PENBERTHY ®

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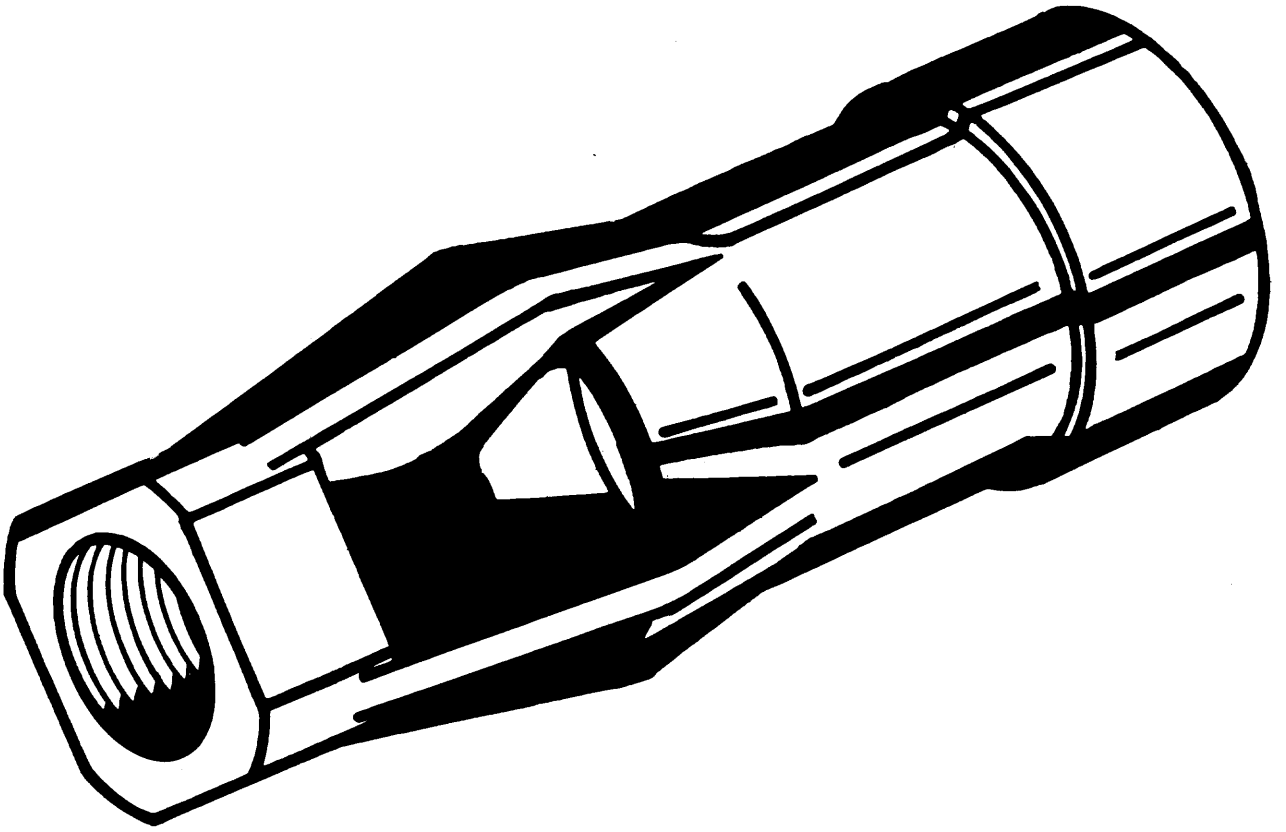
Mixer/ Heater

Model CTE



Installation / Operation / Maintenance Instructions

PENBERTHY

INSTALLATION / OPERATION / MAINTENANCE FOR CTE MIXER / HEATER

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance. Failure to follow *any* instruction could possibly result in a malfunction of the CTE Mixer/Heater with resulting property damage or physical injury to personnel.

⚠ CAUTION ⚠

Penberthy does not have any control over the manner in which its CTE is handled, installed, or used, and Penberthy cannot and does not warrant or guarantee that a CTE is suitable or compatible with the user's specific application.

⚠ WARNING ⚠

Safety glasses and protective clothing should be worn when in the area of a CTE Mixer/Heater installation. Consequences: High Pressure liquid or steam may inadvertently discharge from the unit, resulting in severe personal injury and propery damage.

I. INTRODUCTION:

A. Features and Specifications

Penberthy CTE's (Circulating Tank Eductors) are designed for in tank mixing of liquids using a liquid as the motive fluid, and for in tank heating of liquids using steam as the heating and motive fluid.

Mixing is accomplished first within the CTE as the motive liquid entrains the tank contents into the suction openings, and thoroughly mixes within the unit before being discharged. The discharge flow, or plume, provides further mixing and agitation within the tank. The motive liquid can be drawn from the tank, or it can be a second liquid drawn from another source.

Heating is accomplished by direct condensation of steam in the liquid. The motive steam also induces the liquid to flow into the suction openings and discharge from the CTE. The discharge flow or plume provides further mixing and circulation to promote even temperature distribution.

B. Design Ratings PSIG at Maximum and Minimum Operating Temperatures.

SIZE	MATERIAL	MAXIMUM ALLOWABLE WORKING PRESSURE
3/8" thru 3"	Iron, Bronze, and STS	160 PSIG at -20°F to +370°F
4" - 6", AND 8"	Carbon Steel	160 PSIG at -20°F to +200°F
3/8" thru 3"	PVC	100 PSIG at +70°F 20 PSIG at +140°F
3/8" and 3/4"	Kynar	100 PSIG at +70°F 20 PSIG at +275°F
3/8" and 3/4"	Polypropylene	100 PSIG at +70°F 25 PSIG at +170°F

To determine the maximum allowable working pressure for a specific temperature within the design limits stated above, the user should refer to Penberthy dimension sheets or when provided, the specifically stated design limits on a Penberthy product proposal.

C. Application Data

CTE sizes above 3 inches are metal fabrications to be used only for mixing, not for heating. Unless otherwise specified on a Penberthy product proposal, metal fabrications are not designed for steam heating in tank.

1. Mixing

Minimum inlet pressure — 10 PSIG
Maximum inlet pressure — 160 PSIG

Most efficient operation takes place when inlet pressure is within the range of 20 to 70 PSIG. Three gallons of tank contents can be mixed for every gallon of operating fluid. For inlet pressures outside this range, 2.6 gallons of tank contents can be mixed for every gallon of operating fluid.

2. Heating

Min. Steam Pressure	Max. Tank Liquid Temp
10 PSIG	70°F
20 PSIG	100°F
25 PSIG	120°F
34 PSIG	140°F
50 PSIG	160°F

Operation at steam pressures below those listed for each maximum tank liquid temperature or heating beyond 160°F may cause objectionable noise, water hammer, and vibration.

Note: For specific application data within the above ranges, the user should consult the Penberthy product proposal for the specific model and size CTE, or should request Penberthy to supply the applicable technical data bulletin.

⚠ WARNING ⚠

Under no circumstances should these design ratings or application data be exceeded. Exceeding design ratings or application data can cause the CTE to structurally fail at higher pressures and temperatures causing severe personal injury and property damage.

II. INSPECTION AND PERFORMANCE CONFIRMATION:

A. Receiving Inspection

Upon receipt of CTE, check all components carefully f damage incurred in shipping. If damage is evident o suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

B. User's Rating Inspection

The user should confirm:

1. That the CTE size and model designation (cast on side of body) conforms to the description on the user's purchase order.
2. That the operating conditions described in the purchase order agree with the actual conditions at the installation site.
3. That the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above.
4. That the materials of construction of the CTE are compatible with both the contained fluid and surrounding atmosphere in the specific application.

⚠ CAUTION ⚠

If the size, model or performance data of the CTE as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for direction on what to do.

III. INSTALLATION:

Installation should only be undertaken by qualified experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model CTE.

Check the CTE cut-away view in Figure 1 for the location of the threaded inlet.

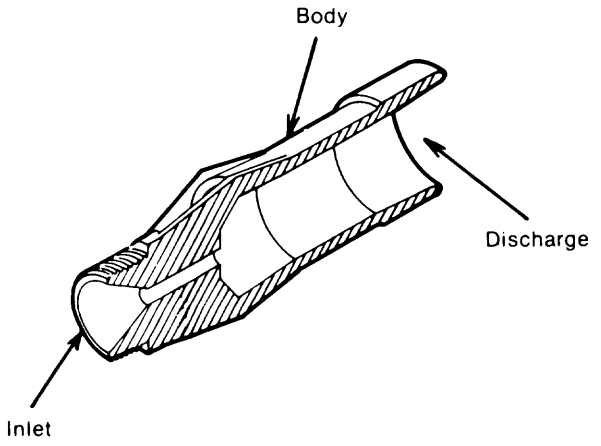


Figure 1

A. Mounting

A CTE can be mounted in any position. The supply line and manifold piping to multiple CTE's must be sized to supply uniform pressure to each CTE.

It is important that the CTE be positioned within the tank to insure the free flow of liquid to be mixed or heated into and out of the unit(s). The greatest agitation occurs within the discharge plume; therefore, the discharge end should be aimed towards the most remote part of the tank. On the other hand, the intake end of the unit must be just far enough from the tank corner or wall to allow the free flow of liquid into the suction openings.

Tank shape and size influence the placement and number of CTE's required to maintain even agitation or temperature distribution. With a spherical tank, a single CTE mounted as shown in the Figure 2 illustration makes the best use of the mixing and heating characteristics of the CTE. With no corners to impede liquid flow, the liquid circulates evenly and undisturbed.

In a cylindrical, square, or rectangular tank, the angular intersection of surfaces can interrupt liquid flow patterns and cause liquid stagnation in these areas. A single CTE mounted as shown in Figure 3 will minimize this. Whenever the ratio of length to diameter of the tank is greater than 2:1 (such as tank trucks or railroad cars), it is recommended that multiple CTE's be used.

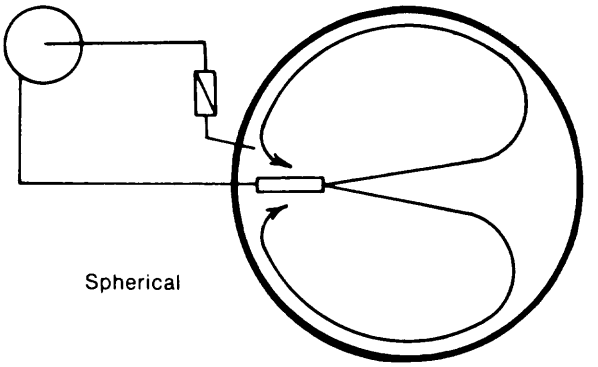


Figure 2

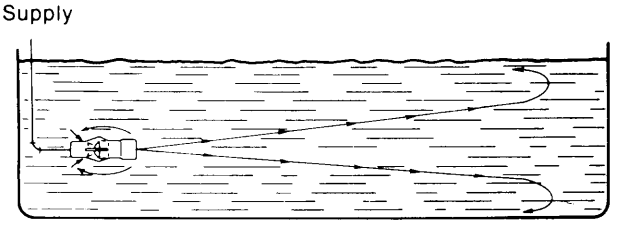


Figure 3

B. Effect of Related Piping and Precautions

1. For Mixing

   a. Operating liquid supply line pressure loss must be taken into account when applying CTE's.
   b. Supply line must be clean and should be provided with a strainer to prevent foreign materials from clogging mixer.
   c. CTE's must be fully submerged to prevent liquid from splashing and drawing atmospheric air, and to promote maximum mixing.
   d. Clearance should be provided for removal of the CTE.
   e. Provisions should be made for a pressure gauge connection at or near the CTE inlet. It may become necessary to install a pressure gauge if operating difficulties are encountered.
   f. Inlet piping must be secured to the tank wall near the CTE to keep strain off piping when in operation.
   g. Supply line and manifold piping must be sized to supply adequate pressure equally to each CTE when multiple CTE's are used.

2. For Heating

   a. Steam must not have more than 20°F of super-

heat, or performance will differ from that published on Penberthy Technical Data Bulletin or product proposal referred to above.

b. Steam line pressure loss must be taken into account when applying CTE's.
c. Steam line must be clean and provided with a strainer to prevent foreign materials from clogging heater.
d. Steam line must be insulated and as short as possible to prevent condensation and friction losses.
e. CTE's must be fully submerged to prevent liquid from splashing and to promote condensation.
f. Clearance should be provided for removal of the CTE.
g. Provisions should be made for a pressure gauge connection at or near the CTE inlet. It may become necessary to install a pressure gauge if operating difficulties are encountered.
h. Steam piping must be secured to the tank wall near the CTE to keep strain off piping when in operation.
i. Steam supply valve must be a quick opening type installed as close to the CTE as practical.

IV. OPERATION:

A. Pre-Operation Check

1. Assure that all installation procedures have been completed.

2. Fill tank with sufficient liquid for full submergence of CTE.

B. Operating

1. For Mixing

a. Turn operating fluid flow on (depending upon the application, this may be liquid drawn from the tank, or it can be a second liquid drawn from another source).

1. For Heating

a. Turn steam flow fully on and maintain throughout heating process.
b. After desired temperature has been reached, steam flow should be turned off.
c. Do not throttle steam supply valve. Throttling of steam flow to conditions outside the recommended operating levels will cause the CTE to hammer with resulting noise and vibration.

⚠ CAUTION ⚠

Excessive vibration can become hazardous due to loosening of pipe joints and release of steam.

Example: A CTE is employed in raising the water temperature in a given tank from ambient to 160°F, and it is sized to accomplish the job using 50 PSIG steam over a period of 30 minutes. Once the tank temperature reaches 160°F, it obviously will take much less quantity of steam to maintain the tank at 160°F than it did to get there. If the steam flow were throttled to maintain 160°F in the tank, the steam pressure would necessarily drop below 50 PSIG at the CTE, and then noise and vibration can be expected. 50 PSIG is the recommended minimum steam pressure for quiet operation when the tank temperature is 160°F.

Temperature of liquid can be thermostatically controlled only if the steam supply is controlled with a snap acting on-off valve.

⚠ WARNING ⚠

Do not attempt to heat liquid beyond the maximum stated temperature of 160°F. Where the user has an open tank installation, heating beyond the maximum does not allow the steam time enough to fully condense by the time it reaches the surface of the liquid, thus splashing can result and cause property damage or personal injury.

V. MAINTENANCE:

Maintenance should only be undertaken by qualified experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

⚠ WARNING ⚠

Do not proceed with any maintenance unless the CTE has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Consequences: Failure to do so can result in unexpected bursts of liquid or steam and severe personal injury and property damage.

A. Preventative Maintenance

The user must create maintenance schedules, safety manuals and inspection details for each specific installation of a CTE Mixer/Heater.

On all installations, the following items should be regularly evaluated by the user for purposes of maintenance.

1. CTE(s) for corrosion or debris build up.
2. Piping and fittings for corrosion or debris build up.
3. All connections for tightness.
4. Units for wear.
5. Units for full submergence.

The user must determine upon evaluation of his or her own operating experience an appropriate maintenance schedule necessary for his or her specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

B. Troubleshooting

Problem

No mixing or heating taking place.

Cause	Cure
Inadequately sized CTE.	Obtain properly sized CTE.
Debris blockage of inlet suction or discharge.	Remove debris.
Loss of operating fluid due to loose connections.	Tighten connections.
Operating fluid pressure too low.	Increase pressure.

Problem

Partial mixing or heating.

Cause	Cure
Debris blockage.	Remove debris.
Operating fluid pressure too low.	Increase pressure.
Increased product demand.	Reduce product flow to heating capability of unit.

Problem

Noise, water hammer, vibration when heating.

Cause	Cure
Operating pressure too low or liquid temperature too high.	Increase pressure or decrease temperature.
Throttling of steam flow.	Thermostatically controlled heating cycles with snap acting on-off valve.
Set point is too high (such as 200°F).	Decrease to recommended operating level.

C. Disassembly - Reassembly

⚠ WARNING ⚠

Do not proceed with removal of CTE from connecting piping unless the CTE has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Consequences: Failure to do so can result in unexpected burst of liquid or steam and severe personal injury and property damage.

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