

# **KETEMA**LP

# **ACME**

## **Water-Cooled Condenser**

### **Installation, Operation and Maintenance**

### **Instructions**

Revision 09/01/2002



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## SAFETY CONSIDERATIONS

Installation and servicing of vessels can be hazardous due to system pressures, electrical components, and equipment locations. Only trained, qualified installation and service personnel should install or service this equipment.

When working on a system, observe precautions in the literature, tags, stickers and labels attached to the equipment and any other safety precautions that apply.

- Follow all safety codes.
- Wear safety glasses and work gloves.
- Use care in handling, rigging and setting bulky equipment.

 **WARNING!** Before performing service or maintenance operations on systems, shut off and tag main power supply. Electrical shock could cause personal injury.

## PRE-INSTALLATION PROCEDURE

**SHIPMENT & HANDLING.** Each condenser is carefully packed at the factory to protect the unit from damage while en route to the purchaser. The vessel is mounted on wooden skids for use as runners or with rollers. Let the unit down gently from trucks or rollers.

Lift the condenser by using straps, belts or chains around the shell, or by attaching chains to the lifting lugs, if lugs are furnished. If the vessel is to be dragged into place, or rollers used, leave it on the skid until you're ready for final lifting into place.

Do not lift by shell connections. Do not weld lifting lugs or other fittings to the shell. Steel mounting brackets are available from Ketema LP, welded to the shell, as an aid in securing and mounting the vessel. Cast iron saddles (cradles) are also available as an accessory to facilitate mounting the vessel in the final location.

**INSPECTION.** All vessels should be examined on arrival for possible shipping damage. Look for bent or broken connections and fittings, loose or missing nuts and bolts. If damage is found, report it to the transportation company and file a damage claim. If damage is not found until the skidding is removed, a concealed damage report should be filed.

## INSTALLATION

**LOCATION.** The vessel should be installed in an area away from boilers, furnaces or other heat sources. Provide adequate clearance at each end for inspection and maintenance of the tube side, and allow at least one tube length plus one foot clearance for tube replacement

The unit should be installed horizontally on a level plane, with the large gas inlet connection on the shell appearing at 12 o'clock on top of the shell. The liquid outlet connection should appear at the 6 o'clock position directly off the bottom of the shell, or tangentially off the bottom of the shell.

**PIPING.** Refrigerant lines should be sized and routed to meet system capacity requirements, pressure drop requirements, and proper refrigerant velocity so that oil return to the compressor will occur. Chapter 2 *System Practices for Halocarbon Refrigerants* in the ASHRAE Refrigeration Handbook provides an excellent guide for refrigeration piping practice.

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The refrigerant liquid line trim should include the following items, in this sequence, starting from the condenser liquid outlet:

- Liquid line shut-off valve
- Charging valve
- Liquid line filter dryer
- Liquid line solenoid valve
- Site glass/moisture indicator
- Externally equalized thermal expansion valve, sized and installed to manufacturer's recommendations

Water piping should be done in accordance with local codes. Pressure-operated condenser water regulating valves are recommended. Water flow rates should not exceed a rate that would result in a velocity through the tubes greater than 8.5 ft/s.

Higher velocities would result in the risk of impingement corrosion and tube failure. Since the condenser incorporates standard copper tubes, care should be taken to insure that the condensing water supply is compatible for use with copper. In the case of brackish water or seawater, marine condensers incorporating 90/10 CuNi tubes and tubesheets and bronze heads are recommended.

Once all piping has been completed, the system should be subjected to pressure tests (both the vessel and the piping) prior to start-up.

 **CAUTION: Never use air-refrigerant mixtures for leak testing.** Under certain conditions, some refrigerant-air mixtures become flammable.

## OPERATION

Water flow rates through the condenser tube side should be in accordance with system requirements and manufacturer's recommendations to maintain the desired condensing temperature and pressure. As indicated earlier, pressure operated automatic condenser water regulating valves are highly recommended.

The frequency of waterside cleaning depends a great deal on a number of variables. Under normal operating conditions, tubeside cleaning once a year during normal seasonal shut down is recommended.

Where cooling tower water is being utilized, care should be taken to see that the tower water is properly treated to inhibit build up of mineral concentration and biological growth, both of which could result in heavy tubeside fouling of the condenser tubes.

When experiencing excessive discharge temperatures and pressures, the following possible causes should be checked before tube side cleaning is undertaken:

- Refrigerant overcharge
- Non-condensable gasses the refrigerant system
- Incorrectly set or defective water regulating valve
- Partially closed compressor discharge valve
- Inadequate or insufficient water flow rate
- Excessively high entering water temperature

During seasonal shut down, or shut down for prolonged periods, the tubeside of the condenser (the waterside), should be thoroughly drained by removing the drain fitting located on the bottom of either the front or the rear head.


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## SERVICE INSTRUCTIONS

**GASKET REPLACEMENT.** Replacement of gaskets as part of a routine regularly scheduled maintenance program is recommended. Whenever the condenser heads are removed for tube side inspection, it is recommended that gaskets be replaced. While a number of gasket materials can be used, compressed fiber gaskets are recommended. Gaskets supplied by Ketema LP should be used whenever possible.

When removing the water heads, mark each head and tubesheet, so that when replacing the heads and gaskets, you will have the proper orientation of connections. Thorough cleaning of the tubesheet surface, the interior of the heads, and both gasket surfaces should be done before the heads and gaskets are reassembled to the tubesheets.

**TUBE SIDE LEAKS.** If preliminary checks have definitely established the presence of leaking tubes, these recommended steps should be followed:

1. Remove the water and refrigerant from the condenser.
2. Remove the refrigerant lines and water lines. Remove the condenser heads.
3. Locate individual tube leaks by using the following procedure:
  - 3.1. Seal the shell connections and install a fitting to permit connection to the refrigerant side or shellside of the condenser.
  - 3.2. Using dry air, nitrogen, carbon dioxide, or other suitable non-condensable and noncombustible gas, fully pressurize the shell side to not more than 100 PSIG test pressure.  
 **CAUTION: Never use air-refrigerant mixtures for leak testing.** Under certain conditions, some refrigerant-air mixtures become flammable.
  - 3.3. With soap solution and a brush, cover the face of both tubesheets. Leaks will appear in the form of bubbles. If the leak is small, a fine foam will appear. Mark the location of all leaks with chalk or crayon.
4. After locating and marking the leaking tubes, gradually remove all pressure from the vessel.
5. Re-roll suspected leaking tubes at both ends and retest.
6. If no leaks appear in the form of bubbles when the shell side is pressurized, and pressure is still being lost, an internal tube leak or rupture has probably occurred. It will be necessary to plug the tube or tubes, or replace them, in accordance with the procedures described below.

**PROCEDURE FOR PLUGGING TUBES WITHOUT REMOVING TUBES.** If a leak occurs at the tube-to-tubesheet joint, it may be possible to re-roll the tube and make a seal, following the re-rolling procedures outlined in these instructions. If the leak persists, it may be possible to obtain a seal by driving a tapered brass plug into the tube.

If it is determined that there is an internal tube leak, it is possible to plug the tube at both ends with tapered brass plugs. If no more than 5% of the tubes in any pass are plugged, very little capacity reduction will occur.

When brass plugs are utilized, cut the excess portion of the plug extending beyond the outside face of the tubesheet, and grind or file flat with the tubesheet surface.

## PROCEDURE FOR REPLACING CONDENSER TUBES

1. To remove tube, drill the tube out at both ends until the two grooves in the tubesheet are visible, or within 1/16" of the back face of the tubesheets. **CAUTION:** *Do not drill the tube entirely out of the tubesheet since this will allow the tube to drop out of the line with the tube*

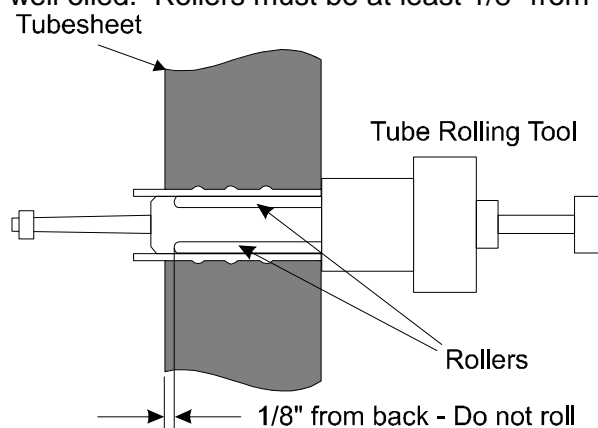
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*hole.* Extreme caution should be used so that no damage will occur to the tubesheet holes when drilling out the tube. Damage to the tube sheet holes will result in future leaks.

2. After the tube ends are drilled out, use a step-drive rod to drive out the tube. If the tube does not start readily from one end, try the opposite end as the tube may be distorted.
3. After starting, the tube should come through the tubesheet easily unless the tube has been expanded or split due to freezing. If this is the case, it will be necessary to flatten a portion of the protruding tube and apply a "C" clamp; with bar plates placed on each side of the tube, so additional pressure may be applied.
4. All chips must be removed from the tube hole following the removal of the leaking tubes. The grooves in the tube holes must also be carefully cleaned without damaging or scratching the tubesheet hole surfaces.

## RE-ROLLING PROCEDURE

1. Inspect the grooves thoroughly to assure that they are clean and free of all foreign material.
2. Insert the new tube until it is flush with both tubesheets. If the tube is slightly longer than the unit, make one end flush with the tubesheet. The other end will have to be cut off after rolling-in operation.
3. Insert the tube roller until it reaches the stop. With firm pressure, roll-expand the tube into the tubesheet. When starting to roll the tube, it will be necessary to hold the other end of the tube to keep it from turning. Use extreme caution not to over-roll the tube. It is better to under-roll and re-roll again after test, than to over-roll and have to replace the tube again. Repeat procedure on the other end. **NOTE:** Be sure that the rolls and the tube roller are well oiled. Rollers must be at least 1/8" from the back edge of the tubesheet.



4. After rolling in the tube, carefully grind the tube flush with the tubesheets using a disc grinder, or trim flush with fly cutter, or carefully with 3/4" drill.
5. Tubes should be swabbed to remove any chips or filings that may have collected. Tubes should then be blown out to remove any additional chips, filings and cleaning agent.
6. Check your tube-to-tubesheet joints for leaks by following this procedure:
  - 6.1. Using dry air, nitrogen, carbon dioxide or other suitable non-condensable and noncombustible gas for pressure, carefully bring the pressure in the shell to not more than 150 PSIG test pressure.

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- 6.2. With soap solution and brush, cover the face area of both tubesheets. Leaks will appear in the form of bubbles, or as a fine foam (with small leaks). Re-roll if necessary.
7. Clean the tubesheets and heads. Re-install the condenser heads using new gaskets.
8. The entire condenser should be re-tested with the pressure on the refrigerant side and checked with a leak detection device.
9. After determining that the system is free of leaks, the pressure removed from the vessel, a vacuum should be drawn on the refrigerant side, and the unit put back in service.