6.0 Equipment Maintenance

6.1 General Maintenance

6.1.1 Introduction

This section of the manual is intended to give the necessary general maintenance procedures usually required in systems and equipment of this type.

This section of the manual is intended to give the necessary periodical preventive maintenance requirements, in a simplified form, for components used in the system.

Other than those specifically stated, intervals indicated in this section are defined as follows:

Periodically — An interval of time that must be determined according to prevailing conditions, such as humidity, temperature, dusty or dirty area, etc.

Daily — A standard 24-hour operating period. (Once per day)

Weekly — A standard seven day period.

Quarterly — A standard quarter-annual (3 Months) period.

NOTE: See also the separate "Vendor Manual" furnished to you by Modern Equipment Company, Inc.

This manual contains installation, operation and maintenance information for various items of equipment furnished to you by Modern Equipment Company, Inc. as part of the system, but not directly manufactured by Modern Equipment Company, Inc.

Follow the individual instructions in these manuals regarding frequency of preventive maintenance, maintenance and/or servicing. Add all applicable items to your respective checklists for their stated frequency.

It is important that before working on any piece of equipment, that particular item should be locked out to prevent accidental operation. Lockout procedures are available from the National Safety Council. Failure to comply may result in minor personal injury and/or equipment damage.

The intervals given in this section are based on normal operation. More frequent inspections may be dictated by severe or abnormal operation conditions.

6.1.2 General Maintenance of Components

The duties and responsibilities of maintenance personnel are extremely important. The recognition that their work will receive depends largely on their reports. An organization will have lower maintenance cost and fewer interruptions of operation if it has maintenance personnel

who supplement good inspection with good reports and a superintendent or operating executive who takes prompt action where questionable or unsafe conditions are reported.

The necessity of a definite maintenance program becomes even more important when an entire operation ceases because of equipment failure.

A definite program of inspection schedules should be organized so that all apparatus is assured of attention at stated periods; these periods should be adjusted to meet the actual need which experience over a number of years has indicated is necessary. To assure adequate inspection, it is essential that a maintenance record be kept for each piece of apparatus.

Consistent use of good maintenance records is important. Whatever form is used, it is essential that provisions be made to record those parts of apparatus that are known to require corrections or special attention.

In addition to the maintenance record suggested, a record should be kept for each piece of apparatus. This gives a complete story for periodic reference which, together with the apparatus record, will provide data regarding the suitability of a given machine and will give information to the engineers and purchasing department as to when new machines should be purchased.

One of the prime requisites of a good maintenance crew is a complete set of inspection tools. Of particular importance are the meters and other devices that give immediate indication of existing conditions for comparison with the information on the apparatus nameplate or in other material furnished by the manufacturer. The meters can be individual instruments, such as a voltmeter, ammeter, megometer, thermometer, spring balance for brush-holder fingers, speed counter, etc., or many of them may be grouped in a case.

WARNING: It is important that before working on any piece of equipment, the particular item should be locked out to prevent accidental operation. Lockout procedures are available from the National Safety Council. Failure to comply may result in severe personal injury and/or equipment damage.

Lubrication is an essential part of preventive maintenance, controlling to a great extent the useful life of the system. Different lubricants are needed and some components in the unit require more frequent lubrication than others. Therefore, it is important that the instructions regarding types of lubricants and the frequency of this application as given in this manual be explicitly followed. Periodic lubrication of the moving parts reduces to a minimum the possibility of mechanical failures.

To prevent minor irregularities from developing into serious conditions that might involve shutdown and major repair, several other services or inspections are recommended for the same intervals as the periodic lubrication. The purpose of these services or inspections, which require only a few minutes, is to assure the uninterrupted operation of the unit by revealing the need for adjustment caused by normal wear. The need for some minor adjustment, if neglected, could result in failure and shutdown.

BALL AND ROLLER BEARINGS SERVICING AND REPAIR INSTRUCTION

Anti-friction bearings should receive special handling. As soon as a bearing is removed, cover it to keep out dirt and abrasives.

Wash bearings in non-flammable cleaning solution and inspect the races and balls or rollers. Discard the bearing if they are pitted, scored or burned. If the bearing is serviceable, coat it with light oil and wrap it in clean paper. Do not unwrap new bearings until ready for installing.

REMOVAL

Always use proper tool or fixture for pressing out bearings. Special tools and fixtures are recommended. Normally it is unnecessary to remove bearings unless replacement is required.

INSPECTION AND REPAIR

Give bearings a careful visual inspection.

INSTALLATION

When installing a bearing against a shoulder in a shaft, be sure the chamfered side is toward the shoulder. When a bearing is to be pressed in, lubricate mating surfaces prior to assembly.

Some bearings have holes that must be carefully aligned with the oil hole in the housing or shaft. When necessary, special tools are recommended for installation of some bearing types.

FLUID CONTACT

The seal should be assembled with the toe or wiping edge of the sealing element pointing toward the fluid to be retained. Exceptions for unusual applications must be by specification in manuals or instructions furnished with the assembly.

BORE

The bore should be checked for adequate chamfer (30° angle to a minimum depth of 1/16"). The bore should be inspected for scratches and all sharp edges removed. The seal outside diameter should be correct for the bore in the assembly. When a leak at the outer edge of either metal or rubber-covered seals is caused by abrasion of the oil seal, it may be directly related to improper chamfer on the bore or the use of improper installation tools.

SHAFT

The surface of the shaft should be uniform and free from burrs, nicks, scratches and grooves. The surface finish should be between 10 and 20 micro-inches, and on a repair job, should be buffed to this finish with crocus cloth.

LUBRICATION

In all cases, a lubricant should be applied to the shaft or to the sealing element of the oil seal. This aids installation and reduces heat build-up during the first few minutes of run. The application of a lubricant to the outer periphery of synthetic rubber covered seal will reduce the possibility of shearing or bruising.

PRESSING TOOLS

In pressing the seal into the bore, it is imperative that the proper size pressing tool be used to localize the pressure on the face of the seal and in direct line with the side walls of the seal case to prevent damage and distortion to the seal cases during the installation. When a seal must penetrate the bore below the surface, the proper pressing tool should be 1/32" smaller than the bore diameter. On installation where the seal is flush with the housing, the proper pressing tool should be taken to avoid hammer blows, uneven pressure on seal surfaces, and cocking of the seal during this operation.

OIL SEAL LUBRICATION

Removal oil seals should not be removed unless absolutely necessary for gaining access to another item or unless they are to be replaced due to damage or wear.

Inspection evidence of lubricant leakage around a shaft or bearing is usually a sign of oil seal failure. Oil seals that leak, or are wearing to a point where they may begin to leak, must be replaced. An oil leak corrected in time will prevent overheated bearings resulting from loss of lubricant. Never use cork seals a second time. Once removed, they must be discarded and replaced with new ones.

OIL SEAL INSTALLATION

When possible, soak new rawhide seals in warm oil for one half hour before installing. Install seal with wiping edge turned in direction recommended. Be careful not to cut leather seal as it is installed or when installing a shaft through the seal. Use shim stock if necessary to protect seal from shoulder or sharp edges during installation.

Packing the seals should always be renewed if contacting part is removed. Lubricant must be applied to lip of all shaft type rubber seals before installation. This will prevent damage to seal during initial running, until oil being sealed has contacted sealing face.

The importance of properly installing an oil seal cannot be over-emphasized. Failure to observe correct installation procedures probably accounts for more cases of the improper functioning of oil seals than any other single cause. To secure the ultimate in satisfactory service, it is recommended that the following precautions be observed.

1. Correct Seal
   It is essential that the seal be the correct size for the installation. Oil seals are made for a specified shaft size. When they are installed on one of a larger diameter, there will be drag, frictional heat and excessive wear on sealing element and shaft. When installed on a shaft having a smaller diameter immediate leakage can occur.

   When an oil seal of open channel construction is pressed, fit heel first into the bore, an installation tool will be helpful. The tool is designed to have contact with the inside diameter of the seal case.

2. Shaft End
   If the seal is to be installed toe first, the end of the shaft should have 30° x 3/16" taper, or an installation tool must be used. If the seal is to be installed heel first, no special precautions are necessary other than to remove burrs or sharp edges from the end of the shaft.

3. Shafts with Keyways, etc.
   When an oil seal is installed over the keyway, splines, etc. an installation thimble should be used with the outside diameter not more than 1/32" over shaft.

4. Pressure Lubricated Bearing
   Because of speeds and bearing loading, it is necessary to pressure lubricate the bearings on some larger motors and generators. Pressure gauge readings may not show the amount of oil flowing, but machines have a slight oil flow detector where oil flow may be checked. Orifices in the feed lines may clog and oil flow detection devices will protect the bearings.

5. Attaching Hardware

Use bolts of correct length. A bolt that is too long may "bottom" before head is tight against the part it is to hold. In addition, threads may be damaged when the screw is removed.

If the screw is too short, there will not be enough threads to hold the part securely.

Lock washers, cotter pins, or flat metal locks should be used to lock each nut and bolt when specified. Flat metal locks must be installed properly to be effective. Bend one end of lock sharply around edge of the part. Bend the other end sharply against one flat surface of the nut or bolt head. Do not bend the lock against more than one side of the nut or bolt.

GEARS

Always use recommended tools, or equivalent, for removal and installation. Gears must be carefully inspected for damages or worn teeth. Remove burrs, using an approved method, before installing. Always align keyway in gear with keyway in shaft, before installing. Lubricate mating surfaces of gear and shaft when pressing gear on shaft.

SHIMS

Be sure to remove all shims that were used. Keep the shims together and identify them as to locations. Keep shims clean and flat until they are re-installed.

GASKETS

Install gaskets where required and use new ones if possible. Never use cork or felt gaskets or seals a second time. Make sure holes in gaskets correspond with lubricant passages in mating parts. If it is necessary to make gaskets, select stock of proper type and thickness and be sure to cut sufficient holes in the right places. Blank gaskets can cause serious damage.

SLEEVE BEARINGS

Do not remove sleeve bearings unless inspection reveals damage or wear that exceeds the specified clearance or if the bearing is loose in its mating bore. Sleeve bearing should be pressed out whenever possible. When pressing or driving (in or out) apply pressure directly in line with bore. If a bearing must be driven, use bearing driver or a bar with a smooth flat end. Never drive bearings with a hammer. If bearing has an oil hole, be sure to line up hole with oil hole in the part in which it is assembled. See later paragraphs in this section for general lubricating information on sleeve bearings.

SHAFTS

If a shaft offers unexpected resistance to removal, check carefully to see that all nuts and bolts have been removed before using force. Also check the possibility that another part is interfering which must be removed first. Shafts fitted to other parts with tapered splines are always very tight. If they are tight when disassembled, inspect tapered splines and discard part if splines are worn. Before assembling shafts with tapered splines, be sure splines are clean, dry and free from burrs. Press mating parts together tightly. Clean rust preventive compound from all machined surfaces of new parts before installing.

REPAIRING DAMAGED THREADS

Damaged threads should be repaired by use of a thread restorer or by chasing in a lathe. Internal threads should be repaired with a clean tap of the correct size. If the threads cannot be satisfactorily repaired, replace the part.

REPAIR OF DAMAGED MACHINED AND POLISHED SURFACES

Smooth rough spots, scores, burrs, galling and gouges from damaged surfaces so that part will efficiently perform its normal function. The finish of the repair part is to approximate that of the original finish. In performing any of the operations, critical dimensions must not be altered.

PIPE AND PIPE FITTINGS

Use compounds such as "Permatex" #2 on pipe threads when replacing pipes or fittings. Be certain that all parts are thoroughly cleaned before they are installed. Replace pipes and fittings as required.

HOSES, TUBING AND FITTINGS

Keep all fittings and connections tight to prevent any oil leaks. Do not over tighten or use sealing compounds. Do not attempt to repair hose or nylon tubing, discard and replace any hose, tubing or fittings as required.

WIRE ROPE OR CABLE

Always keep ropes lubricated. Special rope lubricants can be purchased from major oil companies, however, any good heavy oil or graphite grease is better than no lubricant at all. Keep ropes in drum groove. Crossed or piled ropes become damaged and may wedge and break hoist frame.

Always replace ropes that are doubtful. A doubtful rope may be putting someone's life in danger. Failure to comply may result in death, severe personal injury and/or equipment damage.

Remove ropes when kinked, otherwise rope will not follow groove. Use proper size rope, as larger rope will not fit drums or sheave grooves and may be too stiff to bend around the drum properly.

Start motor slowly until slack is out of ropes, to avoid sudden jerk.

Always be certain that hoist is located directly above load. Side pulling damages more ropes than possibly by any other way.

Obtain ANSI standard B30.16 and B30.11 dated 1973 for inspection and maintenance of wire rope from:

American National Standards Institute
1430 Broadway
New York, New York 10018

For more information on reeving, drum fastening, etc. see manufacturer's maintenance instructions.

The Torque Specifications listed in the following chart apply only when not listed in the maintenance instructions.

Size	Threads Per Inch	SAE Grade 8 ASTM-A325 High Strength Bolts	SAE Grade 5 Std. Heat Treated	Spec Heat Treat Allen Head Self Locking
5/16	18		16-18	24-26
5/16	24		18-20	27-29
3/8	16		29-32	43-46
3/8	24		33-37	49-53
7/16	14		46-50	69-73
7/16	20		52-57	76-82
1/2	13	100	71-78	106-113
1/2	20		101-111	118-128
9/16	12		101-111	138-160
9/16	18		113-124	165-180
5/8	11	200	140-155	210-225
5/8	18		160-176	230-255
3/4	10	355	255-275	365-400
3/4	16		280-310	405-445
3/4	20		285-320	415-460
7/8	9	525	380-410	585-645
7/8	14		415-455	645-710
7/8	20		430-475	670-745
1	8			790
1	12		610-675	955-1055
1	14		625-690	975-1080
1	16		640-705	990-1100
1	20		655-720	1015-1125
1-1/8	7			1060
1-1/8	12		835-925	1385-1535
1-1/8	16		870-960	1430-1590
1-1/4	7			1495
1-1/4	12		1180-1290	1935-2135
1-1/4	16		1210-1330	1985-2210
1-1/4	18		1215-1345	2000-2230
1-3/8	6			1960
1-3/8	12		1565-1730	2600-2875
1-3/8	16		1605-1785	2650-2960
1-1/2	6			2600
1-1/2	12		2045-2270	3390-3765
1-1/2	16		2100-2330	3475-3875

(All Torque Values Are Given In Pound Feet)

SLEEVE BEARINGS

Some oil-lubricated machines are shipped without oil and, in the case of large machines, the journals are often packed and treated for protection during shipment. The rotating elements may also be blocked to prevent damage to the bearing and journals during shipment. All motor and generator bearings should be checked for oil before starting up.

Where lubrication is required, the bearing must be opened, the packing removed, and the journal cleaned and flushed before filling the housing with oil.

The bearings of all equipment should be carefully inspected at scheduled periodic intervals in order to obtain maximum life. The frequency of inspection, including the addition of oil, changing the oil and checking the bearing wear, is best determined by a study of particular operating conditions.

Should it ever become necessary to add excessive amounts of make-up oil, an investigation for oil leaks should be started immediately. Failure to comply may result in minor personal injury and/or equipment damage.

The more modern types of sleeve-bearing housings are relatively dust and oil tight, and require very little attention since the oil does not become contaminated and oil leakage is negligible. Maintenance of the correct oil level is frequently the only up-keep required for years of service with this type of bearing.

Older types of sleeve bearings require more frequent inspection and checking for wear, and oil changes should be made more often.

Never add oil to bearings when the machine is running. Failure to comply may result in severe personal injury and/or equipment damage.

The safe temperature rise for a bearing is considered to be 40° C above the room ambient.

When equipment must operate under extreme differences in air temperatures, the use of lighter oil may be found desirable during cold weather.

Care should always be exercised in the use of reclaimed lubricating oils. The filtering operation should be positive and should remove all foreign and injurious matter.

A hot bearing is usually due to one of the following causes:

1. No oil
2. Poor grade of oil, or dirty oil
3. Failure of the oil rings to revolve with the shaft
4. Excessive belt tension
5. Rough bearing surface
6. Improper fitting of the bearing
7. Bent shaft
8. Misalignment of shaft and bearing
9. Loose bolts in the bearing cap
10. Excessive end thrust, due to improper leveling. A bearing may become warm because of excessive pressure exerted by the shoulder of the shaft against the end of the bearing.

11. Excessive end thrust due to magnetic pull, with the rotating part being "sucked" into the starter of the field because it extends beyond the magnetic structure of field poles further at one end than at the other end.
12. Excessive side pull because the rotating part is out of balance.

If a bearing becomes hot, the load should be reduced if possible and lubricants fed freely, loosening the nuts on the bearing cap. If the machine is belt connected, the belt should be slackened. In case relief is not afforded, the load should be removed and the machine kept running slowly, where possible, until the shaft is cool in order that the bearing will not "Freeze". The oil supply should be renewed before starting the machine again.

A new machine should always be run unloaded, or at slow speed for an hour or so in order to make sure that it operates properly. The bearing should be carefully watched to observe that the oil rings revolve and carry a plentiful supply of oil to the shaft.

Ball or roller bearings carry the load by direct contact, as opposed to sleeve bearings, which carry the load on lubricating film. Lubrication is necessary to minimize the friction and generation of heat caused by the balls rubbing on the outer race as they roll over the top or on the retainer or cage.

On some heavily loaded machines, a so-called free fit type of bearing must be used. This is nothing more than a standard ball or roller bearing with increased clearance. This point should be watched in replacing bearings, since for many years there was no marking on the bearing to indicate that it was a free fit. Today, the bearing manufacturers add a designation after the number to indicate clearance, such as C3.

Anti friction bearings require considerable care to prevent loss of end clearance, distortion of balls and marking of races. If too much force is used in pressing the bearing on the shaft, the clearance may be destroyed. It is recommended that anti friction bearings be heated in a hot bath of clean oil rather than by the use of dry heat. When the bearing is pulled off, with all of the stress on the outer race, both races may be damaged, with resultant failure when put back in service. The bearing manufacturer’s recommendations should be followed when removing and reapplying this type of bearing.

Bearing manufacturers produce a bearing known as the prelubricated shielded bearing. Several years use of this bearing has demonstrated that, for many applications, no further lubrication is needed. Such bearing construction is usually indicated on the nameplate.

In general, to obtain maximum service, ball bearing motors should be re-lubricated at intervals determined by the type, size and service of the bearing. Many motor manufacturers offer a guide or table suggesting the intervals between lubrications. These show time intervals between greasing which range from three months or so for motors operating in very severe service, such as those involving dirty vibrating applications or those where the end of the shaft is hot, high ambient, etc., to three years for easy service where motors operate for short periods or infrequently.

The bearing housing is usually arranged to introduce new grease and purge the bearing of old grease, allowing it to discharge through a partially restricted escape port or relief hole. This will, in general, allow filling to the desired degree, which is one-third to one-half full, leaving some space in the housing to allow for expansion of the grease.

It is again stressed that overgreasing can be just as harmful as under greasing. Overgreasing causes churning and internal friction that results in heating, separation of the oil and soap, oxidation of the grease and possible leakage through the retaining seals.

6.2 Jet Melter

6.2.1 Jet Melter Preventative Maintenance Guide

DAILY (BY OPERATOR)	WEEKLY (BY MAINTENANCE DEPARTMENT)	QUARTERLY (BY MAINTENANCE DEPARTMENT)
1. Jet Melter refractory cleaning – see **Appendix L, Refractory** and **Section 5.3, Refractory Cleaning**.	1. Thermocouples - Check the T/Cs in the stack, hearth, and bath. Pay close attention to the T/C in the bath and that the protective tube has not been damaged by refractory cleaning. Always have a spare T/C in stock.	1. Stock Line Indicator Cooling Lines – Check that the SLI Cooling Lines are operative and are supplying air to the SLIs. If these lines do not supply air, this situation will cause premature failure of the SLI.
2. Metal Level Indicators – Verify that the lengths of the metal level indicator rods are correct. The overall length of the rod is not important. The length of the rod below the attaching nut is important. See the associated drawing in Appendix I for more details.		2. Stack Cover - Insure that the pneumatic cylinder seals are not leaking. Also, verify that the track and wheels are working in proper order and are tracking correctly.
3. Door Seals – Check the stack and hearth doors for any gas leakage. As a stopgap measure you may insert fiber to close the leaking area. The entire door seal should be replaced as soon as possible.		3. Stack Cover Limit Switches– View the stack cover during operation and check that the cover is stopping at the correct location in both the open and closed positions. If it is not, adjust the limit switch to obtain the correct stop location.
4. Stock Line Indicator – Verify that the quartz glass is clean. If this glass is not clean it could lead to false readings that the stack is full and the charger will not operate correctly in automatic mode.		

5. Tapping Mechanism – Verify that a new tapping cone is in place or that the existing cone is sound. Verify that the tapping device is secured and that no metal leaks occur. Visually inspect the tap to see that the refractory trough is clean and clear of dross.		

6.2.2 Troubleshooting

The following table can be used to assist in troubleshooting the Jet Melter. It's set up to address problems that could be encountered while operating the Jet Melter.

Jet Melter Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	RECOMMENDED CORRECTIVE ACTION
Hot spots on shell	Cracked or broken refractory	Repair damaged refractory immediately to prevent shell damage.
	Door seals deteriorating	Replace gasket and fiber seal immediately to prevent shell damage. See **Appendix L, Diagram X**.
	Burner tiles cracked or broken	Repair or replace immediately.
	Burner ports plugged with dross material causing complete burner to heat up.	Properly clean burner to allow flame to penetrate into furnace.
Stack cover won't move	Compressed air not present	Verify proper air pressure to solenoid.
	Fuse blown	Verify proper wiring and replace fuse.
	Solenoid not shifting	Verify voltage to coil and proper air pressure. Repair or replace solenoid.

	Limit switches not functioning properly	Check operation of limit switches and adjust or replace accordingly.
	Cylinder seal(s) failing	Verify air pressure to cylinder. Repair or replace cylinder.
	Stack cover binding	Verify air pressure to cylinder. Observe where equipment is binding and repair accordingly.
Doors don't seal properly	Refractory plug not fitting properly	Verify entire door opening is clean of any dross buildup and clean if necessary.
		Refractory plug broken causing alignment problems. Repair or replace as necessary.
		Shell warped around door opening. Repair immediately.
	Door seals deteriorating.	Replace gasket and fiber seal immediately to prevent shell damage. See **Appendix L, Diagram X**.
		Shell warped around door opening. Repair immediately.

6.3 Burner System

6.3.1 Burner System Preventative Maintenance Guide

DAILY (BY OPERATOR)	WEEKLY (BY MAINTENANCE DEPARTMENT)	QUARTERLY (BY MAINTENANCE DEPARTMENT)
1. Burner Refractory Head – During the shift end cleaning of the Jet Melter, verify that the orifices on the head are clear and that the refractory is not cracked.	1. Igniter – Check to see that the Igniter is free from carbon build up and dross. Clean the electrodes.	1. Blower Filter – Remove the blower filter and inspect for accumulated dust. If in doubt whether the filter is clogged, reset the burners based on **Appendix K, Burner Set-up Sheets**. If it is not possible to obtain the necessary airflow the blower filter should be replaced.
2. Burner O-Rings – During the end of each shift during cleaning, verify that the burner O-rings are in good condition. Replace if necessary.	2. Flame Scanner – Verify that these Scanners detect the condition of flame or no-flame. Use a suitable lighter, and pass the flame in front of the scanner. The corresponding flame relay, located in the control panel, should illuminate showing the condition of flame-on.	2. Fail Safe Conditions – Verify that the gas train complies with all fail safe conditions. This includes testing the blocking valves, manual reset valve, flame safeguards, vent valve, all pressure switches and the flame scanner. For additional information contact Modern Equipment.
3. Pressure Gauges – Refer to the gas train combustion schematic supplied in **Appendix D, Drawings**. Determine the appropriate pressure for each section of gas line that has a	3. Vent Test Push Button – This button located on the gas train junction box. It is used to test the condition if leaks occur in the gas lines between the automatic shutoff valve and the blocking	3. Impulse Lines – Check to see that these air lines which run from the burners to their respective ratio regulators are operating correctly. A manometer can be set to a test cock after the regulator. If the

corresponding pressure gauge. Verify that the pressure reading is in the appropriate range.	valves. (See **Appendix D, Drawings**).	manometer reads approximately 0.4 inches W.C. with the burners operating at low fire, the impulse lines are operating correctly.
	4. Pressure Switches – Verify with the combustion schematic supplied in **Appendix D, Drawings** that the pressure switches are set to the appropriate level.	4. Check Gas/Air Ratios – Using the **Burner Set-up Sheets** supplied in **Appendix K,** set the gas and air pressure drops to the corresponding BTU level of the melting or holding burner. Use a manometer and test cocks on the air and gas orifice valves to determine these pressure drops. For additional help or service in this area, please contact Modern Equipment Company Service Dept. at (262) 284-9431.

6.3.2 Troubleshooting

The following table can be used to assist in troubleshooting the Jet Melter burner system. It's set up to address problems that could be encountered while operating the burners.

Burner System Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	RECOMMENDED CORRECTIVE ACTION
Combustion air blower fails to start	Disconnect open	Close disconnect.
	Overloads tripped	Check for cause; reset overloads.
	Wiring problem	Verify proper wiring and make sure starter coil is energizing.
	Motor not running	Verify proper wiring. Check motor and replace if necessary.

Combustion air blower stops while running	Overloads tripped	Check for cause; reset overloads.
	Fuse blown	Check for cause before replacing fuse; replace fuse.
Failure of furnace to purge	"BURNERS IGNITION – RUN" selector switch in "RUN" position	Set switch to "IGNITION" position
	One of the "purge proof" limit switches not tripped	Take voltage readings on purge circuit to determine which switch(es) aren't tripped. Adjust switch(es) as necessary.
Burner(s) won't light	"Low Fire" limit switch not tripped	Take voltage readings on circuit and adjust limit switch
	Flame safeguard in alarm condition	Reset flame safeguard and retry (Note: Veriflame reset button must be pressed twice to take out of test mode)
	No spark	Remove spark plug and verify spark present. Adjust gap if necessary. Verify wiring to ignition transformer.
	Insufficient gas	Verify gas flow to burner – check flow across orifice plate with manometer. Replace solenoid if necessary. Adjust zero gas regulator slightly to get proper flow. See **Appendix F, Operating Data** for proper setting.
	Flame present but flame safeguard doesn't sense it	Verify wiring to flame scanner, check with lighter and replace if necessary.
	Insufficient air	Verify airflow to burner – check pressure at burner with manometer. Adjust air valve linkage slightly to get proper flow. See **Appendix F, Operating Data** for proper setting.
Burners won't modulate	"BURNERS IGNITION – RUN"	Set switch to "RUN" position

	selector switch in “IGNITION” mode	
	Corresponding burner selector switch not in “AUTO” position	Set corresponding switch to “AUTO” position.
	Open thermocouple. Controllers are set up for upscale burnout.	Verify open thermocouple on controller and replace thermocouple.
	Wiring problem	Verify proper electrical signals reaching control valves and correct accordingly.
	Control valve failure	Verify proper electrical signals reaching control valves. Replace control valve as necessary.
	Control valve linkage problem	Verify modulation of control valve. Repair and set up linkage as necessary to achieve proper burner ratio. See **Appendix E, Design Specifications**.
Yellow flames	Rich Gas in Air Gas Mixture	Check gas/air ratios

6.4 Charging System

6.4.1 Charging System Preventative Maintenance

DAILY (BY OPERATOR)	WEEKLY (BY MAINTENANCE DEPARTMENT)	QUARTERLY (BY MAINTENANCE DEPARTMENT)
1. Hydraulic Oil Level – Verify that this oil level is at the normal operation level.	1. Lubrication – Refer to Section 6.6 Lubrication for additional information.	1. Chain Tension – Verify that each chain has equal tension. This will insure that the charge bucket will lift vertically with the bottom of the bucket horizontal (parallel) to the floor. Pull on each chain and verify that the deflection on each is of the same magnitude.
2. Hose Connections – Check all hydraulic hose connections and verify that no leaks occur.	2. Cylinders – Verify that both the hydraulic lift and tilt cylinders are not leaking hydraulic oil. The most common problem of oil leakage is caused by worn seals. Replace these seals if necessary.	2. Track Wear – Check the vertical 6" x 2" tubing, that the outer carriage rides upon is not worn. Also, verify that the C-Channel that the inner carriage cam rollers travel upon is not worn.
3. Pressure Gauge – Verify that the relief valve pressure gauge is operating under the normal limit of 1,000 psi.	3. Proximity Switches – Clean all proximity switches of dirt and grime to insure that they are reading correctly. This includes the bucket at lower terminal, bucket at upper terminal, bucket tilted up, bucket tilted down, and the safety gate proximity switches.	3. Proximity Switches – Verify that the proximity switches, at each position, are at the correct adjustment. When the bucket is at the lowest position of the charger the proximity switch should be on. In addition, check the proximity switches at the bucket at upper terminal, bucket tilted up, bucket tilted down, and access doors closed.

4. Caps – Make sure that all clean-out holes, filler caps, and breather cap filters on the reservoir are properly fastened. Do not run the system unless all normally provided filtration devices are in place.	4. Test Hydraulic Fluid – Depending upon the hydraulic fluid used in your charging system check the chemical properties of the fluid. At times, the most convenient and exact way to test the fluid is to send it for a testing at a chemistry lab.	4. Anti-Fall Mechanism – Check this mechanism for correct operation. See procedure listed below.
	5. Filters – Change or clean as required or as indicated on filter supplied with visual indicators. Make sure to check indicators shortly after start-up.	5. Cam Followers – Check the cam followers and verify that they are tracking correctly. See also that the cams are rolling across their associated track.
	6. Suction Strainers – Clean after 10 hours of operation initially and every 100 hours thereafter.	6. Bucket – Check the Bucket and verify that the bottom is not deformed to the extent that the lower limit switch is not being made.
	7. Oil Temperature – In most cases, 120° F at the reservoir is considered an ideal operating temperature. Take an oil temperature reading at the reservoir, not at a component or any of the piping. If the temperature is too hot, remove, check, repair, or replace components that are running too hot. If relief or flow-control valves are running hot, check and adjust their setting. Follow your equipment owner's manual. (See procedure listed next page.)	7. Electric Motor – Lubricate as recommended by motor manufacturer.

ANTI-FALL MECHANISM VERIFICATION

With the bucket empty, raise the bucket in manual mode so that a forklift may place its forks directly at the bottom of the charge bucket. Slowly lower the bucket to induce slack in the chain. At this time, remove the forks so that the bucket will drop. At this time the anti-fall device "Dog" should engage and the bucket will stop from falling. If this does not occur set the "Dog" with relation to the charger vertical tube as shown in Figure 6.4.1.

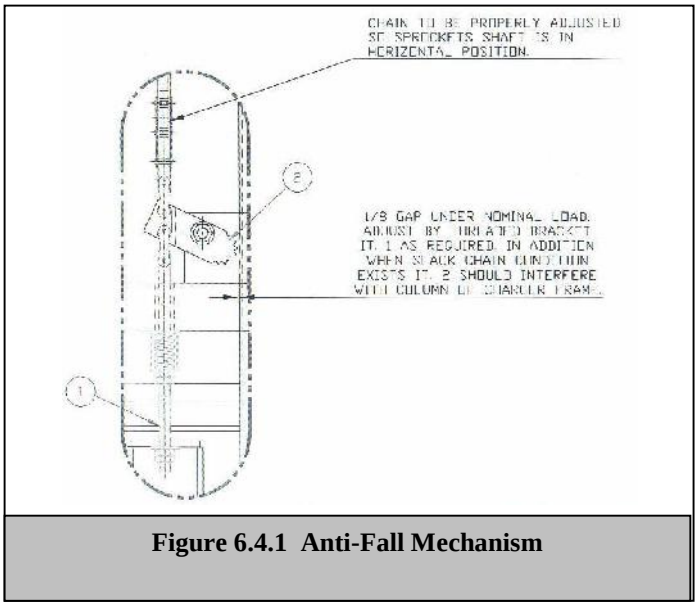

Figure 6.4.1 Anti-Fall Mechanism

OIL TEMPERATURE

Hot oil in your equipment's hydraulic system is one of the primary causes of poor operation, component failure and downtime.

The oil in your hydraulic system was designed for operation within a specified temperature range. You may be able to run at hotter temperatures for short periods of time, intermittently, without adverse effects. If you run continuously with oil that is too hot, your equipment will operate poorly causing key component failure and machine downtime. Some hydraulic systems are designed to operate at 130° F or higher. If you do not know the maximum operating temperature for your equipment, check with your fluid manufacturer for temperature and viscosity limitations.

Here are some pointers on maintaining proper oil temperature.

1. Set up a regular schedule for checking the oil temperature, appearance, smell, and feel. Change the oil as recommended by the equipment manufacturer.
2. Be prompt about removing, checking, and repairing or replacing valves, pumps or other components that are running hot.
3. If relief or flow-control valves are running hot, check and adjust their settings.
4. Break in new components gradually. New, close fitting parts expand at different rates, and are especially prone to seize when they get too hot.
5. Start a cold pump or motor on hot oil by jogging just enough to draw the hot oil into the component. Then wait a few minutes to allow the temperature to equalize in all the pump's parts. Repeat until the temperature on the outside of the pump is the same as that on the piping.
6. Keep your equipment clean. A thick layer of dirt acts as insulation. It will prevent the hydraulic system from dissipating heat.
7. On hot days, and in hot climates, check and change the oil more frequently. Be sure to use oil recommended for hot weather operation by the equipment manufacturer or oil supplier.

MEASURING OIL TEMPERATURE

There are several ways to check the temperature of the oil. The best, most accurate method is by means of a thermometer. On some machines, this is mounted on the reservoir. Make it a habit to check the thermometer periodically, after the equipment has been running for more than an hour.

If your machine does not have a reservoir thermometer, use the "palm test." First check the tank with your fingertip; if it is not too hot to touch, place your palm on the tank. You will be able to hold it there without discomfort if the oil temperature is about 130° F or below.

ISOLATING TROUBLE-SPOTS

To determine which components are "running hot" and overheating the oil, feel the outlet fittings and lines at the valves, pumps and motor. If the oil temperature is normal going into a component but hot coming out, that could be one of the potential problem areas.

A sticking valve can cause excessive heat. If a spool does not return promptly to the neutral position, the pump flow will be dumped continuously. This builds up heat rapidly.

If a relief valve is set too low, part of the oil will be dumped across the valve with every cycle. This too, generates excessive heat. Even when all valves are set properly, they may not be operating well because of worn orifices or seals. Always remove and check the hot components first.

6.4.2 Troubleshooting

The following table can be used to assist in troubleshooting the Jet Melter charging system. It's set up to address problems that could be encountered while operating the charging system.

Charging System Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	RECOMMENDED CORRECTIVE ACTION
Hydraulic motor won't start	Disconnect open	Close disconnect
	Overloads tripped	Check for cause; reset overloads
	Fuse(s) blown	Check for cause; replace fuse(s)
	Wiring problem	Verify wiring and modify accordingly
	Motor failure	Verify wiring and motor windings and replace if necessary
Hydraulic charger won't move up	Hydraulic unit not running	Start hydraulic unit
	Hydraulic hoses not attached properly	Verify proper configuration and revise accordingly. Hoses should be match marked.
	Hydraulic fluid level low	Check for leaks and fix; fill reservoir to proper level.
	Solenoid not energizing	Verify PLC output and solenoid for voltage. Replace solenoid if necessary.
	Fuse blown	Verify PLC output and solenoid for voltage. Replace fuse if necessary.
	Safety door not closed (if applicable)	Verify safety door proximity switch (PLC input) is activated; modify or adjust accordingly.
	Charger at upper terminal proximity switch is tripped prior to reaching position.	Verify charger at upper terminal proximity switch (PLC input) is not made; adjust accordingly.

	Emergency stop push button is pressed	Determine why push button was pressed and fix problem. Release push button and finish cycle in manual mode.
Hydraulic charger won't tilt up	Hydraulic unit not running	Start hydraulic unit
	Hydraulic hoses not attached properly	Verify proper configuration and revise accordingly. Hoses should be match marked.
	Hydraulic fluid level low	Check for leaks and fix; fill reservoir to proper level.
	Solenoid not energizing	Verify PLC output and solenoid for voltage. Replace solenoid if necessary.
	Fuse blown	Verify PLC output and solenoid for voltage. Replace fuse if necessary.
	Safety door not closed (if applicable)	Verify safety door proximity switch (PLC input) is activated; modify or adjust accordingly.
	Charger at upper terminal proximity switch not made	Verify charger at upper terminal proximity switch (PLC input) is made; adjust accordingly.
	Stack cover open limit switch not made	Verify stack cover open limit switch (PLC input) is made; adjust accordingly.
	Charger tilted up proximity switch is made prior to reaching position	Verify charger tilted up proximity switch (PLC input) is not made; adjust accordingly.
	Emergency stop push button is pressed	Determine why push button was pressed and fix problem. Release push button and finish cycle in manual mode.
Hydraulic charger won't tilt down	Hydraulic unit not running	Start hydraulic unit
	Hydraulic hoses not attached properly	Verify proper configuration and revise accordingly. Hoses should be match marked.

	Hydraulic fluid level low	Check for leaks and fix; fill reservoir to proper level.
	Solenoid not energizing	Verify PLC output and solenoid for voltage. Replace solenoid if necessary.
	Fuse blown	Verify PLC output and solenoid for voltage. Replace fuse if necessary.
	Safety door not closed (if applicable)	Verify safety door limit switch (PLC input) is activated; modify or adjust accordingly.
	Charger at upper terminal proximity switch not made	Verify charger at upper terminal proximity switch (PLC input) is made; adjust accordingly.
	Stack cover open limit switch not made	Verify stack cover open limit switch (PLC input) is made; adjust accordingly.
	Charger tilted down proximity switch is made prior to reaching position	Verify charger tilted down proximity switch (PLC input) is not made; adjust accordingly.
	Emergency stop push button is pressed	Determine why push button was pressed and fix problem. Release push button and finish cycle in manual mode.
Hydraulic charger won't move down	Hydraulic unit not running	Start hydraulic unit
	Hydraulic hoses not attached properly	Verify proper configuration and revise accordingly. Hoses should be match marked.
	Hydraulic fluid level low	Check for leaks and fix; fill reservoir to proper level.
	Solenoid not energizing	Verify PLC output and solenoid for voltage. Replace solenoid if necessary.
	Fuse blown	Verify PLC output and solenoid for voltage. Replace fuse if necessary.
	Safety door not closed (if applicable)	Verify safety door proximity switch (PLC input) is

		activated; modify or adjust accordingly.
	Charger tilted down proximity switch not made	Verify charger tilted down limit switch (PLC input) is made; adjust accordingly.
	Charger at lower terminal proximity switch is tripped prior to reaching position.	Verify charger at lower terminal proximity switch (PLC input) is not made; adjust accordingly.
	Emergency stop push button is pressed	Determine why push button was pressed and fix problem. Release push button and finish cycle in manual mode.
Stack cover won't open	Compressed air not present	Verify proper air pressure and quality to solenoid.
	Fuse blown	Verify proper wiring and replace fuse.
	Solenoid not shifting	Verify voltage to coil and proper air pressure. Repair or replace solenoid.
	Limit switches not functioning properly	Check operation of limit switches and adjust or replace accordingly.
	Cylinder seal(s) failing	Verify air pressure to cylinder. Repair or replace cylinder.
	Stack cover binding	Verify air pressure to cylinder. Observe where equipment is binding and repair accordingly.
	PLC ladder logic interlocks not satisfied	Check PLC ladder logic printout (or go online) to see which interlock isn't satisfied and adjust accordingly.

6.5 Refractory Maintenance

The refractory contained within your Jet Melter, if maintained properly, will provide years of service without major repairs. Refer to **Appendix L, Refractory**.

This product contains ceramic fiber or other refractories, which can result in the following. Failure to comply may result in severe personal injury and/or equipment damage.

1. May be irritating to skin, eyes, and respiratory tract.
2. May be harmful if inhaled.
3. May contain or form cristobalite (crystalline silica) with use at high temperatures (above 1600° F), which can cause severe respiratory disease.
4. Possible cancer hazard based on tests with laboratory animals. Animal studies to date are inconclusive. No human exposure studies with this product have been reported.

Before maintaining this equipment, read the applicable Material Safety Data Sheets (MSDS), in **Appendix M**.

6.5.1 Precautions

When installing, maintaining this equipment, or removing the refractory insulation, take the following precautions to minimize exposure to the dust and/or ceramic fiber.

1. Keep personnel exposure to airborne dust and particles from the insulation as low as possible.

2. Use a good vacuum to clean area and equipment. Do NOT use compressed air.

3. Use a NIOSH high efficiency respirator (3M #8710 or equal).

4. Wear long sleeve clothing, gloves, hat, and eye protection to minimize skin and eye contact. Contact lenses should not be worn when handling.

5. Thoroughly wash self immediately after work is complete.

6. Launder work clothing separate from other clothes and thoroughly clean laundering equipment after use. If clothing contains a large amount of dust and/or ceramic fiber then dispose of rather than cleaning.

7. Promptly place used ceramic fiber parts and dust in plastic bags and dispose of properly.

6.6 Lubrication

6.6.1 Jet Melter Lubrication

Lubrication is essential for the correct set up of the Jet Melter. Only a few items need lubrication, however, this lubrication is essential.

STACK & HEARTH DOORS
First it is necessary to use anti-seize on the stack and hearth door threaded rod. This rod is used to raise and lower the door into the correct position for sealing the lower stack and hearth areas. This anti-seize should be applied once every year to promote ease of adjustment of these doors. The hinge assemblies of the doors are made of a graphite material and do not require any lubrication.

METAL LEVEL INDICATOR RODS
These rods are normally checked and repositioned to the correct level on a daily bases (once per shift). Because of this, the connecting nuts on the rods must be easily moved for rod adjustment. Place a liberal amount of anti-seize on the threaded portion of the rods to make this adjustment easier.

STACK COVER WHEEL BUSHINGS
The stack cover wheel bushings are made of graphite and require no special lubrication. Check to see that the wheels are rotating normally. If not replace the bushing within the wheel assembly.

STACK COVER PNEUMATICS
Check the pneumatic oil level in the Filter/Lubricator/Regulator on a monthly basis to ensure that the stack cover pneumatic cylinder is sufficiently lubricated.

COMBUSTION AIR BLOWER
Grease fan bearings according to literature provided with this manual.

6.6.2 Charger Lubrication

HYDRAULIC FLUID LEVEL
The hydraulic fluid in the reservoir must be at sufficient level for the hydraulic charger to perform satisfactory. To fill the reservoir, locate and remove the filler cap on the reservoir. Add a little hydraulic fluid at a time until you are certain the reservoir is full. Reinstall the filler cap and run the charger. At this time, operate the entire charger for a trial run of the system without a load to assure proper operation. Start the motor and push the lift button until the lift cylinder reaches the end of the cylinder stroke. Then press the tilt buttons until the carriage is fully raised. Finally, check the fluid level once more and top off as necessary. Reinstall the filler cap and replace the inner plate on the power unit enclosure.

Before maintaining this equipment, read the applicable Material Safety Data Sheets (MSDS), in **Appendix M**.

The following table describes the lubrication areas of the hydraulic charger:

LUBRICATION POINT	SCHEDULE OF LUBRICATION
Bearings on Top of Inner Carriage	Every 6 Months
Bronze Bushings on Pivot Shaft	Check Every 6 Months
Bronze Bushings on Tilt Cylinders	Check Every 8 to 10 Weeks
Cam Followers	Sealed Type (No Maintenance)
Chain	Inspect Monthly for Wear
Bearing Grease on Power Unit Motor	Replace every 5,000 Hours

Table 6.6.2 Lubrication