moves through the transition zone. Continued rotation of the screw forces the mass into the metering zones which mixes the plastic to free it of any air. It is further mixed in the second metering zone and pumped to the extrusion head.

**Heater/Cooler Bands**
Surrounding the outside of the barrel are cast aluminum heater/cooler bands. These are grouped into zones approximating the design of the screw. The control of each zone is by a set point form of temperature controller which will call for heat if the temperature falls below the set point band width. Or it calls for cooling if the temperature rises above the set point band width for the zone involved. Each zone is controlled individually. The temperature of each zone is monitored by a thermocouple set into the barrel.

**Barrel Cooling**
This is accomplished by means of a heat transfer fluid being pumped through the coils of the heater/cooler band segments that surround the barrel. The fluid is pumped from the reservoir of the barrel cooling unit to the particular zone called for by the temperature controller for this zone. The transfer fluid picks up excess heat and the now hot fluid is returned to reservoir via a heat exchanger which cools the transfer fluid before going into the reservoir to be recycled again. For more details see a separate section on the Barrel Cooling unit in this manual.

**Extruder Drive**
The extruder screw is driven by a 125 horsepower variable speed DC motor. The motor, in turn, drives a gear reduction unit, coupling the two is a matched set of "C" section V-belts. Note: Always replace worn belts with a matched set. Make sure that sheave alignment both for vertical and horizontal is correct. Belt tension must be equal for all belts. The tension for each belt is measured by deflection of the belt. It should require some 5-8 lbs. of force to deflect the belt 5/16" when measured over its length from pulley to pulley.

**Gear Reducer**
This is a double reduction helical gear reducer. It is designed for quiet running, trouble-free operation. It has its own cooling system. This is covered separately in this manual. The reducer output shaft is hollow.

**RECOGATING POWER TRAIN**

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>1. Barrel Mount</td>
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<tr>
<td>2. Split Ring</td>
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<td>3. Barrel</td>
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<tr>
<td>4. Screw</td>
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<tr>
<td>5. Spline Shaft</td>
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<tr>
<td>6. Ball Spline</td>
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<tr>
<td>7. Gear Reducer</td>
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<tr>
<td>8. Hollow Output Shaft</td>
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<tr>
<td>9. Thrust Bearing</td>
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<tr>
<td>10. Shot Cylinder</td>
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<tr>
<td>11. Matched V-Belts</td>
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<tr>
<td>12. Drive Sheaves</td>
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</tbody>
</table>
Fitted to this hollow shaft and secured with eight Allen head cap screws is a ball spline unit.

**Ball Spline Unit**
The screw is socketed to one end of the spline. The opposite end rests against the thrust housing. Torque is transmitted to the spline by the ball races mounted between the spline and outer housing. This allows for forward and rearward movement of the screw with respect to the barrel. The ball race transmits rotational torque to the screw.

**Reciprocation**
Both the gear reducer and barrel are stationary. As the continually rotating screw produces more plastic it forces the screw rearward, filling the void in the barrel with a molten mass of plastic. At the rear of the thrust housing is a hydraulic cylinder whose rod presses against the thrust housing, when the plastic mass has filled the barrel void with the correct amount.

The hydraulic cylinder forces the thrust housing, ball spline, and screw forward driving the plastic mass into the die head forming the parisons. This motion is called making the "shot."

**Shot Cylinder**
The shot cylinder holds the screw fully forward after the shot momentarily then the hydraulic pressure in the cylinder is gradually bled off and the force of the continuous build up of plastic in the barrel forces the screw rearward. This movement is called the fill time. For further details on the control of the shot cylinder see the Hydraulic Section of this manual.

**Gear Reducer Cooling System**
The extruder gear reducer has a recirculating lubricant system which also is cooling the gear lubricant and the gear reducer itself. The lubricant is withdrawn from the reducer by the pump and forced through a heat exchanger where it is cooled then returned to the gear reducer.

The desired temperature is regulated by the flow control valve on the water outlet line of the heat exchanger. Dial thermometers placed at various points let you know the temperature of the system. The thermometer at the discharge of the pump will show reducer temperature. The one at the outlet shows the return oil temperature. The temperature at the outlet of the pump should never exceed 140° F. nor below 100° F. The remaining thermometers are for water inlet and outlet temperatures.

The lubricant used in the gear reducer should be drained and replaced every 2,500 hours of use. Also, check the level weekly. There is a dip stick in the top of the reducer for this purpose. See the section on Lubrication.
elsewhere in this manual for selecting the correct grade of oil for the reducer.

**Barrel Cooling System**

The barrel cooling system is designed to remove excess heat from the barrel to help in producing a more uniform melt temperature. This is accomplished by means of a heat transfer fluid. This fluid picks up heat very readily. Then by allowing it to flow through a heat exchanger, the fluid is cooled, then recirculated to absorb more heat. This system of exchanging heat is in a closed loop system, requiring very little, if any, maintenance work.

The fluid is pumped from a 15 gallon reservoir under 20 PSI pressure to each of four heat zones on the extruder barrel. Each zone is made up of cast aluminum heater/cooler band segments which contain the cooling coils and heater elements. There is a solenoid valve in the inlet line to each zone which responds to a command calling for more or less flow of coolant flow through the zone coils. The outlet of the zone coils is returned to first go through a water cooled heat exchanger which extracts the heat from the fluid, and returns it to the reservoir.

**The Water System**

Cooling water is required by the blow molding machine for the removal of excess heat from several systems within the machine proper: the molds, hydraulic units, extruder barrel cooling unit, and extruder gear reducer cooling unit.

The form of cooling water is generally chiller water or tower water, or both forms are used. For mold cooling chiller water is almost universally recommended and used. The remainder may be run on tower water.

The water supply piping internally in the machine allows the owner to select the method of use for cooling water. Normally, the main water connections are at the rear of the machine. For a split system the additional connections may be made at the side.

The flow rate of water to each of the cooling units is regulated by means of flow control valves generally in the return line of each cooling unit. Each cooling unit is equipped
with thermometers to indicate its operating temperature. This may be regulated by adjusting the unit's flow control valve.

Approximate operating temperature are.

Hydraulic Unit (both)  110-120° F.

Programmer Hydraulic Unit  110-120° F.

Gear Reducer  120-140° F.

Barrel Cooling  150-200° F.

Mold Cooling
Chilled water is a major requirement for mold cooling. The consideration is maximum heat load and the volume of chiller water required, as the greatest portion of cycle time is used in cooling the formed plastic. Plastic enters the mold at a temperature of 350° F. and must be cooled to 180° F. as quickly as possible. This means that the molds be as cold as possible.

The limit of coolness, of course, is related to relative humidity and the mold open (cycle) time also plays a factor in determining the flow of chilled water. Mold operating at temperatures below the dew point can often be used without ill effects. Molds operating too cold for the ambient conditions will sweat on the mold cavity walls causing water spots on the finished containe
THE RECIPROCATING PROGRAMMABLE HEAD

Multiple parison heads such as used on the 400R25 are structured similar to the one shown on the following page (Figure 1). The following will cover this structure.

1. Manifold Block
Molten plastic from the extruder is forced into the manifold block where the stream is split up into several paths, one to each head. The size or diameter of each is different depending on the flow resistance and distance traveled. This is to provide a uniform flow to each head. Electrical heater bands are mounted to the manifold for keeping the plastic in a flowing state.

2. Choke Screw
Mounted in the manifold block path for each head is a choke screw and lock nut. This is for further balancing the flow.

3. Feed Throat
Mounted to the manifold block is the feed throat. This forms the outer shell of the head.

4. Feed Throat - Heater Bands
There are two electrical heater bands surrounding the feed throat for heating the throat and plastic.

5. Pressure Ring
The pressure ring as its name implies causes back pressure on the plastic flowing into the feed throat to help produce a better "weld" at the seam. Its position or concentricity to the mandrel is adjustable for varying the wall thickness of the parison at different points.

6. Adjusting Screws
There are four socket head set screws placed in the feed throat for adjusting the pressure ring. Loosen the screws opposite the direction you wish to move and tighten the ones in the direction you wish to have the ring move.

7. Die
The die forms the outer diameter of the parison. It is adjustable in the same manner as the pressure ring. It should be adjusted if a change is made to the pressure ring to keep the parison falling straight.

8. Die Heater Band
Strapped around the die is an electrical heater band for keeping the die and mandrel hot and for the proper flow temperature.

9. Die Adjusting Bolts
There are four "ferry head cap screws" mounted in the feed throat for adjusting the die in relation to the mandrel. These four bolts are for that purpose and are adjusted in the same manner as the pressure ring.

10. Retaining Ring
This ring is bolted to the bottom end of the feed throat. It holds the die firmly in place against the pressure ring.

11. Diverter Sleeve
The diverter sleeve divides the incoming flow of plastic into two uniform streams diverting it around the mandrel. At a point the two streams meet on the opposite side of the mandrel, the plastic "welds" together again forming a seamless tubular shape. Under the right conditions of pressure and temperature the seam will be unnoticeable in the plastic container.

12. Sleeve Adjusting Nut
The mandrel sleeve threads into this nut. By adjusting this, the sleeve may be raised or lowered.

13. Mandrel Sleeve
The sleeve is concentric with the outside diameter of the mandrel. It is held in position by the sleeve adjusting nut. Its vertical position plays an important part in determining the flow past the point of the pressure ring for wall thickness.
RECIPIROCATING PROGRAMMABLE HEAD

1. Manifold Block
2. Choke Screw
3. Feed Throat
4. Feed Throat Heater Band
5. Pressure Ring
6. Adjusting Screws
7. Die
8. Die Heater Band
9. Die Adjusting Bolts
10. Retaining Ring
11. Diverter Sleeve
12. Sleeve Adjusting Nut
13. Mandrel Sleeve
14. Upper Retainer Ring
15. Mandrel
16. Programming Cylinder
17. Moog Servo Valve
18. LVDT
20. Pre-Finish Cylinder
21. Limit Switch

Figure 1. Programmer Head
14. Upper Retainer Ring
Finishes off the upper part of the head feed throat, holding the sleeves in place.

15. Mandrel
The hollow stem mandrel forms the central core of the head. When properly adjusted for "die gap" it can determine the wall thickness by determining the inside diameter. The mandrel is threaded at its upper end into the hollow shaft of the programming cylinder.

16. Programmer Cylinder
This is a hollow shaft hydraulic cylinder which is programmed to cause changes in wall thickness of the parison as the plastic flows from the head. It also will stop the flow of plastic from the die area by pulling up on the mandrel closing the die gap.

17. Moog Servo Valves
This is the control valve controlling with precision the amount of movement. The programmer cylinder responds to its command signal. There is one for each programmer head.

18. LVDT
This transducer provides an electrical feedback signal to the programmer control unit indicating the amount of movement the programmer cylinder moves and its direction whenever a command signal is given.

One end is attached to the rod of the prefinish cylinder. At the opposite end the blow pin is attached. At the side is provided an air line connection for both the blow and prefinish air.

20. Prefinish Cylinder
This cylinder raises and lowers the long blow pin down into the mold and raises it from the mold. It is hydraulically operated. Flow control valves control the cylinder speed in both directions. In multiple parison heads all of the blow pin cylinders must be adjusted for uniformity with each other.

21. Limit Switch
When the blow pin cylinder is fully up the switch is made, telling the cycle controller that it is ready to side shift the clamping unit.
THE SIDE SHIFT CLAMP

The side shifting type of clamp is generally used for the ability to make off-center neck containers, as in the case of the 400R25. It not only is equipped with the clamp shift, it also is a dual sized clamp holding six molds. The motions of the clamp move front to back and side to side. The main purpose of the clamp is to firmly hold the mold half tightly while the container is being blown, and to reposition itself for off-set necks. The following paragraphs will cover the features of the clamp assembly.

Side Shift Assembly
Refer to Figure 1, on following page. Mounted on the machine base frame (1) are six cross slide rails (2) running left to right, three to a side. Mounted to this frame is a hydraulic cylinder (3). Mounted in line with the cylinder at either side of the frame is a stop screw (4). This is for the purpose of limiting the stroke of the hydraulic cylinder for side shifting of the clamp frame.

The Clamping Assembly
Mounted on the machine base slides rests the clamp shift frame (5), on bronze slide shoes (6). Connected to this frame is the hydraulic cylinder rod for side shifting the clamp. On the top of this frame, a pair of slide rails (7) runs front to back. On these slide rails, the clamp platens are mounted, (8), (9), and (10).

The clamp proper consists of the three platens: front, center, and rear. The front and rear platens are connected by six tie bars (11). The center platen (9) is suspended on the tie bars and is free to slide back and forth while on the tie bars.

Mounted to the clamp base between the center and rear platens are two rotary actuators (14). These are linked to the front and rear platens by a toggle linkage (17). The rotary actuators are hydraulically operated. Through the linkage a counter clockwise rotation of the rotary actuator of 100° moves the rear platen backward along with the front platen. It has pushed the center platen forward, thus in effect closing the clamp. A equal clockwise movement of the rotary actuator will move the rear and front platens in a forward direction while pulling the center platen to the rear, thus opening the clamp. The rotary motion of the actuators produces a linear motion to the platens, causing the front and center platens to move towards each other, while an opposite rotation moves the front and center platens away from each other, thus opening the clamp.

The velocity of the platens' motion starts out at a high speed, and as the rotary actuators' motion nears the end of rotation the velocity diminishes almost to zero. This smooth reduction in speed increases mold life by eliminating all of the impact forces common to many other types of machines.

The hydraulic system operating the rotary actuators produces a low pressure close and a higher pressure lock-up of the clamp. This feature prevents mold damage if some object happens to have fallen between the molds, such as a parison that clings to the blow pin and creates a mass of plastic rather than a parison, the low pressure will not squeeze it into the mold. Under these circumstances the platen movement will be stalled, and after a short time delay, the clamp goes into reverse and opens. Any automatic time cycling will stop.

Platen Adjustments
There are several adjustments required to position the mold under the parison head. First of all, the platens should be parallel to each other and square with the direction of their movement. To adjust this may be accomplished with the tie bar adjusting nuts (12) at the rear of the clamp. These nuts are also used to obtain proper lock-up tension on the molds.
Adjusting these nuts will control the distance between the center and front platens and provide a correct lock-up tension on the molds. Proper adjustment of this distance and lock-up tension will stall the rotary actuators at low pressure but not at high lock-up pressure.

A single check for the uniformity of tie bar nut adjustment is to place a single thickness of paper between the top and bottom of the outside molds, and then close the clamp until it is completely locked up. All four pieces of paper should be tight. Now the center tie bars can be tightened.

Once the platens have been oriented to each other, the next step is to bring the entire platen assembly into the proper relationship with the head. This is done by loosening the cap screws which hold the rotary actuator base (15) to the clamp frame, and rotating the adjustment shaft (22) at the side of the clamp assembly. When the proper location is set, the cap screws should be re-tightened.

**Side Shift**

The clamp frame that the platens are mounted on is moveable from left to right, and is powered by a hydraulic cylinder (3). This side movement is termed side shifting and is used to enable the blowing of containers with off-center necks. The amount of shifting is limited by the adjustment stop screws (4) secured to the machine base.

**CLAMP ASSEMBLY**

**Item**

1. Machine Base
2. Shift Slide Rail
3. Hydraulic Cylinder
4. Stop Screw
5. Shift Clamp Base Frame
6. Base Frame Shoe
7. Clamp Rails
8. Front Platen
9. Center Platen
10. Rear Platen
11. Tie Bar
12. Split Tie Bar Nut
13. Platen Shoes
14. Rotary Actuator
15. Rotary Actuator Base
16. Right Hand Adapter
17. Toggle Link Arm
18. Clevis
19. Link Pin
20. Bushing
21. Bushing Retainer
22. Rotary Actuator Adjusting Shaft
23. Side Shift Limit Switch
24. Center Adapter Arm
25. Left Hand Adapter Arm
Clamp Limit Switches
Limit switches affecting the operation of the clamp are mounted along the side of the right hand rotary actuator. The switches are either actuated by the rotation of the rotary actuator or by a change in position of the rear platen. See Figure 2. LS-2 and LS-3 are activated by a arm attached to the rotary actuator and cam adjusted. The remainder are activated by pencil like rods that mount into the rear platen or the clamp side shift base frame. These rods are adjustable. The functions are:

LS-2 Activated calls for high pressure for lock-up adjust cam to trip when molds are within 1/4" of being closed.

LS-3 Activated turns on blow delay and blow air timer adjust so switch trips as the molds close.

LS-4 Activates starts the stripper down. Adjust so switch trips when the mold mating surface is 1/2" farther apart than the width of a blown container.

LS-5 This starts the plastic to extrude. It is adjusted to trip after LS-4 is tripped.

LS-7 This is adjusted to trip after LS-4. It is used to keep the clamp closed.

LS-9 This switch (23) signals that the clamp has shifted and the blow pins can be extended into the neck area of the mold.

LS-12 This switch is adjusted to trip when the mold is within 1/4" of being closed in full lock-up making the clamp closure pause momentarily to allow preblow air to enter the parison and fill it out before blowing.

Figure 2. Clamp Limit Switches

Lubrication
There are several points on the clamp and shifting base that require lubrication with grease. These are the toggle pin bearings, platen shoes, tie bar bushings, and shift frame shoes. These points are all served by an automatic lubrication system, Figure 3. This system reservoir should be filled with Mobilux EP-1 grease or its equivalent. The system is operated by compressed air and controlled by a timer.

Figure 3. Clamp Lubrication Unit
Clamp Safety Doors
The entire clamp area of the machine is guarded by expanded metal sliding safety doors. Also, a fixed guard is placed over the front and center platens to prevent reaching over the sliding doors. This fixed guard is positioned beneath the parison head. Adjustments can be made to the head without removal of this guard. Each section of the safety doors operates both a three-way air valve and limit switch. The air valves provide air pressure to a pressure safety switch and an air signal to a hydraulic safety valve in the clamp operating circuit. The pressure switch when interrupted by the lack of air signal shuts off electrical power to all machine front end controls. These safety interlocks are in effect at all times, whether in manual or automatic cycles. They should be checked periodically to ensure that they are functioning properly. To check, merely open any one of the safety doors and attempt to open or close the clamp. They should be completely inoperative. **Under no circumstances should a machine be operated with any of the safety guards or devices removed or rendered inoperative. Remember it is for your own safety.**
SWINGING ARMS

The swinging arm unit assembly is for removing blown containers from the molds, and depositing them on a conveyor. The assembly is hydraulically operated with the exception of the tail gripping fingers that are pneumatically operated. The unit is mounted in front of and parallel to the clamp. The swinging arms are mounted on a long shaft which is free to turn in a bearing at one end, and the other end is attached to a rotary actuator which is located on the left side of the machine. A counter clockwise rotation of the actuator swings the arms inward toward the molds, while a clockwise movement swings the arms away from the molds.

Mounted on the arm assembly is a hydraulic cylinder which extends the length of the arm finger portion of the assembly. During operation both motions are present. As the arm swings in, it extends to reach the mold, and as it swings away from the mold, it is retracting the length of the arm in order to properly deposit the container on the conveyor.

The fingers are cylinder operated which are open on the inward swing to be able to grip the tail. They close upon the tail before the mold opens, and during the reverse swing motion, opening to release the container. Limit switches and cams that are mounted on the rotating shaft control the motions.

To prevent the fingers from sticking to the hot plastic tail of the container, the fingers are water cooled with chiller water. Valves to regulate the flow of water through the fingers also are located at the left of the machine.

Hydraulic valves controlling both pressure and direction to both the rotary actuator and hydraulic cylinder are located on the power unit, while flow control valves for both devices are located close to the device. (Refer to the Hydraulic Section of this manual under the part "Additional Circuits").

As a safety guide, hydraulic pressures used to operate either the rotary actuator or the cylinder should never be set for full system pressure. The pressure should be set only
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Plastics Machinery Division

high enough to perform the required motion at the required speed without affecting the cycle timing. This, if carefully set, will help prevent damage or injury if an object were to get in the way of the arm's motions by stalling it. This will not prevent something or someone from getting in its path. It pays to observe all safety precautions. Stay out of its path of motion.
MOLDS

The molds perform the last major operation in blowing a plastic container. Each mold half is mounted on a moveable platen, which when closed centers the mold directly under the die and mandrel. Each clamp accepts two molds. Each mold half is made up of three parts: the neck ring, the mold body, and the bottom insert. These parts are attached to a back plate which in turn is mounted by means of screws to the platen.

Pinch-off is required at any point around the cavity where there is flash. This is depressed area adjacent to the cavity and separated from it by a sharp edge. This sharp edge severs the flash from the container except for a very thin film and facilitates the trimming of the flash. The depth of the pinch-off area is important because if it is too shallow, the molds will be held open, and if it is too deep, the flash will not be properly cooled. Caution must be exercised when changing either container weight or type of resin. Either of these can cause a change in the depth of pinch-off required.

Because the extruded parison is usually 350°F., the molds are water cooled. Normally, this is done by passing chilled water through a series of drilled passages in all three parts of the mold.

Molds are built to exacting dimensions and must be treated as precision tooling. Damage can occur through misuse which results in expensive repair and loss of production. The parting line which includes the pinch-off is very easily damaged. Care should be exercised not only when the mold is in production, but also when in storage.

MOLD

Items

A. Bottom Insert
B. Dowel Pin
C. Mold Body
D. Water Line
E. Neck Ring
F. Tail Grabber Slot
G. Pinch-off
H. Backing Plate
Ram Down Interference Pre-Finish
This arrangement will eliminate the need to convey the container through a facing station to finish the neck.

It is applicable only to container necks whose finishes do not require internal lips or grooves. This I.D. of the finish must be straight and smooth. The main purpose of this system is to produce a heavy walled neck finish.

The pre-finish system is composed of a neck ring, insert, blow pin, and a cylinder arrangement for moving the blow pin up and down. In Figure 1-1 the mold is closed, and the blow pin is extended below the top surface of the insert. In Figure 1-2, the blow pin is down, forcing plastic into the neck finish. The blow pin stroke is determined by the stroke of the pre-finish cylinder. To increase shearing action of the blow pin, adjust it downward so that greater pressure will be applied at the point of interference, or where the blow pin shear sleeve insert and the shear steel meet.

Side Shift Ram Down Pre-Finish
When pre-finishing off-center neck finishes on a shifting clamp, the parison is extruded to the center of the mold. Figure 2-1. The clamp mold closes, then shifts, to align the neck to the blow pin. Refer to Figure 2-2. Then the blow pin is extended into the neck forcing plastic down and pre-finishing the container.

Figure 2. Pull-Up Pre-Finish System

The pre-finish system is composed of a neck ring, insert, blow pin, and a cylinder arrangement for moving the blow pin up and down.

The blow pin stroke is determined by the stroke of the pre-finish cylinder. To increase shearing action of the blow pin, adjust it downward so that greater pressure will be applied at the point of interference, or where the blow pin shear sleeve insert and the shear steel meet.

The size and number of these passages is determined by the container design. The cooling of the container in the mold is of the utmost importance because it is by far the greatest single factor in cycle time. In general, the cooling water should be as cold as existing ambient humidity conditions will allow. Molds will sweat when the temperature of the coolant is below the dew point and condensed water drops inside the mold cavity will mar the appearance of the container. However, the mold open time is so short on these machines that mold temperatures can usually be well below the dew point.

Caution: If Blow Pin Is Set too Low, Damage to Shear Steels, Blow Pins, or Both Will Occur. If Set Too High, No Shearing Action will Occur and Neck Finish will Not be Complete.
HYDRAULIC SYSTEM

The hydraulic system of the 400R25 has both simple and complex circuit functions used to perform some of the hydraulic activities of the machine. To help simplify the total circuit, it has been broken down into smaller circuits explaining the components involved, in the hope that you will have a better understanding of the total machine circuit. Remember all circuits are connected to the same pressure source, the pump, with the exception of the programmer circuit which has its own power source. It too is covered for your information.

General Notes on Operating
Always watch your operating temperature, never allow the oil to run hot (160° F.), find out what the cause is and fix it. Normal operating temperature 110-120° F.

Never allow filters to run in the "bypass" mode as all the dirt they have collected will be washed on into the system.

Learn to change elements regularly. It will save you money in the long run.

Always use a premium grade hydraulic oil. Uniloy recommends Mobil "DTE-26", or its equivalent. Never mix different makes of hydraulic oil. If changing brands, always drain the reservoir of all existing oil first. To keep the system in its best condition, flush the system of the first load of oil after 1,000 hours running time, and at intervals of 2,500 hours thereafter.

Maximum system pressure 1,500 PSI.

Maximum accumulator pre-charge 1,000 PSI of dry nitrogen only.

Plate I  The Main Hydraulic Power Unit

1. Reservoir  This has a capacity of 100 gallons of oil. Use only a premium grade hydraulic oil such as Mobil "DTE -26".

2. Automatic Temperature Switch  It will shut the hydraulic system down if the oil temperature is allowed to get too hot (130° F.).

3. Suction Filter  74 micron with element condition indicator and top loading element for replacement.

4. Heat Exchanger  This is mounted off the power unit, receives hot oil from the pump. Here it is cooled before returning to the reservoir.

5. Flow Control  For regulating the flow of water through the heat exchanger.

6. Pump  Racine PSV-40. This is a pressure compensated variable volume pump, pumping 30 GPM @ 1,500 PSI.

7. Electric Motor  30 horsepower at 1,750 RPM, 460 volt, 60 cycle, 3 phase.

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Main Power Unit Circuit
8. **Pressure Filter**  10 micron, top loading replacement element, filter condition indicator.

9. **Check Valve**  Isolates the pump from the high charge in the accumulators, preventing any damage to the pump from any reverse flow of oil under pressure.

10. **Ten Gallon Accumulator**  Precharged to 1,100 PSI. Provides the necessary storage of hydraulic oil under pressure to make the plastic shot in the barrel to fill the die head.

11. **Pilot Operated Check**  Automatically dumps the accumulators to tank as soon as the main pump motor is turned off or a loss of pressure occurs.

12. **Manual Operated Valve**  To be used only if the check valve 11 should fail for some reason. **Keep tightly closed at all other times.**

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**Plate II The Clamp Circuit Components**

Components controlling the clamp rotacs are located on the main manifold. This covers the valves that are associated with the clamp rotary actuator.

13. **Pressure Reducing Valve**  This is a dual pressure type valve allowing a low pressure for clamp closing and a high pressure while the parison is being blown. The valve shifts between high and low by signal to solenoid

2. The "A" regulator is set for 450 PSI while the "B" regulator is set for 100 PSI. The remote control line is connected to valve 14.

14. **Air Operated Pilot Valve**  Forms a interface between the pneumatic safety circuit and the hydraulic. This valve requires a 40 PSI air signal to operate. The remote control line of valve 13 is connected to the "P" port, the "A" port to tank. The "B" port and "T" ports are plugged. With no air signal, the remote control line from valve 13 is vented to tank through valve 14, and valve 13 passes no pressure to valve 15.

15. **Clamp Operating Valve**  Both pilot and slave sections form a three position valve
with the "A" and "B" draining to tank in the neutral position. The pilot valve is solenoid operated. Sandwiched between the slave valve and the pilot valve is a sequence valve for limiting pilot pressure to 100 PSI.

16. **Flow Control Valves** They are used to balance the flow in the hydraulic lines to the rotacs.

17. **Clamp Rotacs** The bi-directional hydraulic device used to open and close the clamp hydraulically.

**Plate III The Shot Cylinder Circuit**

18. Oil at 1,500 PSI and at more than sufficient volume stored in the accumulator circuit is delivered to valve 18 which is a pressure reducer. There it is reduced to 1,100 PSI. The pressure setting is factory set so **Do not make any adjustment to this valve**. The compensator of this valve is used to work with valve 19.
The remote control line of valve 18 is connected to the drain line of valve 21. In this condition, valve 18 will pass flow to valve 19. The compensator of valve 18 works under pressure in the remote control line. In the opposite condition, (no pressure in the remote control line), valve 18 is shut down.

19. Valve 19 Using the compensator of valve 18, it now becomes a pressure compensated flow control. It is adjustable for regulating the speed of the shot cylinder.

20. The Shot Cylinder Having a 10" diameter bore and a 16" stroke, the shot cylinder will develop 39 tons of force against the plastic load in the barrel.

21. Pressure Relief Valve The inlet is connected to the shot cylinder. Its drain line is connected with the remote control line of valve 18. When this line is under pressure from valve 18, valve 21 is shut down and no oil can be passed back to tank. However, when no pressure is present in this line, the opposite is true, valve 18 is shut down and valve 21 is active. Valve 21 is adjustable to regulate back pressure.

22. Valve 22 This is a two-position, spring return solenoid valve. It is hooked up so that in the de-energized position of the valve, its "A" port is connected to the line between valves 18 and 21. Energizing the solenoid causes valve 18 to be vented to tank making it inoperable and valve 21 operable. Thus valve 22 acts like a switch, switching from one valve to the other.
Plate IV Additional Circuits

23. Pressure Reducing Valve Manually adjustable this is commonly used on all the circuits as shown here. It reduces the individual circuit pressure.

24. Directional Valve This is a two-position, spring loaded solenoid valve common to both the swing arm and clamp shift circuits for motion direction.

25. Flow Control Valves Common to both circuits for flow-speed control.

26. Rotac A rotary actuator for moving the swing arms in and out from under the molds.

27. Hydraulic Cylinder This cylinder is used to extend and retract the length of the swing arm as it is driven by the rotac motion.

28. Deceleration Valve This is a cam operated type valve to control the smoothness of the clamp side shift deceleration without jarring a parison during the mold movement.

Swinging Arm and Clamp Shift Circuits
Plate V  Prefinish Cylinders

29. **Hydraulic Cylinder**  For side shifting the mold clamp section.

30. **Pressure Reducing Valve**  It is set to lower the system pressure from 1,500 PSI to 800 PSI for use with the prefinish cylinders.

31. **Directional Valve**  This valve has a pneumatic valve operator with a source signal from the pneumatic system. When the signal is present, it causes the pilot valve to shift along with the slave portion which sends the prefinish cylinders downward with the blow pins. An absence of this air signal keeps the prefinish cylinders in the up position.

32. **Flow Control Valve**  Each cylinder is equipped with two flow control valves, one for the cap end of the cylinder and one for the rod end. They are required to each be adjusted so that all prefinish cylinders have equal and uniform motion.
33. **Prefinish Cylinder** They are the uppermost cylinders mounted on the parison head. The blow pin is attached to the rod of the prefinish cylinder.

**Plate VI Programmer Circuit**

**Note:** The hydraulic system is composed of two independent hydraulic systems and power units; the programmer is the second unit.

34. **Hydraulic Reservoir** Capacity 36 gallons. It is fully equipped with all necessary components.

35. **Suction Filter** This is a strainer type of 100 micron. The element is non-replaceable.

36. **Ball Check** In this location, it prevents the pump from losing its prime.

37. **Electric Motor** Pump drive is 10 HP and 1,200 RPM.
under pressure for the six programmer cylinders. Precharged to 1,000 PSI.

46. **Dual Pressure Filters** These are Pall .5 micron filter elements for filtering oil to the servo valves.

47. **Moog Servo Valve** For the programming cylinders.

48. **Programming Cylinders** Operate the die head mandrel to vary parison wall thickness.

38. **Hydraulic Pump** 6.2 GPM @ 1,500 PSI when driven at 1,200 RPM.

39. **Unloading Valve** Set of 1,500 PSI for unloading the pump.

40. **Return Filter** 3 micron. Filters oil being returned to the reservoir.

41. **Heat Exchanger** Cools the oil being returned to the reservoir.

42. **Ball Check Valve** For isolating the pumping unit from the accumulator.

43. **Manual Pump Valve** For discharging the accumulator. Keep closed at all times when not in use.

44. **Flow Control Valve** For regulating the water flow through the heat exchanger.

45. **Accumulator** This has a 10 gallon capacity. It is used for storing a volume of oil.
PNEUMATIC SYSTEM

Compressed air is required by the 400R25 blow molder. The pressure supplied should be at least 125 PSI with a minimum of 100 PSI. This supply pressure is measured at the point of entry to the safety lockout valve on the left mid-section of the machine.

Compressed air used by the blow molder takes on two forms. Dry air for blowing, is filtered and all the moisture or condensate is removed before using. Air used for cylinders and valves is filtered and lubricated. Using the circuit schematic, the following is a description of the circuit.

1. Lox Air Shut-Off
   This shut-off and air safety lockout valve is connected to the main supply line.

2. Air Filter
   Has an automatic blow down and drain to remove any trapped moisture and dirt. Here the air line is divided, part to lubricated air and part to blow air.

3. Air Filter
   Air is filtered again, any condensate remaining is removed at this point.

4. Pressure Regulator
   This is set for 20 PSI and is used as the preblow air source.

5. Pressure Regulator
   This is set for 80 PSI and is used as the blow air source.

6. Solenoid Operated Valve
   This determines whether the high or low pressure will be used.

7. Air Piloted Air Valves
   Used for sending high or low pressure air to the blow pins or exhausting the container of blow air.

8. Solenoid Valve
   It either admits air to the pilot section of valve (7) or vents the pilot section.

9. Air Lubricator
   This lubricates the remainder of the air supply for use with valves and cylinders.

10. Air Regulator
    This regulator is set for 40 PSI and used for the safety system.

11. Solenoid Operated Valve
    This valve operates the stripper cylinder.

12. Solenoid Operated Valve
    On command this valve sends a air signal to hydraulic valve 31 for operating the prefinish cylinder circuit. See section on Hydraulics in this manual for more details.
13. Solenoid Valve
This valve operates the opening and closing of the swinging air gripping fingers.

14-15 Flow Control Valves
For regulating the speed of cylinders.

16. Door Safety Valves
Mounted in each safety door, requiring that all doors are closed to make the front end of the machine operable Do not defeat this valve circuit. It is for your own safety and protection.

17. Pressure Switch
This is also part of the safety system. A door open will prevent the front end portion of the blow molder from working. There will be no electrical power.

The air signal to the hydraulic circuit shown just above and to the right of the pressure switch activates hydraulic valve 14 to allow pressure to be present so the clamp will function. See further information in the Hydraulic Section.

The Stripper
The stripping unit is designed for stripping the container from the mold as it is opened, by ejecting the container downward.

The stripper is a pneumatic operated device which is dependent on lubricated compressed air as its source of power. The velocity at which it moves should be set for a reasonable rate of speed, but not to add any time to increase the machine cycle time. Care should be taken when setting the limit switch tripcams that the cylinder is all the way up, allowing the stripper plate to clear the molds when closed. This is controlled by the lower cam. The upper cam, limits the downward stroke. Stripper plates are designed to match the size of and number of parison heads in use on the machine. For further details, consult the Pneumatic Section of the manual.
THE ELECTRICAL SYSTEM

The electrical system for this machine consists of a variety of components ranging from a single pilot light to complex servo mechanisms such as the temperature controllers. In between lies an array of devices designed and interconnected to change, monitor, protect, or control the process of converting resin into a formed container. Fuses provide overload and short circuit protection for various parts of this system. Transformers are used to provide lower, safer voltage levels in some areas. Motor starters give us a means of remotely controlling the motors as well as protecting them against undervoltage and overload. Control relays form the brain of the cycle control, responding to various inputs from limit switches, timers, pushbuttons, etc., making decisions and controlling the outputs accordingly.

All of these items are pre-wired to a single main circuit breaker, the point at which the customer makes his connection to his power supply. This circuit breaker is interlocked with the control panel door, so that the door cannot be opened with the breaker turned on, and the breaker cannot be turned on when the door is open. There are means provided by which qualified personnel can defeat these interlocks.

The major loads in the system are shown in schematic diagram in a way that is largely self-explanatory. Therefore, these items are not covered in detail in this manual, which will be directed toward helping the operator and the maintenance man to understand the controls and the logic employed to make the machine run.

The electrical controls for a machine of this type are of a relatively complex assortment of interdependent devices which may be best understood by breaking by the system into sections.

The nameplate affixed to the panel door of each machine bears the drawing number of the schematic that fits any given machine exactly. It is suggested that the reader refer to this drawing when reviewing the sectional diagrams shown in the manual in order to understand how each section fits the overall picture, and also to detect any additional circuitry that may be peculiar to this machine.
MAIN CONSOLE DOOR - RIGHT SIDE - Figure 1

This door consists of:

1. **Temperature controllers** for the barrel (feed, transition, metering 1 and metering 2), nozzle, left and right die block, and feed throats for six heads. A stock temperature controller to display the temperature of the plastic at the end of the barrel. Also, it stops the extruder from operating if the plastic is not up to the set temperature.

2. **Variacs and fuses** for the six feed throat tip heaters (die tips). These variacs allow a controlled voltage to the die tip heaters for constant temperature.

3. **Main disconnect** used to shut all power "off" to the blow mold system, and allows the doors to be opened in the "off" position.

MAIN CONSOLE DOOR - LEFT SIDE - Figure 2.

This door consists of:

1. **Timers:** Charge delay, preblow delay, clamp pause, blow pin delay, blow delay, blow time, and exhaust.

2. **Push Buttons:** Emergency stop, heat and motor start and stop i.e., heat, hydraulics, programmer, extruder drive, and external circuit.

3. **Push Buttons:** Safety reset, power "On", shift ("Off", "On"), shot control (limit switch or programmer), barrel coolant ("Off", "On"), preblow (1, 2), and mold sequence (1, 2).

4. **Meters:** Cycle count, cycle time, and elapsed time (shows screw running time).

NOTE: Push buttons and selector switches, (Items E and F) are Allen-Bradley Type 13, Oiltite, style 800T.

SUB PLATE OF MAIN CABINET - Figure 3.

Behind Right Door:

1. Main disconnect - Customer main electrical hook-up. Disconnects all power to machine.

2. Distribution block from 30 KVA transformer for downstream of barrel heats.

3. Circuit breaker 2 - Disconnects all heats downstream from the barrel heats.

4. Circuit breaker 3 - Disconnects all barrel heats.

5. Circuit breaker 4 - Disconnects all controls and motors.

6. Fuses and contactor (1-PC) for variacs to control die tip heaters.

7. Fuses and contactors (2-PC through 5-PC) for barrel heat.

8. Fuses and contactors (6-PC through 13-PC) for die block and feed throat heaters.


10. Fuses and contactor (14-PC) for nozzle heat.

11. 3M starter and fuses for barrel coolant pump motor.

12. 4M starter and fuses for reducer coolant pump motor.

13. 6M starter and fuses for programmer hydraulic pump motor.

14. 1M starter for hydraulic pump motor.
SUB PLATE OF MAIN CABINET -
Figure 4.

Behind left door:

1. **Heat load wire** terminal blocks.
2. **Thermocouple wire** terminal blocks.
3. **Control wire** terminal blocks.
4. **Control transformer**.

5. **Fuse Blocks**: Control (Load of control transformer convenience outlets and Trouble Light line of control transformer).

6. **Control Relays**: 1-CR: SCREW FORWARD, and 2-CR: SCREW RETRACT; these two relays are controlled by LS-1 and LS-1A respectively and are required to provide additional points in the circuit that may be affected by these switches. 1-CR is energized when LS-1 is actuated at the forward end of the screw travel, and 2-CR is energized when LS-1A is actuated at the rear end.

3-CR: CHARGE energizes solenoid valve #1 reducing hydraulic pressure on rear of shot cylinder, allowing screw to move backwards or "CHARGE".

4-CR: AUTOMATIC CYCLE energized by "CYCLE START" push button provided that all safety doors are closed. Energizes mold cooling solenoid valves #8 to allow cooling water to flow through the molds.

5-CR: PRE-BLOW energizes solenoid valve #5 (5L and 5R) which introduces air into the parisons at reduced pressure.

6-CR: PRE-BLOW SHUT-OFF de-energizes PRE-BLOW AND BLOW RELAYS and energizes EXHAUST TIMER.

7-CR: HIGH PRESSURE energizes solenoid #2 to apply high pressure to the mold traversing mechanism; energized at all times except as molds are moving closed.

8-CR: LOW energizes solenoid #6, (6L and 6R) to start full pressure blow; energized when molds are closed and BLOW DELAY TIMER times out; de-energized when "Blow" timer times out.
9-CR: MOLD CLOSE energizes solenoid #4 to close molds.

10-CR: MOLD OPEN RELAY energizes solenoid #4 to open molds.

11-CR: BLOW PIN RELAY energizes solenoid valve #9 (9L and 9R) to drive blow pins down.

12-CR: AUXILIARY STRIPPER sets up the stripper control circuit; energized when molds start to open, de-energizes when stripper is in a downward position, actuating LS-6.

13-CR: STRIPPER energizes solenoid #7 (7L and 7R) to operate the stripper(s).

14-CR: CYCLE AUXILIARY ties beginning of successive cycle to end of preceding cycle, energized when stripper is in the downward position, actuating LS-6: de-energized by LS-1 when screw reaches forward position.

15-CR: SAFETY shuts down machine and sounds an alarm in the event of a failure or mal-function; energized by depressing "Safety Reset" push button; de-energized when (1) any "EMERGENCY STOP" push button is depressed, (2) "LOW PRESSURE CLOSE" TIMER is allowed to time out before molds are closed, (3) "MOLD CLOSE" relay becomes energized while LS-6 (LS-6L and LS-6R) indicates the stripper is between the molds, (4) the screw fails to produce material while the machine is cycling, (5) temperature of Hydraulic Oil reaches over 130°F.

23-CR: Blow Pins Up - Prevents clamp from shifting unless blow pins are up.

24-CR: Clamp Right - Prevents blow pins from coming down unless clamp has shifted to right position.

25-CR: Shift Clamp - Shifts clamp to left.

26-CR: Hydraulic Heat Control controlled by oil temperature switch (TS-3) - Prevents machine operation if de-energized.

29-CR: Mold Close - Energizes close mold solenoid (Sol. #3).

30-CR: Shift Off - Turns off shift system when energized.


102-CR: External Circuit: Seals in external power.

201-CR: Raise Arms - Raises swing arms, signal to close fingers.

202-CR: Close Fingers

203-CR: Arms Down - Opens fingers, supplies contact closure for external signal.

204-CR: Extend Swinging Arm arms.

5-TD: Mold Close Safety Delay - Set for amount of time it takes to close the mold, approximately 1.5 seconds.
OPERATOR PANEL - RIGHT SIDE -
Figure 5.

1. **RPM Meter** - Reads screw speed.

2. **Load Meter** - Reads percent (%) of drive motor full load amps.

3. **Speed Pot** - Controls speed of drive motor.

4. **Shot Size** - Light goes on when head fills to program set point, or limit switch set point.

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5. **Emergency Stop** - Push button.

6. **Blow Pins Down, Off, or Automatic Selector switch**, manual or automatic operation.

7. **Charge Push Button** - Allows screw to go back (fill) in manual or automatic.

8. **Swing Arms Up, Off, or Automatic Selector switch for swing arm mode**.

9. **Cycle Start** - Push button, starts automatic cycle providing all safety conditions are met.
10. **Stripper Down Automatic Selector** switch for stripper mode.

11. **Open Mold** - Push button for opening mold in manual mode.

12. **Shift** - Push button for shifting clamp to the left in manual mode.

13. **Open Mold** - Push button for opening mold in manual mode.
The Electrical Schematic
(Refer to Figure 1.) This shows a simple electrical circuit in which most of the common circuit elements are employed. A study of this sample is useful to help one become familiar with the various elements, their symbols, and also the interpretation of an electrical schematic. All Uniloy® schematics follow the form and symbology prescribed by J.I.C. standards.

The following descriptions and explanatory notes are given with reference to the sample diagram:

1. The VERTICAL row of numbers at the left side are line numbers. They provide reference points within the diagram which bear no relationship to wire numbers, terminal number, or any points within the control panel or on the machine.

2. Numbers shown in PARENTHESES are terminal designations provided on a piece of control apparatus by its manufacturer and are not to be confused with wire numbers or terminal numbers assigned to the machine as a whole.

3. RELAYS
A relay is an electrically operated switch. It is similar to an ordinary household toggle switch in function, except that it is operated by an electro-magnet rather than a manual lever, and may have many contacts. Each relay may be divided into two classes of electrical components, coils, and contacts. It is rare to find a relay with more than one coil, but it may have any number of contacts, in various types. In Uniloy® equipment, you will not find more than eight contacts on any given relay, but they may be in any combination of normally open and normally closed. When the power is applied to the relay coil, it is said to be energized; when power is off, the relay is de-energized. Energizing the relay transfers all its contacts simultaneously, closing those which are normally open (N.O.) and opening all those which are normally closed (N.C.). When a contact is closed, current can flow through it.

Schematically, relay coils are designated by circles, the relay designation being inscribed therein. (See ICR shown in line 2 of sample diagram). N.O. contacts are shown as two short vertical parallel lines, N.C. contacts have...
a diagonal line intersecting them. Each contact has the relay " designation directly above it. To the right of each relay coil is a series of numbers indicating the lines in the diagram in which contacts on this relay may be found. Underscored numbers indicate N.C. contacts. Referring again to the sample circuit, you will see 3, 5, 7, 7 to the right of ICR coil, indicating that a N.O. contact is to be found in line 3, two N.O. contacts in line 7, and a N.C. contact in line 5.

4. Limit Switches
These mechanically actuated devices usually contain two sets of contacts, one set normally open and one set normally closed. When actuated, both sets of contacts transfer simultaneously to the opposite condition, remaining there until the actuator is released.

Schematically limit switches are designated as LS and are shown N.O. or N.C. by their symbols. If both contacts are used, they will be connected by a broken line which indicates that they are both part of the same switch. Either contact may be used and the other omitted, depending on the requirements of the circuit. In this case, only that portion of the switch (N.O. or N.C.) will be shown on the diagram. Referring to the sample diagram, LS-1 is shown N.C. in line 2, and N.O. in line 5. Actuation may be thought of as the application of a force to the pressure pad which is part of each symbol. Therefore, it is apparent that force applied to LS-1 will cause its contact in line 2 to open and its contact in line 5 to close. It is important to note that Uniloys schematics show limit switches in the "START CYCLE" or idle position. Therefore, N.O. contacts may be shown held closed or actuated and N.C. contacts may be shown held open.

There are limit switches which do not obey all of these rules. One such type is the neutral position switch used on the stripper. This switch has two N.O. contacts which we can call "A" and "B" for the purpose of discussion. When the actuating lever is moved clockwise, contact "A" closes, but "B" remains open. Releasing the lever allows "A" to open again. Moving the lever counter-clockwise causes "B" to close, but "A" remains open. Because the contacts are independent of each other, they can provide signals at different times, or indicate different positions, eliminating the need for a second switch.

5. Selector Switches
These are similar to pushbuttons, both in appearance and in their schematic symbols, the difference being that a selector symbol has an arrow to indicate the position in which it is shown. Physically, a selector has a knob or key that must be rotated to switch from one position to another. They may have any number of positions, but those in Uniloys equipment do not usually have more than three.

In the sample diagram, an "OFF-ON" selector is shown in line 2, its arrow indicating it is in the "OFF" position and its contact is open. Switching to the "ON" position will reverse this condition.

Some selectors have more contacts as well as more positions. To help interpret the symbols, X’s and O’s are placed beside each contact to show its condition in all positions. X denotes closed and O denotes open.

6. Time Delay Relays
These are relatively complex solid state electronic devices that transfer electrical contacts to switch parts or the external circuit on or off. In this function, it is exactly the same as a control relay; energizing the transfer contacts, de-energizing it restores the contacts to their N.C. or N.O. condition, as the case may be. As the timer times, it actuates the time delay contacts.

An analysis of this will show that the timer experiences three conditions during each cycle:
1. POWER OFF
2. TIMING
3. TIMED OUT

To help identify contact conditions, a series of X's and O's are shown by each contact in a diagram, X denoting normally closed and O denoting normally open. The N.O. instantaneous contact operated by the timer may then be described as OXX which means that in condition "1" (POWER OFF) the contact is open and will be closed when power is applied to the coil; it remains closed during the time delay period (condition "2"); it remains closed in condition "3" (timed out); and it will return to its normal state (open) only when the power to the timer coil is turned off. An N.C. contact is the direct opposite, XOO. The first time delay contact is shown OOX OR XXO.

When the timer is de-energized, the timer resets and is then ready for the next cycle.

These timers are of the plug-in type, and they may be removed from their cases without disturbing the wiring. This facilitates inspection, range changes, and trouble shooting. If a malfunction is suspected, it is a simple matter to remove the timer and substitute another one.

7. Pressure Switches
Pressure switches are similar in function to limit switches. They usually have N.O. and N.C. contacts which transfer to the opposite condition when the switch is actuated. The difference is that a pressure switch is actuated when air or hydraulic pressure is applied to the self-contained piston or diaphragm. This piston type is usually used for high pressure applications and the diaphragm type is for low pressure applications.

Schematically, they are designated as PS. Refer to PS-1 in the sample diagram which is shown N.O. in line 2 and will close when sufficient pressure is applied to actuate it.

8. Thermal Switches
These are temperature operated devices but differ from a temperature controller in that they serve as a protective limit device rather than as a controller which regulates temperature to a pre-set value.

Schematically they are designated as TS. In line 2 of the sample diagram, TS-1 is shown N.C. and will open when its sensor is overheated.

9. Plugs and Receptacles
These are used wherever it is necessary to disconnect some portion of the equipment for shipping, service, or because it may not be required at all times.

Schematically, each plug pin and receptacle socket are shown as adjoining arrows, and designated by a "P" with both a numerical prefix and a numerical suffix. The prefix denotes the plug number, and the suffix denotes the pin number within the plug. Thus, 3P5 would indicate pin #5 in plug #3 socket #5 receptacle #3. See IP1 and IP2 in line 7 of the sample diagram.

NOTE: In some cases, the plug and its mating receptacle may be on different machines so that one machine may receive either power or control signals or both from the second machine. In these cases, the pins and sockets will be shown on different diagrams. Where this situation occurs, the socket will be designated by "S" as in 3S7. This will mate with pin #3P7 on another machine.

The plugs and receptacles in Uniloy equipment are so keyed that you cannot mismatch them. They appear to be identical, but if they do not connect together easily, they do not belong together.
10. Solenoids
Generally speaking solenoids, are devices which convert electrical energy into mechanical energy. When current flows through a solenoid coil, a magnet is created which causes the moveable portion (armature) to shift, usually compressing a spring which will return the armature to its normal position when the coil is de-energized. Most solenoids are used to shift the spool of a valve, which in turn allows fluid to flow, thus controlling a cylinder or other fluid power device. Now let us assume a set of conditions which must be satisfied to enable a machine to run:

A. 460 VAC power is available, but for safety and uniformity, it is desired to operate our control circuit at 115 volts AC.

B. An "OFF" switch is required so that machine may not be started inadvertently.

C. Hydraulic pressure is applied by pulling the "hydraulic" push-pull button to turn the pump on.

D. The pump will turn off if the oil temperature is over 130° F.

E. The desired sequence of operations is as follows:

1. When started by an operator, the cylinder is required to advance to a stop.

2. The cylinder retracts.

3. After an adjustable time delay, the cylinder repeats steps 1 and 2 automatically.

4. Steps 1, 2, and 3 are to repeat until the operator commands it to stop or there is a power failure, such as a blown fuse.

5. In the event of a power failure, the machine must be re-started by the operator, not automatically.

F. The assembly that contains the solenoid valve must be easily removed for service.

Referring again to the sample circuit, you will see that all these requirements are met. Even though AC power alternates its direction of flow periodically, it is convenient, when interpreting a schematic, to think of current flow in terms of D.C., or unidirectional current; flowing out the left side of the transformer, then down the main line on the left, from where it always seeks the shortest route to the main line, up the right side, then back into the transformer. Small directional arrows in the sample circuit show this D.C. flow analogy.

Electricity, being rather lazy, always follows the path of least resistance, but its urge to get back to the transformer is so strong that it is willing to do some work along the way. This is the thing we take advantage of. By opening and closing contacts at the right point in the circuit at the right time, we can control the current flow to make it perform any desired task at any desired time.

To satisfy the first requirement, we must use a transformer. The primary side is now shown in the diagram, but we will assume it is connected to a 460 volt source. The output (secondary) of the transformer will then be our control circuit power supply at 115 volts. In order to prevent overloading, a fuse is installed in the line leading away from the transformer. This is the "hot" side of line #1. The other side of the secondary winding is then connected to wire #2 as shown. This now becomes what may be referred to as the neutral, common, or return side of the line. We now have voltage present at any point along #1 wire. This is connected to two devices, the selector switch and a NO contact on 1 CR. Since both devices are open, a voltage detector (light bulb) will show voltage between #1 and #2 only.

Turning the selector switch to its "ON" position closes its contact, so that voltage is
now present at wire #3 and since both the "STOP" pushbutton and the 1 CR NC contact are closed, voltage will also be present at wire Nos. 4 and 9.

Depressing the "START" pushbutton will close its contact, making voltage present at wire #5. If the hydraulic pressure is low, PS-1 will be open as shown, and we can go no further until this condition has been corrected.

Once the hydraulic pressure problem has been corrected (this may have required opening a valve, or connected a hose), the pressure will be applied to PS-1, closing it. Voltage is now preset at wire #8. Assuming that the thermal switch does not indicate overheating, TS-1 is closed so we have voltage at wire #7.

LS-1 is located so that it will be actuated when the cylinder is extended. Since the cylinder has not yet extended, LS-1 is closed, we have voltage at wire #8.

Now there is nothing blocking the voltage between wires 1 and 3 so current will flow through the circuit and through the coil of 1-CR. This energizes the relay and, as described previously, its contacts will transfer, closing those in line 3 and 7 and opening in line 5. Closing the contact in line 3 provides a second path between wire Nos. 4 and 5, allowing us to release the "START" pushbutton and still have a continuous circuit through 1-CR coil.

Closing the contacts in line 7 sets up a second path for current flow, if the solenoid is plugged in; this one passing through the solenoid valve coil. Energizing Sol. 1 shifts the valve spool, causing the cylinder piston to extend.

When the piston rod is fully extended, LS-1, is actuated, opening its contact in line 2, thus interrupting the current flow through 1-CR, which now drops out, transferring all its contacts to their normal state.

Opening 1-CR contacts in line 7 interrupts the current flow to this solenoid valve, de-energizing it, and allowing the valve spring to return the spool to its normal position. This reverses the direction of oil flow, causing the piston rod to retract.

Closing the 1-CR contact in line 5, applied voltage to wire #9 again, and since LS-1 is actuated, its NO contact is now closed. We will now have voltage at wire Nos. 10 and 11, allowing current to flow through both the timer clutch coil and the timer motor. The timer is now energized and timing, so its contacts will be as indicated by the second position (see timer description). That is, the time delay contact in line 4 remains open, the time delay contact in line 6 remains closed, and the instantaneous contact in line 5 has transferred and is now closed, providing a second path between wire Nos. 9 and 10.

As the piston rod retracts, LS-1 is released, allowing its contacts to transfer to their normal condition, but has no effect at this time.

After a preset time delay, the timer is "timed-out", the third condition described previously. At this point, the contact in line 4 will close and if PS-1 and TS-1 are still closed, 1-CR will be energized.

When 1-CR is energized, the circuit reaction is the same as before, except that when its NC contact opens in line 5, the circuit to the timer is interrupted and the time is de-energized, allowing it to reset.

Motor Control
Depressing the "START" pushbutton allows current to flow from one side of the line through the "STOP" button, the "START" button, the operating coil of the motor starter "M", and the overload contacts, to the other
side of the line. This magnetizes the operating coil, causing it to pull its contacts closed. One contact closes a circuit around the "START" button so the circuit is maintained after the button is released. Three other contacts close, applying power to the motor.

The motor may be stopped by interrupting the current flow to the operating coil. Depressing one of the "EMERGENCY STOP" push-buttons will stop all motors. The hydraulic pump may also be stopped at any time by depressing its "STOP" button.

The extruder motor will be stopped if its "STOP" button is depressed or if the "SAFETY" relay drops out for any reason. The coolant pump is controlled only by the main heat contactor. When the heat is turned on, the pump runs continuously. It should be noted that all overload contacts (3 for each motor) are connected in series, so that opening any one will stop all motors. When this occurs, it is necessary to allow a few minutes for the element to cool before resetting it. Resetting is accomplished by depressing the white buttons located on each motor starter. When the tripped element is reset, a definite ratcheting action will be felt.

You can then determine which motor is being overloaded from the nameplate affixed adjacent to the starter and the identification provided in the schematic diagram for your machine.

The most common overload problem is due to excessive pressure or flow rate. See the Hydraulic Section of this manual for proper settings. (Refer to Figure 2.)

**Temperature Control**

All heaters on the machine are controlled by a single contactor, either directly through its power contacts or indirectly through auxiliary contacts in the control circuit. This contactor is energized by pulling the "HEAT" pushbutton and is normally de-energized by pushing the "HEAT" pushbutton. However, it will also be de-energized if any "EMERGENCY STOP" button is depressed. This is a safety measure employed to assure that all power to the accessible areas of the machine is switched off in an emergency. The operator must remember to turn the heaters on again after using an "EMERGENCY STOP" button if he does not want the machine to cool off.

When the main heat contactor is energized, power is made available to the head heaters and the die heaters through a transformer. Auxiliary contacts mounted on the main heat

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*Figure 2. Motor Control Circuit*
contactor energize the coolant pump and also the temperature controllers. From this point, the temperature controller for each zone then controls the heat input and, in some cases, the cooling input to the area or zone that it is connected to.

Figure 3. shows schematically the elements required for the control of a typical heating and cooling zone. When power is applied to the temperature controller at terminals L-1 and L-2, the controller will then compare the temperature asked for by the red setting pointer to the temperature indicated by the green pointer and respond as required to bring the two pointers in line. The green pointer receives its power from the heat sensor or thermocouple located in the object that is to be controlled. If the green pointer is below the red pointer, an internal contact in the controller closes to energize PC, the power contactor, which in turn closes contacts to energize the heaters for its zone. As the temperature rises, the thermocouple output is increased, driving the green pointer toward the set point. When the two pointers coincide, the controller will de-energize the PC coil, allowing the PC contacts to open the circuit to the heaters.

The controller used for the head heaters and the feed zone heaters are only capable of the action described above. In other areas, however, there is sometimes enough heat generated in the extrusion process that it becomes necessary to provide cooling capability. This is accomplished in a similar manner, except that the cooling control relay CR is energized only when the green pointer is above the red pointer. The CR contacts close, energizing a solenoid valve. The valve opens, allowing cooling fluid to circulate through the controlled zone. As the temperature drops, the green pointer moves down toward the set point and as it approaches the point of coincidence, the relay is de-energized, opening the circuit to the solenoid valve, allowing it to close.

Figure 3. Typical Heating - Cooling Zone Circuit
To prevent a cyclic condition, there is an adjustable differential provided in the controller, which permits a deadband setting of 1% full scale, maximum.

When none of the zones requires cooling, an optional by-pass valve can be employed to energize which permits the cooling fluid to recirculate. This maintains a constant temperature in the coolant and prevents the pump from dead heading. (Refer to Figure 4.)

Figure 4. Typical Heating - Cooling Zone Diagram
Control Circuit Power Supply
Except in isolated cases where deviation from Uniloy standards is specifically requested by the purchaser, all controls operate at 115 volts. This lower voltage level is not only safer, but also more convenient to work with. In addition, the use of a transformer to reduce the voltage level also provides a buffer which diminishes the effect of line voltage variations and transients on the control devices. This transformer is sized to supply only the control requirements for the machine and will not permit the use of portable hand tools or work lights. There is a receptacle provided on the control panel that is fed from another source and can be used for these purposes.

Power is supplied to the primary side at line voltage, usually 230 or 460 volts. The transformer then converts this to 115 volts for use in the control circuit. This control power is then fed into a group of fuses. F-1 is sized to protect the transformer, F-2 is sized to carry the load in the solenoid circuit, and F-4 is selected to carry the balance of the controls. A pilot light indicates when the power is "ON" and three "EMERGENCY STOP" push-buttons are provided, one in the control panel and one on each side of the machine. As the diagram shows, all circuit elements are supplied through the "EMERGENCY STOP" button so that depressing any of them will interrupt the power being supplied to any device. Since all action devices such as motors, heaters, and solenoids are controlled by magnetically operated devices in the control circuit, opening this circuit by any means will disconnect all devices from their source of power. (Refer to Figure 5.)

Figure 5. Control Power Supply Circuit
Reciprocation Control
Since a general description of the screw reciprocation appears in another section of this manual, discussion here will be limited to the electrical controls and it will be assumed that the reader is familiar with the sections titled, "EXTRUDER RECIPROcation" and "SCREW FORWARD LIMIT SWITCH".

The diagram shows schematically all the circuit elements involved in controlling screw reciprocation. The safety relay must be energized before power is available to any part of this circuit. (Refer to Figure 6.)

Manual Control
There is a pushbutton "A" labeled "CHARGE" on each side of the machine. Depressing either of these buttons will energize the CHARGE RELAY "B" which, in turn, closes its contacts B-2 in the solenoid circuit to energize the "CHARGE" SOLENOID valve "D". Solenoid "D" shifts the spool in a hydraulic valve, connecting the shot cylinder through a relief valve to tank. The relief valve is set low so that the plastic being produced by screw rotation forces the screw to retract against this low pressure.

When the "CHARGE" button is released, the CHARGE RELAY and therefore, the charge solenoid are de-energized, and the valve spool returns to its spring offset position shifting the valve spool to the opposite side, which connects the shot cylinder to the hydraulic pump at high pressure so that oil can flow into the cylinder with sufficient force to drive the piston, and therefore the screw, forward to discharge the stored plastic out through the extrusion dies.

Automatic Operation
When the shot has been completed, that is, the screw is forward, the SCREW FORWARD LIMIT SWITCH LS-1 will be actuated, energizing the SCREW FORWARD RELAY and closing its contact "K". If the AUTOMATIC CYCLE RELAY is energized, its contact "J" will be closed and the CHARGE DELAY TIMER "C" becomes energized and begins timing. Contact "C-1" opens instantly to prevent limit switch "H" from completing its circuit if the molds close before the charge delay timer period ends. When the time delay is complete, contact "C-2" closes, energizing the CHARGE RELAY "B", contacts "B-2", "F", and "G", are all closed, a path is closed around

Figure 6, Reciprocation Control Circuit
"C-2". The screw begins retracting and "K" is released to de-energize the timer "C", allowing "C-2" to open and "C-1" to close, but no action occurs at this time. This condition remains until the molds close, time out, and open. As they are opening, contact "F" opens and then "E" opens. Since timer contact "C-1" is closed, charge relay "B" is now dependent on the limit switch contact "H" which is actuated as the molds are opening. Opening "H" causes relay "B" to drop out, de-energizing valve "D", returning it to the spring offset position which drives the screw forward as described above. When forward, the screw forward relay is energized, closing contact "K" and the cycle repeats.

TO SUMMARIZE

1. The "SCREW FORWARD LIMIT SWITCH" LS-1 energizes the "CHARGE DELAY" TIMER.

2. AFTER A TIME DELAY, THE "CHARGE RELAY" is energized, allowing the screw to retract.

3. The "shot" begins when the DISCHARGE LIMIT SWITCH LS-5 is actuated as the molds are opening.

Platen Actuation
In the interest of clarity, the description presented in this section will be limited to the directional control of the platen movement. For further details regarding Low Pressure Closing, Safety Door Interlock, and Safety Circuit Operation, refer to those specific sections.

Figure 7 shows schematically all circuit elements required for mold closing and opening. Before power is made available to any part of this circuit, the safety doors must both be closed, actuating the air pressure switch "C". No manual control or automatic cycling can be achieved unless the safety relay is energized, closing its contacts "D-1" and "D-2". (Refer to Figure 7.)

Manual Operation
Assuming that the above mentioned conditions are satisfactory, with the auto cycle relay de-energized, contact "E-1" is open, preventing automatic cycling, and contact "E-2" is closed making power available to the four manual control buttons. A MOLD CLOSE and a MOLD OPEN pushbutton is located on each side of the platen area.

Depressing either MOLD CLOSE pushbutton will energize the MOLD CLOSE RELAY "A", since the stripper auxiliary relay contact "I" and the MOLD OPEN RELAY contact "B-1" must be closed at this time.

When relay "A" becomes energized, it opens the interlock contact "A-1" to prevent the actuation of the MOLD OPEN RELAY "B", and closes contacts "A-2" in the solenoid circuit to energize the MOLD CLOSE SOLENOID "Q". Energizing "Q" shifts the spool of a four-way hydraulic valve, allowing oil to flow to the rotary actuator, closing the molds.

Depressing either MOLD OPEN pushbutton will energize the MOLD OPEN RELAY "B", except that if the MOLD OPEN LIMIT SWITCH is actuated, its contact "P" will be open and
relay "B" will not be energized. When relay "B" pulls in, the interlock contact "B1" opens to prevent the actuation of the MOLD CLOSE RELAY "A", and contacts "B3" close in the solenoid circuit to energize the MOLD OPEN SOLENOID "R", allowing oil to flow to the opposite side of the rotary actuator mentioned above, and the molds open until either the pushbutton is released or the MOLD OPEN limit switch is actuated.

**Automatic Operation**

If the AUTO CYCLE RELAY is energized, contact "E-2" will be open, interrupting the manual control, and "E-1" will be closed, making power available to those elements required for automatic sequencing. The MOLD SEQUENCE SELECTOR SWITCH provides a choice of two points in the machine cycle at which the molds begin closing. In position 3, contact "K" is closed so that MOLD CLOSE RELAY "A" and MOLD SOLENOID RELAY "A-2" becomes energized as soon as the shot is completed, closing contact "E-1". If the selector is in position 1, contact "K" is open and relay "A" and "A-2" are not energized until the charge relay pulls in, closing contact "F". All other contacts in the "A" and "A-2" relay circuit, "G", "H-1", "I", and "B-1" are closed at this time, so the mold closing actuation is dependent solely upon the choice between contacts "F" and "J". The difference is that "J" always close before "F", the interval between them being determined by the CHARGE DELAY TIMER. A more detailed description of the timer circuit will be found in the section "Reciprocation Control".

When relay "A-2" becomes energized, it allows direct power to solenoid "Q" and the molds close just as was described in manual operation. As the mold closes, it trips LS-12, clamp pause limit switch. This starts the clamp pause timer and de-energizes the mold solenoid relay "A-2". When the clamp pause timer

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**Figure 7. Platen Actuation Circuit**
times out, the mold will continue to the completely closed position.

Unless an abnormal condition arises, such as safety circuit drop-out or a safety door opening, the molds will remain closed until the EXHAUST TIMER times out opening contact "H-1" and closing contact "H-2". The Blow-Air Control section describes the exhaust timer control in detail.

Opening "H-1" de-energizes relay "A-2", and it drops out, de-energizing solenoid "Q" and closing contact "A-1". Since "H-2" closed when "H-1" opened, closing "A-1" energizes the MOLD OPEN RELAY "B", which in turn energizes solenoid "R" as described under manual operation. As the molds are opening, and the MOLD CLOSE LIMIT SWITCH is released, de-energizing the EXHAUST TIMER, it resets and transfers contacts "H-1" and "H-2" to their normal state. In other words, "H-1" is now closed and "H-2" is now open, but since MOLD OPEN RELAY contact "B-2" also closed when the relay was energized, the circuit is maintained and the molds continue to open until the MOLD OPEN LIMIT SWITCH is actuated, opening contact "P", at which time relay "B" and solenoid "R" are both de-energized.

As the molds are opening, other limit switches are actuated to initiate the stripper action and to start the discharge or shot stroke. When the shot is completed, the SCREW FORWARD LIMIT SWITCH is actuated, energizing the SCREW FORWARD RELAY, closing contact "J" and the mold closing sequence repeats.

Two contacts, "G" and "I" are required to prevent relay "A" from being energized prematurely. Contact "I" opens when the molds start to open and remains open until the stripper reaches bottom of its stroke. Contact "G" opens when the stripper is down and remains open until the shot has been completed.

In the event the safety circuit is de-energized while the molds are not open, and the pressure switch "C" indicates all safety doors are closed, the AUTO CYCLE RELAY contact "E-2" and the Safety Relay Contact "D-3" will be closed energizing the MOLD OPEN RELAY "B" and the molds will open.

TO SUMMARIZE

1. With the MOLD SEQUENCE selector switch in position 2, the molds start to close as soon as the shot is completed, actuating the SCREW FORWARD LIMIT SWITCH.

2. In position 1, the molds wait until the CHARGE DELAY TIMER has timed out, then begin closing.

3. LS-12 is tripped approximately 1/4 inch before molds are closed, starting clamp pause timer and stopping mold close.

4. Clamp pause timer times out, molds close.

5. The molds remain closed for the sum of two time delays, blow time and exhaust time.

6. The molds open when the EXHAUST TIMER times out.

7. As the molds open, the SHOT LIMIT SWITCH IS ACTUATED, starting the next shot.

8. When the shot is completed, the molds close as in step 1 or step 2 above. If the safety circuit is tripped while all safety doors are closed, the molds will open automatically.
Stripper Control
The stripper control solenoid valve and its related circuitry are shown in Figure 8. A manual switch is located on each side of the machine to permit the operator to extend the stripper down where it will remain until the switch is returned to the "AUTO" POSITION. This permits cleaning or removal of molten plastic that may have accumulated on the stripper plate. Both switches are normally in the "AUTO" position. (Refer to Figure 8.)

Manual Operation
Turning a selector switch to the "MAN" position will close contacts "G-1" or "H-1" and open contacts "G-2" or "H-2" to prevent a feedback into the automatic controls. When relay "B" pulls in, contacts "B-1" in the solenoid circuit will close, energizing the stripper solenoid "M" to shift the spool of a 4-way air valve, directing air into the cylinder that drives the stripper down. When both switches are in the "AUTO" position, relay "B" and solenoid "M" are both de-energized, and a spring in the valve will return the spool to its normal position, directing air to the opposite end of the cylinder, driving the stripper up to its normal position.

Automatic Operation
When the machine is in automatic cycle, the AUTO CYCLE RELAY contact "E" will be closed, making power available to the stripper control circuit. As soon as the molds start to open, the MOLD OPEN RELAY contact "F" closes energizing the STRIPPER AUXILIARY RELAY "A", which closes its contact "A-1" to hold the relay energized until the stripping function is completed. This relay sets up the stripper circuit and holds it as long as required, thus making its action independent of the other circuits, assuring that the stripper can still operate even if the MOLD OPEN RELAY drops out first. As the molds are opening, the stripper start limit switch LS-4 is actuated, energizing the STRIPPER RELAY "B" and solenoid "M" to drive the stripper down as described above. As the stripper moves downward, the stripper limit switch LS-6 is released, opening contact "J-2" in the safety circuit. This contact is held closed only when the stripper is up and must be adjusted carefully so it will not be closed at any time when the stripper plate is not clear of the neck rings in the molds. If the molds attempt to close at any time when this contact "J-2" is not

Figure 8. Stripper Control Circuit
closed, the MOLD CLOSE RELAY contact "L" will open and the safety relay will be de-energized, stopping the machine. Refer to the section entitled, "Safeties" for further details.

When the stripper reaches the bottom of its stroke, the limit switch LS-6 is actuated to close contact "J-1", energizing the CYCLE AUXILIARY RELAY "C", which opens its contact "C-1". By this time, the MOLD OPEN RELAY will have dropped out and its contact "F" will be open, so opening "C-1" de-energizes the STRIPPER AUXILIARY RELAY "A" and the STRIPPER RELAY "B", which in turn, de-energizes solenoid "M" as described above, and the stripper starts to return upward. As it moves up, LS-6 is released, opening contact "J-1", but since the CYCLE AUXILIARY CONTACT "C-2" closed when relay "C" was energized, and the SCREW FORWARD RELAY contact "K" is closed, relay "C" does not drop out, but will remain energized until the shot is completed. The effect of this relay may be seen in the "Reciprocation Control" and "Platen Actuation" sections of this manual. When the stripper reaches the upward limit of its stroke, the "Up" contact of LS-6 will be closed again so that the molds may be closed without tripping the safety circuit.

TO SUMMARIZE

1. The stripper starts down; the LS-4 is actuated as the molds are opening.

2. The stripper returns upward as soon as LS-6 is actuated downward.

3. LS-6 must be actuated upward or the molds cannot be closed without tripping the safety.

Some machines are provided with two strippers, one each for the right and left half of the die head. In these cases, there are two cylinders, two solenoid valves, and two stripper limit switches. The only deviations from the sequence described above are that the two solenoids are connected together so they are both energized or de-energized at the same time, and the two limit switches are connected in series. Both switches must be actuated at the bottom of the stroke to de-energize the valves, retracting the stripper. Both switches must be actuated upward to allow the molds to close.

Cylinder Operated Blow Pins
As indicated in other sections of this manual, the use of cylinder operated blow pins is optional, and not all machines are equipped with this feature. The electrical controls are simple and inexpensive enough that they are included in all machines as standard equipment. An exception to this is the BLOW PIN DELAY TIMER. The timer is only used with a compacting system, therefore, is not installed unless required as indicated below. (Refer to Figure 9.).

Manual Blow Pin Operation
A three position selector switch is provided in the control panel. In the center position, both of its contacts "F-1" and "F-2" are open and the system cannot be operated either manually or automatically. Turning the selector clockwise closes its contact "F-2", energizing the BLOW PIN RELAY "B", RELAY "B" pulls in, closing contact "B-1" in the solenoid circuit to energize BLOW PIN SOLENOID "H-1". Energizing the solenoid shifts the valve spool, directing air into all of the cylinders simultaneously, driving the blow pins down, where they will remain until the switch is returned to the center position, de-energizing the BLOW PIN RELAY "B" and the solenoid, allowing a spring in the valve to return the spool to its normal position, thus directing air to the opposite side of the cylinders, and the blow pins pull upward.
Automatic Blow Pin Operation

If the selector is turned counter-clockwise, contact "F-1" will close. If the machine is in automatic cycle, relay contact "C" will be closed, and as soon as the molds start to close, contact "D" will close, allowing power to flow through contacts "C", "D", "E", "F-1", and the jumper "G" to the relay coil "B", energizing the BLOW PIN RELAY and the solenoid valve as described above, driving the blow pins down.

The molds close while the blow pins are down, and they remain down until the BLOW TIMER times out and energizes the PRE-BLOW SHUT-OFF RELAY, opening its contact "E". When "E" opens, the BLOW PIN RELAY and solenoid "H" are both de-energized, forcing the blow pins to pull forward. When a time delay is required, the BLOW PIN DELAY TIMER must be added and jumper "G" is removed. Now, when contact "D" closes and the molds start to close, the BLOW PIN DELAY TIMER becomes energized and begins timing. When its time delay period expires, contact "A-1" closes, energizing the BLOW PIN RELAY and solenoid "H". The remaining sequence is the same as it was without the timer.

TO SUMMARIZE

1. Without the timer, the blow pins drive down as soon as the molds start to close. This is the "shear" or PULL-UP type of operation.

2. When the timer is used, the blow pins drive down when the timer times out, usually shortly after the molds are closed. This is the "COMPACTING" or "RAM-DOWN" type of operation.

3. In either case, the blow pins pull up at the time air begins exhausting from the blown containers.

Figure 9. Blow Pin Control Circuit
Blow Air Control
The air system for blowing containers is a two pressure system, using low pressure initially (Pre-blow) and then switching to high pressure (Blow). A selector switch provides a choice as to whether or not the Pre-blow air is used during the time the molds are moving closed. Although there are valves provided for each individual die head, they are controlled by pilot air pressure which in turn, is controlled by solenoid valves. In this way, air is controlled to each die head, but only two electrical outputs are required. In describing the electrical controls, it will be assumed that the reader is familiar with the section of this manual entitled "THE AIR SYSTEM-BLOW AND PRE-BLOW."

Some machines are provided with a split head arrangement which also requires a separate air valving system for each side. The electrical controls for the double system are identical to the single system except that there are two pre-blow solenoids and two blow solenoids, one for each side. The two solenoids are connected to the same wires and controlled by a common relay. When applying the following description to a double system, the only change required is to read all solenoid and valve references as if they were plural.

Figure 10. shows schematically all of the elements required for blow air control. The AUTO CYCLE RELAY must be energized before power is available to any portion of this circuit. (Refer to Figure 10.).

With PRE-BLOW SELECTOR in position 2, contact "J" will be closed. With the CHARGE RELAY energized, contact "I" will be open and "H" will remain closed. When the CHARGE PRE-BLOW is released, contact "I" will close energizing PRE-BLOW DELAY TIMER "A".

With PRE-BLOW SELECTOR in position 1, contact "J" will be open. PRE-BLOW DELAY TIMER "A" is energized when the shot is completed (screw forward), tripping screw forward LS-1. SCREW FORWARD RELAY energizes, closing contact "K".

When the PRE-BLOW DELAY TIMER "A" times out, contact "A-2" will close energizing PRE-BLOW RELAY "B", closing contact "B-
and energizing PRE-BLOW SOLENOID "M".

In the event the PRE-BLOW DELAY TIMER "A" does not time out before the clamp closes, MOLD CLOSE LIMIT SWITCH 3, contact "L" will close. This will energize PRE-BLOW RELAY "B", closing contact "B-1", and energizing PRE-BLOW SOLENOID "M".

From this point, all conditions are the same and the remaining sequence identical in either case. It should be noted that the PRE-BLOW SOLENOID valve must remain energized, maintaining the "ON-OFF" valves in the open position to allow either low pressure or high pressure air to pass through.

At the time the MOLD CLOSING LIMIT SWITCH is actuated closing contact "L", two time delay relays become energized. These are the BLOW DELAY TIMER "D", and the BLOW TIMER "E", and they both begin timing at this point. When the BLOW DELAY TIMER times out, its contact "D-1" closes, energizing the BLOW RELAY "F" which in turn closes its contact "F-1" in the solenoid circuit to energize the the BLOW SOLENOID "N". This applies pilot air pressure to the pilot operated selector valves on each die head and they shift from the low-pressure supply to the high pressure supply. This condition remains for the duration of the blow time setting. When the BLOW TIMER "E" reaches the end of its delay period, it switches to contact "E-1".

The PRE-BLOW SHUT-OFF RELAY "C" becomes energized, closing contact "C-2" and energizes the EXHAUST TIMER "G". Relay "A" drops out, opening contacts "A-2" to de-energize relay "B", opening contact "B-1", de-energizing Solenoid "M". The air which has been trapped in the blown container now exhausts to the atmosphere.

When the EXHAUST TIMER times out, its contacts, which are not shown in this diagram, signal the molds to open. As they open, the MOLD CLOSE LIMIT SWITCH is released, opening contact "L", and all timers reset.

TO SUMMARIZE

1. PRE-BLOW begins either before the molds close (position 1) or after the molds start closing (position 2). The point at which pre-blow begins in position #2 depends on the length of the cam that actuates LS-3.

2. The BLOW DELAY TIMER determines the length of the low pressure blow, and starts the high pressure blow.

3. The BLOW TIMER determines the cooling time for the container.

4. The EXHAUST TIMER determines the interval between blow shut-off and mold opening.

5. The timers reset when the molds start to open, releasing the MOLD CLOSING LIMIT SWITCH LS-3.

Low Pressure Closing

All Unicolor blowmolding machines are provided with a protective feature which allows the molds to close at reduced hydraulic pressure, greatly reducing the force exerted upon the closing mechanism which in turn serves to protect the molds and tooling as well as the machine operator from serious injury. This feature also serves to sense obstructions and malfunctions, and react to them by interrupting the cycle and sounding an alarm. In addition, this system is designed to fail safe, that is, all components are used in such a way that any failure that is likely to occur, will result in the hydraulic system being limited to low pressure only. Therefore, the machine cannot be operated unless deliberate steps are taken to defeat the system. (Refer to Figure 11.)
The low pressure closing control functions exactly the same when closing the molds manually as when in automatic cycle.

When the MOLD CLOSE RELAY is energized to close the molds, a normally closed contact "D" is opened interrupting the flow of current through the HIGH PRESSURE RELAY coil "A", allowing it to drop out. This opens the HIGH PRESSURE RELAY contacts "A-2" in the solenoid circuit, de-energizing the HIGH PRESSURE SOLENOID valve "F". When this valve is de-energized, the hydraulic pressure available to move the molds is limited to the setting of the LOW PRESSURE CLOSE RELIEF VALVE, which should be set at about 250-300 PSI, or just high enough to move the molds at a normal rate.

When the HIGH PRESSURE RELAY dropped out, it also opened its contact "A-1" which controls the LOW PRESSURE CLOSE TIMER, de-energizing it. This timer now begins its time delay period, and a race is begun between the timer and the mold closing mechanism. Normally, the race is won by the molds, which actuate the HIGH PRESSURE LIMIT SWITCH "E" when they are nearly closed.

Closing this switch energizes the HIGH PRESSURE RELAY "A" and its contacts "A-1" and "A-2" close to energize the HIGH PRESSURE SOLENOID "F" AND THE LOW PRESSURE CLOSE TIMER "B". When the timer is energized, it stops timing and begins recharging for the next cycle. Energizing the solenoid valve transfers pressure control to the high pressure setting, thus applying the added force necessary to lock up the molds and hold them closed against the air pressure which will be exerted within the molded containers.

If there should be a malfunction or obstruction in the mold closing mechanism, the molds will be slow in closing and the timer will win the race. When this occurs, the timer contact opens, de-energizing the SAFETY RELAY, which shuts down the machine.

**TO SUMMARIZE**

1. The machine operates at the high pressure setting at all times except as the molds are moving closed.
2. When the molds start to close, the available pressures dropped to the low setting, and the time delay period begins.

3. When the molds are nearly closed, the pressure is increased to the high setting for lock-up, and the timer resets.

4. The timer does not control the pressure, but provides a signal in the event the molds do not close properly.

**Signal to Auxiliary Equipment**

Most machine lines use some form of auxiliary equipment such as a trimmer, a conveyor, or some other form of take-off which must be synchronized with the blowmolding machine cycle. A relay is provided in the panel to facilitate this correlation with other equipment. The relay coil may be connected to two different points in the blowmolder cycle, depending on the type of signal required. An isolated contact is connected to a plug-in socket located underneath the clamp support arm. This contact is not connected to any blowmolder circuitry but is operated by it. (Refer to Figure 12).

When the blowmolder is in automatic cycle the AUTO CYCLE RELAY contact "B" is closed or closing, making power available to this circuit. When the molds are closed or closing, the MOLD CLOSE RELAY contact "E" is closed, so as soon as the MOLD CLOSE LIMIT SWITCH LS-3 is actuated, closing contact "D", power is applied to both points 98 and 99 through the BLOW DELAY TIMER contact "G". These two points, 98 and 99, will be found as terminals located adjacent to the relay 101CR in the panel. Both points are pre-wired as shown and the coil of the relay may be connected to either point.

The BLOW DELAY TIMER started timing when LS-3 was actuated and when it times out, its contact "G" opens, de-energizing point 99. If the relay coil were connected to this point, it would drop out at this time and its contact "A-2" would open. If the coil "A" were connected to 98, it would remain energized because both "D" and "E" are still closed. When "A" is energized, its contact "A-1" closes to hold the circuit closed after "D" and "E" open. As the molds open, the STRIPPER RELAY is energized to drive the stripper down. At this time, contact "C" opens and the EXTERNAL SIGNAL RELAY is de-energized, opening its contact "A-2".

---

*Figure 12. External Signal Circuit*
The EXTERNAL SIGNAL CONTACT "A-2" is provided with an adjustable time delay, so that its closure may be delayed after the relay is energized.

 Usually a trimmer or conveyor should start at about the time the molds close. In this case, the coil connection should be to point 99 and the signal will be just a brief pulse, one second or less, at the time the MOLD CLOSE LIMIT SWITCH is actuated.

 If another take-off device is used that requires gripping and holding the bottles as they are removed from the molds, this movement must be synchronized with the stripper, and point 98 is used. The time delay on 101-CR is adjusted so the device grips the bottles just before the molds open, to prevent the gripping fingers from being in contact with the hot plastic for too long a time so they do not overheat.

 **Screw Forward Limit Switch**
 When the extruder reaches its forward position at the end of a shot, a limit switch, LS1 is actuated. The actuation point is adjustable, so the switch may be tripped earlier or later in the stroke as desired. This section will describe the variations that may be employed through the adjustment of this switch and other related devices, the MOLD SEQUENCE SELECTOR SWITCH and the CHARGE DELAY TIMER.

 Parison wall thickness is affected somewhat by the extrusion rate. The highest rate and therefore the heaviest wall will be experienced while the shot is being made. Once the screw is all the way forward, if it is not returned immediately, the output is reduced to the rate of flow that is produced by screw rotation only, hence a thinner parison wall will be observed. If the parisons are allowed to hang, the molten plastic cannot support its own weight and will stretch or "DRAW DOWN" and further thinning of the wall around the top of the parisons will be experienced.

 If a slightly larger parison is required, careful adjustment of the controls can achieve a "BOUNCE" effect, in which the screw is rammed forward at the high extrusion rate, then returned immediately, before the molds are closed. The sudden relaxation of pressure allows the parisons to expand slightly in diameter, which shortens their length slightly, creating the illusion of "BOUNCING". However, this condition exists for only a short time after which the effect of draw-down overcomes the bounce effect, and the parison diameter decreases.

 A third method can be used, that of closing the molds on moving parisons. This method results in the shortest cycle time, so it is advantageous where it can be used. If the molds close before the screw starts retracting, neither draw-down nor bounce will be experienced. In addition, the screw retraction may be delayed for an instant after mold lock-up, extruding a ring or washer at the top of the neck rings, forming a seal against air escaping, and also providing a barrier between the hot die and mandrel and the cold neck ring.

 **Draw-Down Machine Setting**

 1. The MOLD SEQUENCE SELECTOR SWITCH should be in position 1.

 2. The SCREW FORWARD LIMIT SWITCH LS-1 should be set so that it is tripped at the very end of the forward stroke.

 3. The CHARGE DELAY TIMER should be set short, possibly at zero.

 The draw-down effect can now be controlled by adjusting the timer. With the timer at zero, the screw will begin retracting as soon as LS-1 is actuated, stopping the extrusion. The molds also start closing when LS-1 is tripped because there is no time delay. The parisons hang, supporting their own weight or "drawing down" while the molds are closing.
If the timer is set at .5 seconds, the screw will come forward, tripping LS-1 which starts the time delay period. The screw will remain in the forward position for .5 seconds during which time the plastic output results only from straight extrusion and a noticeable step will appear in the parison wall. After the time delay, the screw begins retracting shutting off the flow of plastic and the molds begin to close, draw-down, or further thinning of the parisons will be experienced during the time the molds are closing.

**Bounce Machine Setting**

1. MOLD SEQUENCE SELECTOR SWITCH should be in position 2.

2. LS-1--set to trip near the end of the screw travel.

3. CHARGE DELAY TIMER--set equal to or less than time elapsed between the tripping of LS-1 and the end of the screw stroke.

When LS-1 is tripped, the molds start to close immediately and the time delay begins. At the end of the time delay, extrusion stops and the screw begins retracting. The point at which the molds start to close is adjusted by LS-1 and the bounce point is adjusted by the timer.

**Short Cycle Setting**

1. MOLD SEQUENCE SELECTOR SWITCH should be in position 2.

2. LS-1--set to trip well ahead of the end of screw travel.

3. CHARGE DELAY TIMER--set at least equal to the mold close time. The molds start closing immediately when LS-1 is tripped and the time delay begins. At the time the molds lock-up, or shortly thereafter, the timer should time out, retracting the screw.
External Power Supply
Whenever any accessory equipment such as a trimmer or conveyor is provided by Uniloy, a plug-in connection is provided to supply power to this equipment. This plug-in is fed from a separate set of fuses in the panel, and these fuses are in turn fed through a magnetically operated contactor as shown in Figure 13.

Also, a set of control circuit fuses isolate the external accessory circuit from the internal blowmolder circuit. The control circuit is also provided with a plug-in connection so that any piece of accessory equipment may be unplugged and removed if required.

The contactor is energized by depressing the pushbutton labeled EXTERNAL CIRCUIT ON, which is located on the control panel. The holding circuit for the contactor runs out through the plug 4 as wire no. 413, through the emergency stop buttons on the accessory equipment, and back through plug 4AS wire, No. 403 to the contactor, 101-PC. A pilot light indicates whether or not the circuit is energized. The circuit cannot be energized unless all accessory equipment is plugged in. The interconnection diagram supplied with the equipment shows the proper arrangement for a particular installation.

Limit Switches
Limit switches are position indicators used in various places to provide an electrical signal when its actuator is in the desired position. If reasonable care is taken in their application, actuation, and adjustment, they will give millions of trouble-free operations. One of the most frequent causes of a cycle failure is that a limit switch is not properly adjusted and is not being tripped by its actuator. Careful adjustment avoids this problem. Any limit switch should be adjusted so that its plunger or arm moves far enough to trip the switch, but not so far that there is no over-travel left. (Refer to Figure 14.).

Description of Limit Switches
Following is an itemized list of limit switches used in the control circuitry and a description of their individual functions:

![Diagram of External Power Supply Circuit](image-url)
LS-1  This switch is mounted on top of the machine base, at the rear of the machine. It is a position switch, providing a contact closure when the screw is forward. Its effect is covered in another section of the manual, "Screw Forward Limit Switch."

LS-1A  Mounted on top of machine base at the rear of machine and is actuated when the screw has traveled almost to "shot size". During a normal machine cycle, it is necessary that LS-1A be actuated. If it is not tripped, the SAFETY RELAY will de-energize indicating that material is not being fed at a normal rate. Or the material hopper may be empty altogether.

On the other hand, if LS-1A stays actuated for longer than 10 seconds, the SAFETY RELAY will de-energize also.

TO SUMMARIZE

LS-1A  Must be actuated every cycle but for not as long or longer than 10 seconds.

LS-2  Mounted on clamp base near rotac unit; indicates molded are closed but not locked; energizes "HIGH PRESSURE RELAY" and energizes "LOW PRESSURE CLOSING" timer 5-TD.

LS-3  Mounted on clamp base near rotac unit; indicates toggle system is locked in position; energizes "BLOW DELAY TIMER" 3-TD and "BLOW TIMER" 4-TD.

LS-4  Mounted on clamp base near rotac unit; operates as molds are opening; initiates "STRIPPER" action.

LS-5  Mounted on clamp base near rotac unit; operates as molds are opening; causes screw to move forward, discharging stored plastic.

LS-6  Mounted on stripper. This is a neutral position switch, neither contact being made when the switch is in its normal position. Clockwise rotation of the arm closes one contact; counter clock-wise rotation closes one other contact. One contact indicates the stripper to be fully retracted and clear of the molds, and will de-energize the safety circuit if the molds start to close while this contact is not held closed. The second contact indicates the stripper has reached the end of its stroke and signals it to return.

LS-6L  On machines equipped with two strippers.

Figure 14. LS1 - LS1A Limit Switch Circuit
**LS-6R** These switches take the place of and perform the same as:

**LS-6** Described above. Their CW contacts are connected in series as are their CCW contacts. Both switches must be actuated upward to allow the molds to close. Both switches must be actuated downward to retract the stripper.

**LS-7** Mounted on clamp base near rotac unit; indicates molds are completely open; de-energizes “MOLD OPEN RELAY”.

**LS-12** Clamp pause is mounted on the bridge of the machine or actuated by a rod from the rear platen. When molds are about 1/8 inch from closing, the molds stop, and then go into lock up. This feature is designed to achieve a better weld line in handle area.

**LS-1** Mounted on top of the shot cylinder at the rear of machine. If the screw should be retracted to its maximum stroke either because of a malfunction or the lack of synchronization between cycle time and extruder output, LS-17 will be actuated and the machine will ring out on safety relay.

**Safeties**
Screw Travel Limit Switch (Refer to Figure 15).

1. If the screw should be retracted to its maximum stroke, either because of a malfunction of the lack of synchronism between cycle time and extruder output, LS-1A will be actuated for more than 10 seconds and will de-energize the safety relay.

2. If the screw does not actuate LS-1A, as it travels rearward, indicating that material is low or machine cycle is not matched to extruder output, the safety relay will de-energize.

**Stripper Failure**
To prevent damage to the molds, the stripper must be retracted before the molds can close. A limit switch, LS-6 has been provided to indicate this condition, guarding against failures caused by:

1. Lack of air pressure due to broken or pinched line, valve failure, or compressor failure.

2. Mechanical interference caused by an obstruction, misalignment, or breakage.

![Figure 15. Safety Circuit](image-url)

4. Electrical malfunction in relay, limit switch or wiring. If LS-6 is open at any time during mold close portion of the cycle, the safety relay will be de-energized.

**Mold Obstruction**

In order to minimize damage to molds and injury to personnel, the molds close with hydraulic pressure reduced to a level just great enough to provide sufficient speed. A pressure setting of 250-350 PSI will close the molds from the maximum open position in about 1 second or less. As the molds start to close, a timer is de-energized and begins timing out. When the molds reach the closed position, a limit switch, LS-2, is actuated, energizing the timer and energizing a valve to boost the hydraulic pressure, increasing the locking force. In the event the molds do not reach the closed position before the timer times out, the safety relay will be de-energized. This condition may be caused by an obstruction in the molds, excessive friction, or lack of lubrication in the mold traverse mechanism, or low hydraulic pressure.

**Material Hopper Empty**

Should the extruder fail to produce material while cycling, either because the hopper is empty or the screw is not turning, the machine will complete one cycle and shut down. Since there is not any material produced, the screw does not retract and LS-1 remains actuated. Because of the incomplete cycle, the molds attempt to close as soon as the stripper starts to return to its normal position, but since it has not had time to retract and actuate LS-6 and the molds are trying to close, the safety relay is de-energized. SAFETY RELAY (Refer to Figure 15.) To energize the safety relay, depress the reset pushbutton "E" and when the relay picks up, its contact "A-1" closes to hold the relay in after the pushbutton is released. This condition remains until interrupted by one of the items listed above, or a power failure.

When de-energized, the relay drops out closing contact "A-2" which energizes the bell and the warning lights.
START UP PROCEDURES

1. Start the following equipment:
   A. Chiller
   B. Air Compressor
   C. Grinder
   D. Conveyor
   E. Plastic Vacuum System

2. Turn main power supply on.

3. Reset safety circuit.

4. Pull heat start button.

5. Set barrel and head heat instruments as indicated below: All temperature settings are estimated. They will vary according to materials and speeds.

   A. Feed zone 250° F.
   B. Transition Zone 250° F.
   C. Metering Zone 1 250° F.
   D. Metering Zone 2 250° F.
   E. Left Head 340° F.
   F. Right Head 340° F.
   G. Stock Temperature 340° F.

6. Constantly monitor these instruments as the heat increases in each zone. Make sure that all zones rise in temperature.

7. The die head instruments will be the slowest in temperature rise due to the head block being the largest single piece of steel, thus requiring longer to heat up.

8. Make the following instrument changes when the head heats reach 310° F.

   A. Feed Zone 300° F.
   B. Transition Zone 340° F.
   C. Metering Zone 1 340° F.
   D. Metering Zone 2 340° F.
   E. Left-Right Head(s) Unchanged

NOTE: Leave head zone(s) and stock temperature at 340° F.

9. Let zone(s) reach these temperatures for at least thirty (30) minutes.

10. You are now ready to start the machine. So far, the time consumed will be close to one and one-half (1-1/2) hours after the power and heats have been turned on.

11. You are now ready to start blowing containers if you previously have checked the following:

   A. All switches must be in "automatic" on the blowmolder.

   B. All switches on the eight-foot cooling conveyor and trimmer are on "automatic" and "run" and the external circuit pushbutton depressed with the (yellow) reset button lit.

12. Turn on hydraulic pump. System pressure should be 1,500 PSI.

13. Push reset button on stock temperature instrument. The flashing yellow light will go off and the red light will appear if the stock temperature is above 340° F. This is a temperature safety device and must not be moved below its set point 340° F.

14. Turn drive speed pot to "O"

15. Pull extruder start button

16. Gradually turn speed pot clockwise and observe the flow of plastic from die head(s). Do not increase the pot too fast. It is best to start the flow of material very slowly as you watch the percentage (%) of load on the extruder motor. Continue to increase the RPM's of the clutch until you reach the desired running speed.

17. Hold the charge button in until the screw position meter (inch meter) reaches 5-1/2".

18. Push the blue charge button. The parison(s) will fall off the die(s).
19. Release charge button and push in cycle start button.

20. Push the charge button in again just before the molds open the first time.

21. Continue to hold the button in for 2 seconds after the molds are all the way open.

22. Release the charge button and the next shot will come from the head(s).

23. The holding-in of the charge button is important as it insures you of a longer start-up parison until the flow of the plastic is continuous and uniform.

24. Repeat this procedure of holding-in of the charge button for at least 4 or 5 mold closures, or until the parison lengths are long enough for the swinging arm fingers to grasp the container from the mold(s) and extract them.

25. Put all containers in the grinder until the tails are centered in the container and the handles are formed properly.
GENERAL LUBRICATION AND MAINTENANCE INSTRUCTIONS

Daily Lubrication and Maintenance

Lubrication Items

Hydraulic Oil
Mobil DTE-26
-Check to maintain proper oil level
-Check water flow to heat exchanger to maintain 100° F. to 130° F. oil temperature

Stripper Guide Rods
Mobil DTE-26
-Oil lightly

Air Lubricator
Mobil DTE-26
-Oil lightly

Grease as follows

Ball Spline
-Grease Gun

Thrust Bearing
Shoes
-Grease-Mobilux EP-1

Clamp Toggle Pins
-Grease

-Platen Shoes
-Grease

-Tie Bar
Bushings
-Grease

Maintenance Items

Safety Doors
-Check to insure proper cam valve actuation

Stripper Speed Control
-Check adjustment and readjust as required

Weekly Lubrication and Maintenance

Lubrication Items

Reducer
Mobilgears 630 or Mobil DTE Oil BB
-Check to maintain proper oil level
Maintenance Items

Barrel Cooling Fluid
- Check level and add U’Con Con fluid as required U-Con 50HB-280X
- Adjust water flow to heat exchanger to maintain normal running reservoir temperature at 150° F. to 200° F.

Drive Sheaves
- Check tension 5.5-8.5 lbs. to deflect 5/16 inches

Monthly Lubrication

Hydraulic Reservoir Mobil DTE
- Flush and clean suction filters. If damaged, replace

Three Month Lubrication and Maintenance

Thrust Bearing Mobilux EP-2
- Remove and repack each three months

Hydraulic Pump
- Remove and thoroughly clean Strainer

Yearly Maintenance

Temperature Controls
- Recalibrate and check pivots and jewels. See Manual for local authorized service

Barrel Cooling Fluid
- Clean reservoir and replace fluid with U’Con 50HB-280X.

Special Gear Reducer Requirements

Check the reducer case temperature carefully in several spots after at least eight hours of constant running. If the temperature is:

Below 150° F.
- Change oil every 2,500 hours

Between 150° F. and 180° F.
- Change oil every 1,500 hours

Above 180° F.
- Change oil every 1,000 hours and consult Uniloy Service Department for recommendations.
When changing reducer oil, be sure to drain the unit completely. Flush the case with new oil for a few minutes. Then refill to the proper level with new oil.

**LUBRICANT CHARACTERISTICS**

- **Mobil DTE-24**: -155 SUS at 100°F. premium anti-wear hydraulic and circulating oil. Also has the properties needed for an air line oil.

- **Mobil DTE-26**: -335 SUS at 100°F. premium anti-wear hydraulic and circulating oil.

- **Mobil DTE Oil BB**: -1100 SUS at 100°F. premium double inhibited oil for use in multi-functional reuse application.

- **Mobilgear 630**: -1100 SUS at 100°F. premium quality, heavy duty industrial gear lubricant. This is formulated with the new sulfur phosphorous-extreme pressure additives which provide improved anti-wear and friction reducing characteristics.

- **Mobilux EP-1 and EP-2**: These are NLGI No. 1 and No. 2 consistency extreme pressure unlead lithium soap greases. They are multi-purpose products for both anti-friction and plain bearings under wet and dry conditions, and for use in the temperature range of -20°F. to 250°F.

**CROSS REFERENCE CHART**

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>SAE 10-20 WITH ADDITIVES</th>
<th>SAE 50 - 110</th>
</tr>
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<tbody>
<tr>
<td>Atlantic Richfield Co.</td>
<td>Duro AW-21</td>
<td>RubiineE xtra Heavy</td>
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<tr>
<td>Standard Oil Co. (Ca.)</td>
<td>Chevron EP Hyd. 11</td>
<td>Chevron Mach. Oil 50</td>
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<tr>
<td>Cities Service Oil Co.</td>
<td>Citgo XD 20</td>
<td>Pacemaker Oil 110</td>
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<td>Continental Oil Co.</td>
<td>Super HD 21</td>
<td>Conoco Dectal 92 R&amp;O</td>
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<td>Mobil Oil Corp.</td>
<td>DTE-24</td>
<td>DTE BB</td>
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<td></td>
<td>DTE-26</td>
<td>Mobilgear 630</td>
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**GREASE GREASE LITHIUM TYPE**

- Atlantic Richfield Co.
- Mobil Oil Corp.
- Litholine Ind. EP-2
- Mobilux EP2
## Routine Maintenance Checklist for Blow Molding Machine Model 400R25

### Daily Maintenance Schedule

<table>
<thead>
<tr>
<th>Task Description</th>
<th>SUN</th>
<th>MON</th>
<th>TUES</th>
<th>WED</th>
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<tbody>
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<td>11. Hydraulic temperature *</td>
<td></td>
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</tr>
<tr>
<td>- Check and adjust as needed 110° - 120° optimum</td>
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</tr>
<tr>
<td>12. Barrel cooling temperature *</td>
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</tr>
<tr>
<td>- Check and adjust as needed 150° - 200° F optimum</td>
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</tr>
<tr>
<td>13. Air lubricator</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>- SAE 10 as needed</td>
<td></td>
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</tr>
<tr>
<td>14. Thrust bearing shoes</td>
<td></td>
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<tr>
<td>- Grease</td>
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</tr>
</tbody>
</table>

* Adjust Temperature only if the machine is running and has been running for at least one hour.
# Weekly Maintenance Schedule

1. Barrel cooling fluid level - Check and add heat transfer fluid to level mark. Fill at running temp.
2. Reducer gear level oil - Add SAE 50 gear lube to bring up to level
3. Ball spline lubrication - Four or five shots of Lithium grease
4. Thrust bearing lubrication - Two or three shots of Lithium grease
5. Drive belt tension - Adjust tension to deflection norm or than 5/16" inch
6. Clutch coolant level - Add antifreeze-water mix to maintain 0° - 10° F. Use automotive hydrometer
7. Hydraulic fluid - Check and fill as needed with SAE 20 or equivalent
8. Trimmer lubrication - Grease and check gear lube fill to top of sight glass
9. Cooling conveyor lubrication - Grease live roller and caps. Check gear box fluid level

# Monthly Maintenance Schedule

1. Air filters - Clean or replace filter cartridges

# Quarterly Maintenance Schedule

1. Thrust bearing repacking - Remove, clean and repack 2/3 full with Lithium grease
2. Hydraulic oil reservoir - Drain, clean and fill with SAE 20
3. Reducer gear box - Drain, flush and refill with SAE 50

# Yearly Maintenance Schedule

1. Temperature controllers - Recalibrate and check for wear by qualified technician
2. Barrel cooling - Drain, clean and refill with heat transfer fluid

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1. Grease with Mobilux #EP2 on a daily basis

2. Grease with Mobilux #EP2 remove, clean and repack 1/2 - 2/3 full on a quarterly basis

3. Grease with Mobilux #EP2 use grease gun adding two to three pumps every 2 - 3 weeks

4. Gear lube with Mobil oil DTE-BB, check dipstick daily; drain and refill every 1200 hours

5. Nitrogen pressure is 70% of the system pressure(350R2 -250R1- 400R251050 to 1150PSI) check on a monthly basis

6. Heat transfer fluid check on a weekly basis and replace annually

7. Clutch cooling fluid is a mixture of 40% Ethylene Glycol (automotive grade with inhibitors and anti-foaming agents) 60% water, check daily, "Caution" do not use propylene glycol

8. Drive motor grease with Texaco premium RB every 2000 hours

9. Hydraulic fluid fill with Mobil DTE #26, check weekly and drain, clean, and refill every 1200 hours

* Fluid capacities: Falkgear box - Approx. 56 Qts.  Browning gear box Approx. 40 Qts.
Extruder Temperatures and Pressures

Reducer Cooling
176°F to 180°F

Shot Pressure 1100-1200 PSI (depending on application)

Accumulator 75% of system pressure

U/C or Barrel Cooling
50°F ~ 30 PSI

Barrel Cooling 175°F to 200°F

Hydraulic System Pressure 1500 PSI

Water Pressure Clutch Cooling 10-30 PSI

Clutch Cooling
Approximately 50°F
Supply to Drive

Hydraulic Reservoir
110°F to 120°F
Eight Foot Cooling Conveyor
## 10039 - 10040 TRIMMER

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>LUBRICANT</th>
<th>LUBRICATION FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sight gage fill to top of gage</td>
<td></td>
<td>Daily</td>
</tr>
<tr>
<td>2</td>
<td>Filler tube - gear box</td>
<td>SAE 50</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Bucket guide chain</td>
<td>All Purpose grease</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Flange bearing w/zhk flg.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Idler sprocket</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Stripper tie rod bushing (2 Places)</td>
<td>Light Wt. Machine Oil</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Platen tie rod bearings (4 Places)</td>
<td>All Purpose grease</td>
<td>X</td>
</tr>
<tr>
<td>8 - 9</td>
<td>Crank shaft pin (4 Places)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Take up sprocket</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

LUBRICATION AND MAINTENANCE
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TROUBLE-SHOOTING GUIDE

Trouble-shooting is one of the most important parts in operating your Uniloy® machine. It is also probably the most challenging and interesting part of the job.

For continuous top performance, periodic adjustment is required just as it is with any finely tuned machine—a Formula 2 racing car for example. Unlike a racing car, however, the machine is safety oriented and will shut down whenever it senses developing trouble.

Conditions over which you may have little control have a bad habit of changing. And that is what usually causes troubles with the machine. There may be a slight difference in resin from one lot to the next. Or it could be a shift in the surrounding temperature or humidity that causes trouble in the mold.

Whatever the cause, the changing condition may well be one that occurs within the machine itself. Troubles you may not be able to see. The machine will handle these by shutting down and ringing a bell asking the operator to do something to correct the problem.

Then there are troubles you can see. These are usually bottle troubles that occur either in the parison, in the mold, or after the bottle is molded. In this booklet we will treat the internal machine troubles and the bottle troubles in separate sections that are subdivided into categories that will make it easier for you to find the trouble.

Machine troubles, though mostly hidden, leave some hints behind. The most important one to remember is the point in the cycle where the machine has stopped, or "run out"; it will tell you where to start looking.

One problem is that many different machine troubles have very similar symptoms or causes. In many cases when a trouble pops up you will have to try a number of remedies before you find the right one.

In the trouble-shooting guide that follows, only the most probable causes of the particular trouble will be dealt with. It should be second nature for the trained operator to check out all obvious trouble sources first, before picking up the guide.

The warning lights are part of the safety circuit that is designed to protect the operator as much as the machine. Whenever any one of the many relays or switches fails to operate during the machine cycle the safety circuit will be broken, no current will flow in it and the machine will immediately "ring-out"—to protect both you and itself.

"Ring-Out" is our shorthand way of saying that the warning bell will sound and at the same time the machine will stop in the midst of the operating cycle.

You can save yourself a lot of time—not to mention more trouble—if you check out the possible causes of trouble in this guide before doing anything else. Whether or not you cure the trouble, you are going to need the information you will get from this check-out process. It is exactly the kind of information you are going to need to give to our customer service engineer when you pick up your phone and dial our HOT LINE.

—OUT OF STATE 1-800-521-2257
—IN MICHIGAN 1-800-482-2285

We welcome all calls from our customers at any time of the working day. To save you a lot of time running back and forth from machine to phone, we recommend that you use this guide first. If you have done so, our engineer will be able to quickly zero in on the source of your particular trouble—and get your machine back in production as fast as possible.
Keep in mind that the troubles here are listed generally in order of the frequency of their occurrence. The first trouble is the one that happens most often--the one we get the most calls about.

Use good common sense in dealing with suggested repairs and replacements. Replacing a coolant system motor, for instance, may cost a great deal more than repairing the motor winding. But, if the repair means a lot of downtime that could be even more costly. It may be simpler in the long run to replace the motor and keep the repaired one as a spare.

This trouble-shooting guide is meant only to given maintenance personnel and machine operators something to refer to when trying to correct a problem. It is impossible to include every possibility which might be the cause of a problem and indeed, the solution may be a combination of several important things to remember when trouble-shooting a problem.

1. **Think!** about the problem and the possible reasons for it before you try anything.

2. **Try one change at a time.** Don't lose your perspective.

3. **Be patient!** Give a change an opportunity to work before you try something else. For example, a change in the barrel or head temperature may take 15 to 20 minutes before its true effect will be noticed.

4. **If one change doesn't work, return that change to its original position** before trying something else.

5. **Observe and learn** from the incorrect changes that have been made. For example, if you find that lowering the head temperature aggravates a situation, then raise the same temperature to see if improvement occurs.

6. **After a problem appears to be solved, watch the machine for a while to be sure something else hasn't been upset.**

7. **Communicate with others** so they can learn from your work.

8. **Use machine setup sheets and record the changes** made regardless of what effect it had on the operation. Don't forget--call us when you have run out of possible corrective actions, or whenever you have a real emergency that cannot wait. We will be ready to help with whatever resources we can command.
## BLOW MOLDING TROUBLE-SHOOTING GUIDE FOR INTERMITTENT EXTRUSION MACHINES

### Machine Troubles - General

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAFETY BUTTON</strong> will not reset. <em>(HYDRAULIC OIL SAFETY)</em></td>
<td>Hydraulic oil overheated.</td>
<td>Check temperature of water heat exchanger See Hydraulic System</td>
</tr>
<tr>
<td><strong>TS-3 TEMPERATURE SWITCH</strong> defective on oil tank.</td>
<td></td>
<td>Replace defective TS-3</td>
</tr>
<tr>
<td>Machine <strong>RINGS OUT</strong> before parison drops <em>(OVERFILL SAFETY)</em></td>
<td><strong>7TD TIMER</strong> timed out (Screw overfill)</td>
<td>Adjust <strong>7TD TIMER</strong> Adjust <strong>LS-1A</strong>, cycle time and/or RPM of drive</td>
</tr>
<tr>
<td>Machine <strong>RINGS OUT</strong> when molds should close after parison drop <em>(STRIPPER SAFETY)</em></td>
<td><strong>LS-6 LIMIT SWITCH</strong> is not actuated in the &quot;UP&quot; position</td>
<td>Adjust <strong>LS-6 actuator cam</strong></td>
</tr>
<tr>
<td></td>
<td>Plastic hung up on stripper plate</td>
<td>Clean stripper plate</td>
</tr>
<tr>
<td>Machine <strong>RINGS OUT</strong> as molds close. <em>(LOW PRESSURE CLOSE SAFETY)</em></td>
<td>Hydraulic low-pressure set too low</td>
<td>Adjust low-pressure higher</td>
</tr>
<tr>
<td></td>
<td>Mechanical drag on tie bars</td>
<td>Lubricate tie bars</td>
</tr>
<tr>
<td></td>
<td><strong>5TD TIMER</strong> defective or set too low</td>
<td>Replace or adjust timer higher</td>
</tr>
</tbody>
</table>

*Used on machines without 7TD TIMER*
<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LS-2 HIGH PRESSURE LIMIT SWITCH does not actuate or is defective</strong></td>
<td>Adjust or replace limit switch</td>
<td></td>
</tr>
<tr>
<td>Machine <strong>RINGS OUT</strong> as molds reach full open position. <strong>(OUT OF MATERIAL SAFETY)</strong></td>
<td>Refill hopper with resin</td>
<td></td>
</tr>
<tr>
<td>Machine out of resin</td>
<td>Adjust LS-1A, LIMIT SWITCH, Screw RPM, and/or cycle timer</td>
<td></td>
</tr>
<tr>
<td>screw did not retract far enough to activate LS-1A</td>
<td>Repair or replace parts</td>
<td></td>
</tr>
<tr>
<td><strong>STRIPPER PLATE</strong> does not go down</td>
<td>LS-4 LIMIT SWITCH does not actuate as molds open</td>
<td>Adjust switch actuator rod or replace switch</td>
</tr>
<tr>
<td>Solenoid #7 coil burned out or valve spool does not move</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STRIPPER PLATE</strong> does not return to &quot;UP&quot; position</td>
<td>LS-6 not actuated in down position</td>
<td>Adjust actuator cam to make LS-6 actuate when stripper is down</td>
</tr>
<tr>
<td>Valve spool does not move</td>
<td>Clean or replace spool</td>
<td></td>
</tr>
<tr>
<td><strong>TEMPERATURE CONTROLLER</strong></td>
<td>Pointer at fill does not turn on heat to heater zones</td>
<td>Replace thermocouple scale indicates open thermocouple</td>
</tr>
<tr>
<td>Defective controller</td>
<td>Replace controller</td>
<td></td>
</tr>
<tr>
<td>Thermocouple short-circuited does not reach set point</td>
<td>Replace thermocouple</td>
<td></td>
</tr>
<tr>
<td>TROUBLE</td>
<td>CAUSE</td>
<td>WHAT TO DO</td>
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<tr>
<td>---------</td>
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</tr>
<tr>
<td>Cooling valve stuck open</td>
<td>Replace cooling valve</td>
<td></td>
</tr>
<tr>
<td>Temperature controller defective</td>
<td>Replace controller</td>
<td></td>
</tr>
<tr>
<td>All die heaters heat up, 115-V OUTLETS and TROUBLE LIGHT do not work</td>
<td>(F9) fuse melted, circuit open</td>
<td>Replace fuse</td>
</tr>
<tr>
<td>115-V OUTLETS and TROUBLE LIGHT do not work</td>
<td>(F8) fuse melted, circuit open</td>
<td>Replace fuse</td>
</tr>
<tr>
<td>HYDRAULIC PUMP MOTOR does not Start (1M)</td>
<td>&quot;Overload&quot; switch has tripped open at either: BARREL COOLANT MOTOR (3M) HYDRAULIC MOTOR (1M) GEAR BOX COOLANT MOTOR (4M) CLUTCH COOLANT MOTOR (4M) DRIVE MOTOR (2M)</td>
<td>Reset overload</td>
</tr>
<tr>
<td>STOCK TEMPERATURE instrument does not reset</td>
<td>Head heater or metering heat zones not up to heat Correct respective heat zone trouble (See Heater Troubles)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermocouple short-circuited Replace thermocouple</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Instrument defective Replace instrument</td>
<td></td>
</tr>
</tbody>
</table>

TROUBLE-SHOOTING GUIDE

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<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTRUDER MOTOR does not start</td>
<td>&quot;Overload&quot; switch has tripped open at either:</td>
<td>Reset overload</td>
</tr>
<tr>
<td></td>
<td>BARREL COOLANT MOTOR (3M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HYDRAULIC MOTOR (1M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GEAR BOX COOLANT MOTOR (4M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CLUTCH COOLANT MOTOR (5M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DRIVE MOTOR (2M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock temperature indicating controller has not been reset</td>
<td>Reset stock temperature controller</td>
</tr>
<tr>
<td></td>
<td>Barrel cooling pump not running.</td>
<td>Turn on barrel cooling pump.</td>
</tr>
<tr>
<td>CLUTCH does not start</td>
<td>Water pressure not above 11-PSI</td>
<td>Check coolant level in clutch cooling tank, and refill if needed</td>
</tr>
<tr>
<td></td>
<td>Clutch cooling motor not running</td>
<td>Reset &quot;overload&quot;, or replace motor</td>
</tr>
<tr>
<td></td>
<td>Temperature switch open</td>
<td>Allow coolant and clutch to cool and then check for the source of the overheating</td>
</tr>
<tr>
<td>CLUTCH runs at full speed at all speed settings</td>
<td>Defective clutch control board</td>
<td>Replace printed circuit board and recalibrate</td>
</tr>
<tr>
<td>CLUTCH Speed erratic</td>
<td>Drive controller out of adjustment (Eddy Current Controller)</td>
<td>Check adjustment of controller settings (Calibration procedure in Drive instruction Manual).</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>CAUSE</td>
<td>WHAT TO DO</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>SCREW does not retract all or part of the way</td>
<td>Drive belt tension wrong</td>
<td>For belt adjustment procedure see Machine Maintenance Manual</td>
</tr>
<tr>
<td></td>
<td>A collar has formed on screw</td>
<td>Pour 10-15 gallons of handle slugs into material hopper</td>
</tr>
<tr>
<td></td>
<td>Lack of resin</td>
<td>Add more resin</td>
</tr>
<tr>
<td></td>
<td>Defective manual CHARGE pushbutton</td>
<td>Replace pushbutton</td>
</tr>
<tr>
<td></td>
<td>Burned out solenoid coil on CHARGE VALVE. (Solenoid #1)</td>
<td>Replace coil</td>
</tr>
<tr>
<td>MATERIAL WEEPS from dies as screw retracts</td>
<td>Fill pressure too high</td>
<td>Reduce fill pressure untilweeping stops</td>
</tr>
<tr>
<td>Machine does not go into AUTO CYCLE</td>
<td>DOOR LIMIT SWITCHES are not actuated, LS-9A, LS-9B, LS-9C, LS-9D)</td>
<td>Close door, adjust or replace limit switch</td>
</tr>
<tr>
<td></td>
<td>DOOR AIR VALVES (Versa Valves) do not actuate, are defective, or PS-3, PRESSURE SWITCH does not actuate</td>
<td>Adjust or replace valve, and/or pressure switch</td>
</tr>
<tr>
<td></td>
<td>Defective CYCLE START button</td>
<td>Replace defective button</td>
</tr>
<tr>
<td>MOLDS do not close</td>
<td>PRE-BLOW, BLOW and EXHAUST TIMERS do not reset at end of cycle</td>
<td>Jammed LS-3 LIMIT SWITCH should be cleared</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>CAUSE</td>
<td>WHAT TO DO</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Solenoid #3 energizes but valve does not shift</td>
<td>Replace solenoid</td>
<td></td>
</tr>
<tr>
<td>Low pressure (Hydraulic) set too low</td>
<td>Adjust low pressure to 350 PSI</td>
<td></td>
</tr>
<tr>
<td>Spool sticks in hydraulic valve #3</td>
<td>Free spool, or change valve assembly</td>
<td></td>
</tr>
<tr>
<td><strong>MOLDS do not go into high-pressure lock-up</strong></td>
<td><strong>Defective or improperly adjusted LS-2 LIMIT SWITCH</strong></td>
<td>Adjust or replace LS-2 LIMIT SWITCH</td>
</tr>
<tr>
<td>Solenoid #2 has burned out coil</td>
<td>Replace coil</td>
<td></td>
</tr>
<tr>
<td>Spool sticks in hydraulic valve #2</td>
<td>Free spool or replace</td>
<td></td>
</tr>
<tr>
<td><strong>MOLDS fail to close automatically but close manually</strong></td>
<td><strong>LS-1 LIMIT SWITCH not actuated</strong></td>
<td>Replace LS-1 LIMIT SWITCH</td>
</tr>
<tr>
<td><strong>CHARGE DELAY TIMER, PRE-BLOW, BLOW AND EXHAUST TIMERS do not reset</strong></td>
<td>Replace 1TD TIMER, Repair or replace jammed, LS-3 LIMIT SWITCH</td>
<td></td>
</tr>
<tr>
<td>Some <strong>BLOW PINS do not blow</strong></td>
<td>Clean, repair or replace valve sticks</td>
<td></td>
</tr>
<tr>
<td><strong>HIGH-PRESSURE AIR blow does not operate</strong></td>
<td>Clean blow pin</td>
<td></td>
</tr>
<tr>
<td>Solenoid #5 or #6 sticks or coil burned out</td>
<td>Repair or replace solenoid valve or coil</td>
<td></td>
</tr>
<tr>
<td>TROUBLE</td>
<td>CAUSE</td>
<td>WHAT TO DO</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>EXHAUST TIMER (2TD), BLOW DELAY TIMER (3TD), and BLOW TIMER (4TD) do not reset when molds open</td>
<td>LS-3 LIMIT SWITCH head sticks</td>
<td>Repair or replace limit switch or head</td>
</tr>
<tr>
<td>No LOW-PRESSURE AIR blow</td>
<td>Solenoid #5 has burned out coil</td>
<td>Replace coil</td>
</tr>
<tr>
<td>Valve #5 sticks and unable to shift</td>
<td>Free spool or replace</td>
<td></td>
</tr>
<tr>
<td>SWINGING ARMS do not go up in automatic cycle</td>
<td>TD101 TIME DELAY not timing out</td>
<td>Adjust or replace 101 TIMER</td>
</tr>
<tr>
<td>SWINGING ARM fingers do not close or open</td>
<td>LS-102 LIMIT SWITCH defective or actuator out of adjustment</td>
<td>Replace LS-102 LIMIT SWITCH or adjust actuator</td>
</tr>
</tbody>
</table>

**Machine Troubles - Heaters**

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any HEATER ZONE fails to heat properly; red pilot light on</td>
<td>Blown fuses in heater circuit</td>
<td>Replace fuses as needed</td>
</tr>
<tr>
<td></td>
<td>Defective Controller</td>
<td>Check Controller</td>
</tr>
<tr>
<td></td>
<td>Defective heater replace heater as required</td>
<td>Check zone amp draw;</td>
</tr>
<tr>
<td>TEMPERATURE CONTROLLER does not turn on heat to heater zones</td>
<td>Pointer at full scale, indicates open thermocouple</td>
<td>Replace thermocouple</td>
</tr>
<tr>
<td></td>
<td>Defective temperature controller</td>
<td>Replace controller</td>
</tr>
<tr>
<td>TROUBLE</td>
<td>CAUSE</td>
<td>WHAT TO DO</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>TEMPERATURE CONTROLLER does not reach set point, but heaters are working</td>
<td>Thermocouple short-circuited</td>
<td>Repair or replace thermocouple</td>
</tr>
<tr>
<td></td>
<td>Cooling valve stuck open</td>
<td>Replace or repair cooling valve</td>
</tr>
<tr>
<td></td>
<td>Defective temperature controller</td>
<td>Replace controller</td>
</tr>
<tr>
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## TROUBLE-SHOOTING GUIDE

### Machine Troubles - Hydraulic System

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<td>Degraded material the head</td>
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<td>Degraded resin on die or mandrel</td>
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<td>ALL TAIL LENGTHS change longer or shorter</td>
<td>Timer(s) malfunction resulting in a cycle time variation</td>
<td>Replace defective timer(s).</td>
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</table>
| **ALL TAIL LENGTHS**  
  change longer or shorter | Insufficient back pressure (fill pressure) or erratic operation of the regulator | Increase fill pressure  
  Replace fill pressure regulator |
| | Virgin regrind stratification in the hopper | Insure complete mixing of virgin and regrind |
| | Partially bridged or collared screw | Introduce handle slugs into feed throat of machine while running |
| | **LS-1 LIMIT SWITCH**  
  too far back which results in a cushion in front of the screw. The thrust bearing should be within 1/4" of the gear reducer when on automatic cycle | Reset LIMIT SWITCH |
| | Malfunctioning barrel temperature controllers or barrel cooling systems | Replace temperature controller(s)  
  Repair barrel coolant system |
| | Worn barrel and/or screw  
  V-belts slipping from drive motor to gear reducer | Replace either barrel or screw  
  Tighten V-belts |
<p>| | Excessive screw speed and/or improper screw design | Contact machinery manufacturer |
| | Hydraulic system malfunction | |</p>
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<td>System pressure relief valve</td>
<td>Repair or replace relief valve</td>
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<td>Manitrol valve</td>
<td>Clean Manitrol valve</td>
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<td>Mold close rotac rotac or grease tile bars</td>
<td>Check seals in</td>
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<td>Any of the 4-way valves (sluggish operation)</td>
<td>Clean 4-way valves</td>
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<td>Malfunctioning Eddy current clutch resulting in a screw speed variation</td>
<td>Contact machine manufacturer</td>
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<td>Worn thrust bearing resulting in a screw speed variation</td>
<td>Repair or replace thrust bearing</td>
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<tr>
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<td>Extruder drive AC motor malfunction resulting in a screw speed variation</td>
<td>Repair or replace AC motor</td>
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<td>Gear reducer, ball spline damaged resulting in a screw speed</td>
<td>Repair or replace gear reducer, ball spline</td>
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<td>Incoming line voltage fluctuation</td>
<td>Contact local power company</td>
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<td>A mixture of dissimilar materials</td>
<td>Isolate to one type of material only</td>
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<td>TAIL LENGTHS uneven</td>
<td>Manifold Chokes out of adjustment ails longer first</td>
<td>Adjust manifold chokes, make short</td>
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<td>Bottle weights not uniform</td>
<td>Adjust bottle weights to +1 gram of target weight</td>
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<td>Nonuniform head heats</td>
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<td>Reset head chokes</td>
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<td>MELT FRACTURE (sharkskin)</td>
<td>Melt flow is unstable</td>
<td>Increase or decrease stock temperature; increase or decrease drop time; check to insure that the head choke and manifold chokes are open as much as possible; clean the tooling</td>
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<td>AIR BUBBLES</td>
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<td>Raise feed zone temperature to 3550 F, switch to back up material</td>
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<td>Check head temperature setting and heater band function; shut off die variacs</td>
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<td>Degraded material on die face</td>
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<td>too high or too low</td>
<td>Material or tooling too hot</td>
<td>Reduce stock temperature; reduce head temperature</td>
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<td>“Rupturing” blow air</td>
<td>Check blow pin and shear steel</td>
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<td>Stripper not adjusted properly</td>
<td>Adjust stripper plate</td>
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<td>Raise or lower blow pins</td>
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<td>Turn mandrel adjusting nut clockwise to decrease or counter clockwise to increase bottle weight, making sure the mandrel does not turn</td>
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<td>Defective solenoid air valve</td>
<td>Repair valve</td>
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### Machine Troubles - During Molding

| BOTTOM OR VOLUME CONTROL INSERT       | Insufficient exhaust time | Increase exhaust |
| inverted (blown out)                 | Bottle weight too low      | Increase bottle weight   |

<p>| POOR WELD or hole at pinchoff area   | Pinchoff too sharp         | Roll pinchoff slightly |
|                                       | Molds too hot or cycle time | Increase mold cooling   |
|                                       | Stock temperature too high | Reduce stock temperature |
|                                       | Excessive PRE-BLOW pressure or timing | Reduce PRE-BLOW |
|                                       | Molds closing too fast     | Slow down mold closing speed |</p>
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<td>Increase blow air pressure (to 80 PSI minimum)</td>
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<td>Cap dimensions wrong caps or call cap manufacturer</td>
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<td>too high</td>
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<td>Reduce bottle weight</td>
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<td>Mold volume incorrect</td>
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<td>Remove inserts for packed bottles only</td>
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<td>Blow air pressure too low</td>
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<td>Reduce melt temperature</td>
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<td><strong>PARISON tail sticking in bottle bottom</strong></td>
<td>Tail too long</td>
<td>If all tails are long - reduce screw speed - reduce 4TD BLOW TIME.</td>
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<td>If one tail is long - check bottle weight - adjust manifold choke</td>
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Glossary of Terms

Accumulator Head
The purpose of this "reservoir" is to store plastic melt. It is a cylinder which contains a plunger. When the cylinder is filled with plastic melt, the plunger pushes at a fast speed forcing the melt through the die to form the parison.

Adiabatic
A term used to describe a process in which heat neither escapes nor is added into a system. In extrusion, it means no heat is added to maintain the molten stock temperature.

Average Molecular Weight
Plastics (polymers) are long, chain-like structures. The number of units which comprise an individual chain varies from chain to chain. Average molecular weight indicates chain length of the most typical chain in a given plastic; it is neither the longest chain nor the shortest.

Backing Plate
In injection molding equipment, a heavy steel plate that is used as a support for the cavity blocks, guide pins, bushings, etc. In blow molding equipment, it is the steel plate on which the cavities (i.e., the bottle molds) are mounted.

Back Pressure (Fill Pressure)
Hydraulic pressure exerted on the rearward motion of the screw while accumulating a charge.

Ball Spline
Contained within the hollow shaft of the reducer drive. Its function is to transmit the drive torque to the rotating and reciprocating screw and to reduce the drag created by reciprocating the screw.

Barrel Cooling
This assembly includes all the necessary equipment to dissipate excess heat from the heater bands and barrel.

Blow Molding
A fabricating technique in which a hollow tube (parison) is clamped in the mold and then blown by air to the interior shape of the mold.

Blow Pin
A device which injects air into the parison to effect the blowing of the bottle. It may also function as a neck finishing device.

Blow Pressure
The air pressure required to form the parison into the shape of the mold cavity, in a blow molding operation.

Blow Up Ratio
In blow molding, the ratio of the diameter of the container (usually its greatest diameter) divided by the diameter of the parison from which the container is formed.

Bridging
A partial blockage between flights caused by material stuck to the screw.

Bulk Density
The weight of the plastic pellets in a given space. Usually expressed as pounds per cubic foot.
Burn Line
A dark streak of material in a container resulting from decomposed material dislodged from the extruder and incorporated in the material used to blow the container.

Capacity
1. The amount of space inside a container provided for a given amount of product.
2. Also, the total amount of volume inside a container. The latter is more correctly called the overflow capacity.

Cavity
In blow molding, the parts of the mold that combined provide the container body shape.

Charge
The volume or weight of material required to load a mold for one complete cycle.

Choke
A valve usually located between the extruder and die which controls the amount of melt flowing as well as affects back pressure.

Choked Neck
The opening in the neck of a bottle which has either been obstructed or narrowed.

Clamping Pressure
The pressure that is used to keep the halves of the molds together.

Clevis
Part of toggle mechanism of the clamp. The clevis bolts to the center or rear platen in which the linkage is attached.

Compacting
To compress plastic using the blow pin to achieve a heavy walled neck finish.

Contamination
Any visible foreign material in the resin.

Converging Tooling
Die and mandrel that direct the flow of plastic through channels which are angled inwards.

Cooling Channels
Channels or passageways located within the body of a mold through which a cooling medium can be circulated to control temperature on the mold surface.

Cooling Conveyor
An auxiliary system used to transfer containers from the extruder to the trimmer.

Copolymer
Polymer made from the two starting materials, for example, ethylene + butene = ethylene - butene copolymer.

Curling
A condition in which the parison sticks to the outer face of the die ring due to the parison curling upwards and outwards.

Curvature
Any bending or "hooking" of the parison when it is being extruded.

Curtaining
The vertical draping or folding caused by extruding a parison which swells, i.e. grows in diameter as it is extruded. Because of
gravitational forces, the parison tends to hang directly below the die opening. As the circumference of the parison "swells" or grows, it tends to fold or wrinkle beneath the die.

**Cycle**
The complete, repeating sequence of operations in a process or part of a process. In molding, the cycle time is the period of elapsed time between a certain point in one cycle and the same point in the next.

**Deflashing**
A finishing process which trims the unwanted material from the molded part.

**Density**
Weight per unit volume. Usually expressed as grams/cubic centimeter.

**Detabber**
A trimmer system used in removing tail flash.

**Die**
Any tool or arrangement of tools designed to cut, shape or otherwise form materials to a desired configuration.

**Die Gap**
The distance between the metal faces forming the die opening.

**Die Land**
A parallel section of the die and mandrel just before the exit of the die head.

**Die Lines**
Vertical lines formed on the parison as it is being extruded due to die imperfections or degraded polymer build-up.

**Die Swell Ratio**
The ratio of the outer parison diameter (or parison thickness) to the outer diameter of the die (or die gap). Die swell is influenced by polymer type, head construction, land length, extrusion speed and temperature.

**Diverging Tooled**
A die and mandrel that directs the flow of plastic through channels which are angled outwards.

**Dome**
Contained blown flash above the container neck, used primarily with a large spin-off trimmer application.

**Drooling**
The extrusion of plastic from the die opening other than during the normal parison drop.

**Drop Test**
Any test method in which the article being tested is dropped in a specified manner for a specified number of times or until the article fails from impact.

**Eccentricity**
Off-centering of the die with respect to the mandrel.
Elasticity
In blow molding, a molten polymer characteristic which relates to swell or "snap-back".

Emboss (-ed), (-ing)
Raised design or lettering on the surface of an object.

Extrusion
The compacting and forcing of plastic through a narrow opening.

Fill Point
The level to which a container must be filled to furnish a designated quantity of the contents.

Fill Pressure (Back Pressure)
Hydraulic pressure exerted on the rearward motion of the screw while accumulating a charge.

Finish
The plastic forming the opening of a container shaped to accommodate a specific closure. Also, the ultimate surface of an article.

Flame Treating
A method of treating plastic objects to make them more receptive to inks, lacquers, paints, adhesives, etc. The part (bottle) is bathed in an open flame to oxidize the surface.

Flash Line
A raised line appearing on the surface of a molding and formed at a junction of mold faces.

Gloss
The shine or lustre of the surface of a material.

Grit-Blasted
A surface treatment of a mold in which steel grit or sand materials are blown to the walls of the cavity to produce a roughened surface. Air escape from the mold is improved and special appearances are often obtained by this method.

Head
The end section of a blow molding machine (in a general extruder) in which the melt is transformed into a hollow parison.

Homopolymer
A straight chain of high density polyethylene having no branches.

Hooking
The bending of a parison away from vertical.

Hopper
A "bin" which accumulates material prior to its falling into the machine.

Hopper Loader
A device that transfers material from silo or gaylords to machine hoppers.

Hydraulic
A system which utilizes pressurized fluid flow to transfer energy.
Uniloy Machine Systems

Hydraulic Accumulator
A device for storing pressurized hydraulic fluids.

Impact Resistance
Relative susceptibility of plastics to fracture by shock e.g., as indicated by the energy expanded by a standard pendulum-type machine in breaking a standard specimen in one blow.

Land
The length of any channel through which molten polymer flows. Frequently, the term means the finishing portion of a die which shapes the plastic to form the parison or the "thickness" areas in the pinch-off insert.

Layflat (Bottle)
The width of the pinched portion of the parison measured perpendicular to the extrusion direction.

Layflat Area (Mold)
The recessed area of the mold which accommodates the flash or excess plastic attached to the bottle.

L/D Ratio
A term used to define an extrusion screw which denotes the ratio of the screw length to the screw diameter.

Label Panel
That portion of the body of a container to which labels are affixed or decoration imprinted.

Linear Position Transducer
Potentiometer which works in conjunction with the screw position meter in monitoring the plastic accumulation.

Low Boy Loader
See Cooling Conveyor.

Low Pressure Close
All Uniloy® machines are provided with a protective feature which allows the clamp to close at a reduced hydraulic pressure.

Mandrel
An inner part of the head tooling that forms the parison.

Manifold
A term used mainly with reference to blow molding and sometimes with injection molding equipment. It refers to the distribution or piping system which takes the single channel flow output of the extruder or injection cylinder and divides it to feed several blow molding heads or injection nozzles.

Masterbatch
Usually concentrated color in a plastic. It is added to the plastic in the hopper to obtain the desired color of the molten plastic container.

Material Distribution
A term which describes the variation in thickness of various parts of the container, i.e., body, wall, shoulder, heel, base, etc. Material distribution is controlled by parison programming, temperature of the melted plastic, bottle geometry, blow-up ratio, etc.
Melt Fracture
An instability in the melt flow through a die, starting at the entry into the die. It leads to surface irregularities on the finished article like a regular helix or irregularly-spaced ripples.

Melt Index
The amount, in grams, of a thermoplastic resin which can be forced through a 0.825-inch orifice in ten minutes at 190° C., when subjected to 2,160 grams force.

Melt Strength
The strength of a plastic in its molten state.

Melt Temperature
The temperature of the plastic in its molten state (Stock Temperature).

Metering Screw
An extrusion screw which has a shallow constant depth, and constant pitch section usually over the last 3 to 4 flights.

Minimum Wall
A term that designates the thickness of the wall (body) of a container. Usually specified as the minimum thickness allowable for the body of a container.

Mold
(1) To shape plastic parts or finished articles by heat and pressure. (2) The cavity or matrix into which the plastic composition is placed and from which it takes form. (3) The assembly of all the parts that function collectively in the molding process.

Mold Number
The number assigned to each mold or set of molds for indentification purposes. The number is usually placed in that part of the container mold that forms the base of the container.

Mold Seam
A vertical line formed at the point of contact of the mold halves. The prominence of the line depends on the accuracy with which the mating mold halves are matched. (See Parting Line.)

Mold Shrinkage
The difference in size of the molded part versus the mold cavity.

Molecular Weight Distribution
The magnitude of differences in sizes of chains in a material.

Multiple Head Machine
Any blow molding machine having two or more heads.

Neck
The part of a container where the bottle cross-section decreases to form the finish. (See also Neck Finish.)

Off-Center
A condition in which the mandrel is not centered within the die ring.

Orifice
The area formed between the die and the mandrel.
Uniloy Machine Systems

Out-of Round
A round plastic container which when molded, does not remain round.

Over Fill
To accumulate plastic beyond the extruder limits.

Parison
The plastic tube formed by ejecting plastic through the die orifice.

Parison Programmer
An electronic feedback servo system which controls the die gap opening throughout the parison drop, thus varying the wall thickness precisely as needed to match the mold shape.

Parison Swell
The ratio of the diameter of the parison to the diameter of the die opening.

Parting Line
Mark on a molding or casting where halves of mold met in closing.

Pinch-off
A raised edge, around the cavity in the mold which seals off the part and separates the excess material as the mold closes around the parison in the blow molding operation.

Pinch-off Tall
The bottom of the parison that is pinched off when the mold closes.

Pinhole
A very small hole in a plastic container, film, etc.

Pinch-Off Land
The width of the pinch-off edge.

Pinch-Off Tall (Tab)
The tab or bottom of the parison resulting from the mold closing, pinching off the parison.

Plastic
A general term to describe a family of materials that can be formed into shapes by flowing. Thermoplastics are repeatedly molded by melting, flowing, and cooling.

Plastic Accumulator
The purpose of this "reservoir" is to store plastic melt. It is a cylinder which contains a plunger. When the cylinder is filled with plastic melt, the plunger pushes at a fast speed forcing the melt through the die to form the parison. Used primarily on large industrial machines.

Plasticity
The characteristic of being able to be shaped by plastic flow.

Plasticize
Making a solid moldable.

Platens
The mounting plates of a press on which the complete mold assembly is fastened.

Platen Shoes
Brass wear blocks which the platens smoothly ride on.
Pleating or Curtaining
Vertical folds or wrinkles in the parison.

Polyethylene
A thermoplastic material composed of polymers or ethylene. It is normally a translucent, tough, waxy solid which is unaffected by water and by a large range of chemicals.

Polymer
A high molecular weight organic compound, natural or synthetic, whose structure can be represented by a repeated small unit, the mer, e.g., polyethylene, rubber, cellulose. Synthetic polymers are formed by addition or condensation polymerization of monomers. If two or more monomers are involved, a copolymer is obtained. Some polymers are elastomers, some plastics.

Pre-Blow
The introduction of air, into the parison, through the mandrel or blow pin, prior to the molds locking closed.

Pre-Finish
A method used in finishing the sealing surface of the container in the mold.

Pull-Up
Type of pre-finish used exclusively with center fill containers with an internal lip and calibrated ID (inside diameter) determined by the blow pin size.

Purging
The procedure by which a material is cleaned out of an extruder by forcing it out with the new material used.

Push-Up
The contour of the bottom of a plastic container designed in such a manner as to allow an even bearing surface on the outside edge and to prevent the bottle from rocking.

Ram Down
Type of pre-finish used only on containers whose finishes do not require internal lips or grooves. The main purpose of this type of finish is to produce a heavy walled neck finish.

Reciprocating Screw
This type of screw rotates and is pushed backwards as molten plastic accumulates in front of the screw. When the proper amount of molten plastic is obtained in front of the screw, the screw moves forward rapidly, thus forcing the plastic through the head and die forming the parison.

Recessed Panel
A container design in which the flat area for labeling is indented or recessed.

Regrind
This term refers to material being fed back into the blow molder. It consists of ground up trimmings from the container flash which is mixed with virgin material and reused.

Resin
Any of a class of solid or semi-solid organic products of natural or synthetic origin, generally of high molecular weight with no definite melting point. Most resins are polymers.
Rocker
A plastic container with a bulged or deformed bottom, causing rocking of the container in the upright position.

Rotac
Hydraulic rotary actuator used to open and close the clamp and also to raise and lower swinging arms.

Sag
A thinning of the upper position of the parison due to the weight of the parison.

Scrap
The parts of a molded piece which were not intended to be part of the molded product.

Sealing Surface
The surface of the finish of the container on which the closure forms the seal.

Shear Rate
The velocity of flow of a molten plastic.

Shear Steel
Part of the neck ring assembly that when combined with the blow pin body forms ID (inside diameter) of the fill hole of the container.

Shot
The total amount of material extruded during one complete molding cycle.

Shot Capacity
The total weight of plastic that an accumulator can push out with one forward stroke when it is running at maximum force.

Shrinkage
The amount a container contracts after it has been cooled.

Snap Back
The phenomenon of plastic memory in attempting to return to its previous shape.

Specific Gravity
The density of plastic or any other material divided by the density of water. The density of water is approximately 1.00g/cc, thus density and specific gravity are mathematically nearly equal.

Spin Off
A trimmer system used primarily to remove blown flash above the container neck.

Split Tie Bar Nut
Clamp lock up adjustment nut which is threaded onto the tie bar. The nut is split for locking purposes.

Stock Temperature
The temperature of the plastic in its molten state. (Melt Temperature).

Stress Crack
Cracks or breaks on a container caused by stresses. The stresses may be either molded into the container or applied to the container internally or externally. The amount of time required to stress crack a given container depends on the amount of stress and the environment (whatever is surrounding or inside the container: air, water, milk, bleach, detergent, etc.).
Stripper Plate
The plate that pushes the blown containers away from the blow pin and die face.

Surging
An uneven flow of melted material through the extruder.

Sweating
The condensation of water vapor on the inside of the mold cavity.

Tab
The trim protruding below the base of the bottle. (See Tall).

Tall
Flash formed in the flash pocket at the bottom of the bottle. The tail is removed during the trimming operation.

Thermoplastic
(1) Capable of being repeatedly softened by heat and hardened by cooling. (2) A material that will repeatedly soften when heated and harden when cooled. Typical of the thermoplastics family are the styrene polymers and copolymers, acrylics, cellulosics, polyethylene, vinyls, nylons, and the various fluorocarbon materials.

Thrust Bearing
Located between the reducer drive and the shot cylinder. Its function is to allow the screw to rotate and reciprocate without rotating the shot cylinder.

Tie Bars
Steel bars that hold and guide the platens together smoothly.

Toggle Link
Part of the clamp mechanism connecting the clevis to the rotac adapter.

Toggle Pin
Part of the clamp mechanism which holds the clevis to its linkage.

Tooling
Another name for dies and mandrels.

Top Load
The amount of weight bearing on the top of a container. The term is sometimes used to indicate the maximum load the container will bear without becoming distorted.

U'Con Fluid
A heat transfer coolant used in the barrel cooling system.

Underblown Container
An imperfect container caused by insufficient air pressure or loss of pressure within the mold.

Upper Handle Web
A web of plastic (chevron stripes) within the hollow upper interior of the handle caused by pleating.

Varilac
An instrument used to vary the amount of voltage to a heater or other piece of electrical equipment.

Vent
In a mold, a shallow channel or minute hole cut in the cavity to allow air to escape as the material enters.
Virgin Resin
Unprocessed plastic, as obtained from the resin supplier.

Viscosity
The frictional forces in a fluid that resist flow. High viscosity means slow flow. Low viscosity means fast flow.

Weld Lines
A narrow line on a container caused by the fusion of two streams of plastic.