1. Check pump and piping for leaks. Repair immediately.
2. Record pressure gauge readings for future reference.
3. Record voltage, amperage per phase, and kw (if an indicating
   wattmeter is available).
4. Check bearings for lubrication and temperature.
5. Check and adjust stuffing box for correct operation. Check seal-
   ing water lines and valves.
6. Adjust pump output (capacity) ONLY with discharge valve.
   DO NOT throttle suction line.

**Shutdown**
- 1. Close discharge valve slowly.
- 2. Shut down the motor.
- 3. Close seal-liquid valves (for packed pumps). (If pumped liquid
    is dirty or if inleakage is to be prevented, these external lines
    should always be left open.)
- 4. Open drain valves as required.
- 5. Close suction line valves, to retain prime or to isolate pump.

**Freezing Protection** – Protect pumps shut down during freezing
conditions by one of the following methods:
1. Drain pump, remove all liquid from the casing.
2. Keep fluid moving in pump and insulate or heat the pump to
   prevent freezing. If heated, do not let temperature go above 100°
   to 150° F.
3. Fill pump completely with antifreeze solution.

**Troubles** – Watch for signs of pump trouble at all times. Immedi-
ately correct any trouble to avoid costly shut down and repair. Refer to
applicable maintenance manuals for list of symptoms and cures.

**MAINTENANCE**
- Routine, regular maintenance is the best assurance of trouble-free,
  long-life pump and motor operation. In addition to having trained per-
  sonnel, the best way to insure regular maintenance is by use of Pump
  and Motor Service Records (forms available on request to A-C Pump).
- Several more important items of good maintenance are (include others
  for adverse or unusual conditions):
  - **Periodic Inspection** – Each month measure bearing temperature
    by thermometer. If hot there may be too much grease. If not corrected
    by grease change, disassemble and inspect bearings.
  - Every 6 months check packing, shaft or shaft sleeve for scoring,
    alignment of piping with pump, and seal-liquid connections.
  - Each year remove rotating element to inspect and clean thor-
    oughly. Clean stuffing box passages or piping (if external). Inspect and clean
    check and foot valves.
  - **Cleaning** – Remove oil, dust, dirt, water, chemicals from exterior of
    motor and pump. Keep motor air inlet and outlet open. Blow out interior
    of open motors with clean, compressed air at low pressure. Regularly
    drain moisture from TEFC motors.
  - **Labeled Motors** – It is imperative for repair of a motor with Un-
    derwriters’ Laboratories label that original clearances be held, that all
    plugs, screws, other hardware be fastened securely, and that part re-
    placements be exact duplicates or approved equals. Violation of any of
    the above invalidates Underwriters’ label.

**Lubrication** – Motor bearings are factory lubricated with grease to
give 6 months service for normal conditions. Relubricate bearings each
6 months for horizontal motors, for vertical motors top bearing each
6 months or 1 year depending on speed, bottom bearing each 3 or 6
months depending on speed. Relubricate as follows:
1. Stop the motor. Lock out the switch.
2. Thoroughly clean off and remove plugs from fill and drain lines.
3. Remove hardened grease from drains with stiff wire or rod.
4. Add grease to fill line with hand gun until small amount of new
   grease is forced out drain. Agitate drain with wire or rod to aid
   grease movement. Catch used greaser in suitable container.
5. Replace plugs in fill lines.
6. Put motor back in operation.
7. Run motor for at least one hour to expel excess grease, then
   replace plugs in drain lines.

**Trouble Shooting** – Refer to Maintenance Manuals for other procedures applicable only to
vertically mounted pumps. Inner cap of top bearing must be inspected and grease re-
moved, or a procedure followed that provides grease above bearing and does
not completely fill inner cap.

**Packing Adjustment** – Fiber packing should not be tightened to the
point of no leakage. Without some leakage packing may burn and score
shaft or sleeve. With new packing gradually take up gland with pump
running to control leakage as packing seats. New metallic packing may
smoke during run-in. When seated metallic packing forms a solid, bear-
ing-like surface. Adjust gland with pump running, for either type, to pro-
vide leakage of 40 to 60 drops per minute. Pipe away all leakage. Never
tighten gland with pump is idle.

**Temperature** - Total temperature, not the rise, is the measure of safe
operation for a motor. If temperature by thermometer exceeds limits for in-
sulation class, investigate and change operating conditions. When pump-
ing hot liquids, shaft may provide an unsafe temperature for packing or
bearings. In this case a jacketed stuffing box should be used, and cooled
with water from external source.

**Insulation** - Measure insulation resistance regularly. Refer to Motor or
Pump Maintenance Manuals, or to AIEE Standard No. 43.
Base — Use a substantial base for horizontal shaft pumps; isolate if necessary, to keep vibrations from pump. Shim under feet to make shaft level. Check pump flanges with spirit level. Dowel the feet. For vertical-shaft pumps that are wall, tank, or bracket mounted use a heavy rugged support that does not deflect when pump is mounted, nor when pump is operating.

Piping — Suction and discharge gauges are useful to check pump operation and are excellent trouble indicators. Install gauges in the lines if pump nozzles do not have gauge taps. Observe these precautions when installing piping:
1. Support close to, but independently of pump.
2. Use at least next larger pipe size for suction and discharge.
3. Keep as straight as possible, with few or no bends and fittings.
4. Remove burrs, sharp edges, ream pipe cuts, and make joints air-tight.
5. Do not “spring” pipe to make connections. Strain must not be permitted in any piping.
6. Allow for pipe expansion with hot fluids; expansion joints are not recommended.

Suction — Size and install suction piping to keep pressure loss at minimum and to provide correct NPSH. Straight length not less than 10 times suction pipe diameter should be provided at pump connection.
1. Size must never be smaller than suction port; for long runs use 1 or 2 sizes larger.
2. Pipe should slope upward to pump, even for horizontal run.
3. Use eccentric reducer at pump, eccentric side down.
4. Use 45-degree or long sweep 90-degree elbows.
5. Use flapper type foot valve, but only to hold prime when pump is shut down and suction level is below pump.
6. Use gate valves only; for parallel connection and for isolating pump when shut down. Stem must be horizontal or slope downward. Never use globe valves in suction line.

Discharge - Some close-coupled pumps permit discharge port location at any of four positions, 90 degrees apart. Change by removing cover bolts, rotate casing, and replace bolts. Be sure there is adequate clearance with selected position - wall or tank, motor conduit box, for bearing lubrication, casing may extend beyond base or feet. If discharge line is short, size may be same as discharge port: if long, use 1 or 2 sizes larger.
1. For long horizontal runs keep grade as even as possible, avoid high spots and loops. Trapped air will throttle flow and may result in erratic pumping.
2. Install check and gate valves in discharge line, check valve (if used) between pump and gate valve.

External-Injection Liquid — For packed stuffing boxes if pumped liquid will damage or deteriorate seal material, suitable clean liquid must be supplied from an outside source. Install valves in this piping to regulate flow and pressure to the box.

Stuffing Box — For packed pumps the stuffing box must have clean, clear liquid to flush and lubricate packing. The best means of assuring this is regulation of seal liquid pressure. In general, provide external liquid at 15 to 25 psi above pump suction pressure. If pumped liquid is used, adjust needle valve to give pressure 5 to 10 psi above maximum box operating pressure (must be found by trial). It is not possible to adjust this pressure on internal-liquid seal pumps not fitted with needle valves.

Adjustment or special procedures are not required for pumps having mechanical seals.

OPERATION

Pre-Start - Before initial start of the pump, check as follows:
1. Be sure that pump operates in direction indicated by the arrow on the pump casing (suction cover). Check rotation each time motor leads have been disconnected.
2. Check all connections to motor and starting device with wiring diagram. Check voltage, phase, and frequency of line circuit with motor nameplate.
3. Check suction and discharge piping and pressure gauges for proper operation.
4. Turn rotating element by hand to assure that it rotates freely.
5. Check stuffing box adjustment, lubrication, and piping.
6. Assure that motor bearings are properly lubricated.
7. Assure that pump is full of liquid (primed).

Priming — If pump is installed with a positive head on the suction, prime by opening suction valve and allowing liquid to enter the casing, at some time venting air out of the top of the casing. If pump is installed with a suction lift, priming must be done by other methods, such as foot valves, ejectors, or by manually filling casing and suction line.

CAUTION — DO NOT RUN PUMP DRY WITH HOPE IT WILL SELF-PRIIME. Serious damage may result if started dry.

Starting — Proceed as follows to start pump:
1. Close drain valves and valve in discharge line.
2. Open fully all valves in the suction line.
3. Turn on seal water to the stuffing box (for external-injection). (If pumped liquid is dirty or if leakage of air is to be prevented, this line should be always left open.)
4. Prime the pump. If pump does not prime properly, or loses prime during start-up, shut down and correct condition before repeating procedure.
5. For pumps moving high temperature liquids, open warm-up valve to circulate liquid for preheating. Close valve after pump is warmed up.
6. Start the motor (pump).
7. When pump is operating at full speed, open discharge valve slowly.
8. Adjust seal-liquid valves to produce a pressure of 15-25 psi above pump suction pressure.

Running — Periodically inspect pump while running, but especially after first start, and following repair.