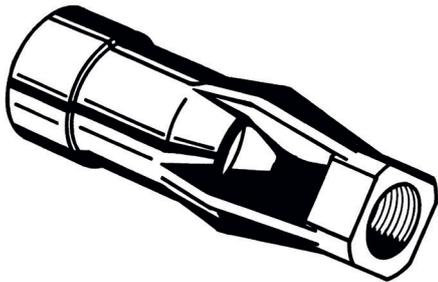




PENBERTHY MODEL CTE MIXER / HEATER
 INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Before installation, these instructions must be read carefully and understood.



PRODUCT WARRANTY

Emerson warrants its Penberthy products as designed and manufactured to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. Emerson will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to Emerson and obtain written authorization to return the product. Thereafter, the product shall be returned to Emerson with freight prepaid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of the Emerson factory, or if it has been subject to misuse, neglect or accident.

The responsibility of Emerson hereunder is limited to repairing or replacing the product at its expense. Emerson shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that Emerson is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

This is Emerson's sole warranty and in lieu of all other warranties, expressed or implied which are hereby excluded, including in particular all warranties of merchantability or fitness for a particular purpose.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of Emerson unless made in writing and signed by the company's general manager or director of engineering.

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1 ABOUT THE MANUAL

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.

IMPORTANT

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

WARNING

Safety glasses and protective clothing should be worn installing a CTE mixer/heater. Failure to follow any instruction may cause a malfunction of the unit in which high pressure liquid or steam may discharge from the unit inadvertently, resulting in severe personal injury and property damage.

2 INTRODUCTION

2.1 Features and specifications

Penberthy CTEs (circulating tank eductors) are designed for in-tank mixing of liquids 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 mixes with the unit thoroughly 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 includes 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.

2.2 Design ratings at maximum and minimum operating temperatures

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in Table 1, the user should refer to relevant data sheets or, when provided, the specifically stated design limits on a product proposal.

2.3 Application data

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

1. Mixing

Minimum inlet pressure - 10 psig (70 kPaG)
 Maximum inlet pressure - 160 psig (1100 kPaG)
 Most efficient operation takes place when inlet pressure is within the range of 20 to 70 psig (140 to 480 kPaG). 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 (see Table 2)

Operation at steam pressures below those listed for each maximum tank liquid temperature or heating beyond 160°F (71°C) may cause objectionable noise, water hammer, and vibration.

Note: For specific application data within the ranges stated, the user should consult the product proposal for the specific model and size CTE, or should request the supply of the applicable technical data sheet.

WARNING

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

3 INSPECTION AND PERFORMANCE CONFIRMATION

3.1 Receiving inspection

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

3.2 User's rating inspection

The user should confirm that:

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

IMPORTANT

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 assistance.

TABLE 1 - DESIGN RATINGS AT MAX. AND MIN. OPERATING TEMPERATURES

Size	Material	Maximum allowable working pressure
¾" thru 3"	Iron, bronze and SS	160 psig [1100 kPaG] at -20°F [-29°C] to +370°F [188°C]
4" - 6" and 8"	Carbon steel	160 psig [1100 kPaG] at -20°F [-29°C] to +200°F [93°C]
¾" thru 3"	PVC	100 psig [690 kPaG] at +70°F [21°C]
		20 psig [140 kPaG] at +140°F [60°C]
¾" and ¾"	Kynar®	100 psig [690 kPaG] at +70°F [21°C]
		20 psig [140 kPaG] at +275°F [135°C]
¾" and ¾"	Polypropylene	100 psig [690 kPaG] at +70°F [21°C]
		25 psig [170 kPaG] at +170°F [77°C]

Note: Kynar® is a registered trademark of Arkema polyvinylidene fluoride (PVDF) resin.

TABLE 2 - APPLICATION (HEATING)

Min. steam pressure		Max. tank liquid temp.	
psig	kPaG	°F	°C
10	70	70	21
20	140	100	38
25	170	120	49
34	230	140	60
50	340	160	71

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4 INSTALLATION

Installation should only be undertaken by qualified, experienced personnel who are familiar with this equipment and have read and understand all the instructions in this manual. The user should refer to the relevant technical data sheet or product proposal to obtain dimensional information for the specific size and model of CTE. Check the cut-away view (Figure 1) for the location of the threaded inlet.

4.1 Mounting

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

It is important that the CTE be positioned within the tank so as 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 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 CTEs required to maintain even agitation or temperature distribution. With a spherical tank, a single CTE mounted as shown in Figure 2 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 CTEs be used.

4.2 Effect of related piping and precautions

1. For mixing

- Operating liquid supply line pressure loss must be taken into account when applying CTEs.
- Supply line must be clean and should be provided with a strainer to prevent foreign materials from clogging the mixer.
- CTEs must be fully submerged to prevent liquid from splashing and drawing atmospheric air, and to promote maximum mixing.
- Clearance should be provided for removal of the CTE.
- 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.

FIGURE 1

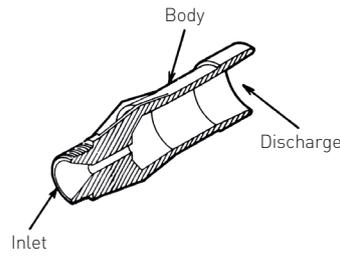


FIGURE 2

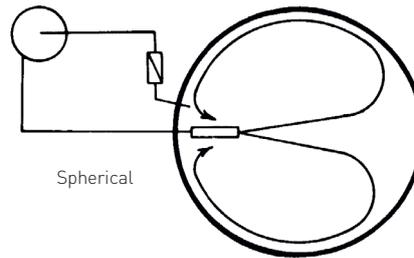
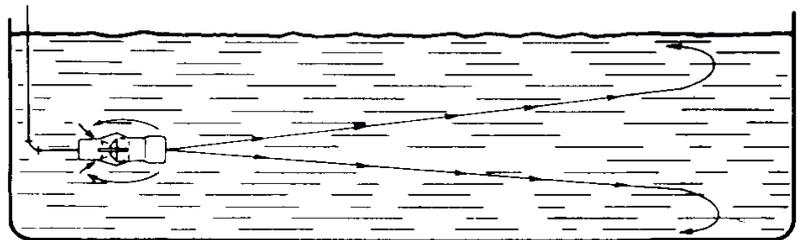


FIGURE 3



- Inlet piping must be secured to the tank wall near the CTE to keep strain off piping when in operation.
 - Supply line and manifold piping must be sized to supply adequate pressure equally to each CTE when multiple CTEs are used.
 - 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.
 - Steam piping must be secured to the tank wall near the CTE to keep strain off piping when in operation.
 - The steam supply valve must be a quick opening type installed as close to the CTE as practical.
- For heating*
 - Steam must not have more than 20°F (-7°C) of superheat or performance will differ from that published in the relevant technical data sheet or product proposal referred to previously.
 - Steam line pressure loss must be taken into account when applying CTEs.
 - The steam line must be clean and should be provided with a strainer to prevent foreign materials from clogging heater.
 - The steam line must be insulated and as short as possible to prevent condensation and friction losses.
 - CTEs must be fully submerged to prevent liquid from splashing and to promote condensation.
 - Clearance should be provided for removal of the CTE.

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5 OPERATION

5.1 Pre-operational check

1. Ensure that all installation procedures have been completed.
2. Fill the tank with sufficient liquid for full submergence of the CTE.

5.2 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).
2. *For heating*
 - a. Turn the steam flow fully on and maintain throughout the heating process.
 - b. After the desired temperature is reached, the steam pressure should be turned off.
3. Do not throttle the 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.

IMPORTANT

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 (71°C) and it is sized to accomplish the job using 50 psig (340 kPaG) steam over a period of 30 minutes. Once the tank temperature reaches 160°F (71°C), obviously it will take much less quantity of steam to maintain the tank at 160°F (71°C) than it did to get there. If the steam flow was throttled to maintain 160°F (71°C) in the tank, the steam pressure would drop necessarily below 50 psig (340 kPaG) at the CTE and then noise and vibration can be expected. 50 psig (340 kPaG) is the recommended minimum steam pressure for quiet operation when the tank temperature is 160°F (71°C).

Temperature of liquid can be controlled thermostatically 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 (71°C). Where the user has an open tank installation, heating beyond the maximum does not allow the steam time enough to condense fully by the time it reaches the surface of the liquid, thus splashing can result causing severe personal injury or property damage.

6 MAINTENANCE

WARNING

Maintenance should only be undertaken by qualified, experienced personnel who are familiar with this equipment and have read and understood thoroughly all the instructions in this manual. 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. Failure to follow these instructions may cause a sudden release of liquid or steam resulting in severe personal injury or property damage.

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

6.2 Troubleshooting (see Table 3)

TABLE 3 - TROUBLESHOOTING

Problem	Cause	Solution
No mixing or heating taking place	<ol style="list-style-type: none"> 1. Inadequately sized CTE 2. Debris blockage of inlet, suction or discharge 3. Loss of operating fluid due to loose connections 4. Operating fluid pressure too low 	<ol style="list-style-type: none"> 1. Obtain properly sized CTE 2. Remove debris 3. Tighten connections 4. Increase pressure
Partial mixing or heating	<ol style="list-style-type: none"> 1. Debris blockage 2. Operating fluid pressure too low 3. Increased product demand 	<ol style="list-style-type: none"> 1. Remove debris 2. Increase pressure 3. Reduce product flow to heating capability of unit
Noise, water hammer, vibration when heating	<ol style="list-style-type: none"> 1. Operating pressure too low or liquid temperature too high 2. Throttling of steam flow 3. Set point is too high (such as 200°F [93°C]) 	<ol style="list-style-type: none"> 1. Increase pressure or decrease temperature 2. Thermostatically controlled heating cycles with snap acting on-off valve 3. Decrease to recommended operating level

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7 DISASSEMBLY - REASSEMBLY

WARNING

Do not proceed with removal of the 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. Failure to follow these instructions may cause a sudden release of liquid or steam resulting in severe personal injury or property damage.

8 DISPOSAL AT END OF USEFUL LIFE

Penberthy CTEs are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the CTE must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metal, glass and polymers should be recycled whenever possible. Refer to order and relevant data sheet for materials of construction.

9 TELEPHONE ASSISTANCE

If you are having difficulty with your CTE, contact your local Penberthy distributor. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

- Model number
- Name of the company from whom you purchased the CTE
- Invoice number and date
- Process conditions (pressure, flow rates, tank shape, etc.)
- A brief description of the problem
- Troubleshooting procedures that failed

If attempts to solve your problem fail, you may request to return your CTE to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from Emerson before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect. To obtain an R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- 'Ship-to' address

There is a minimum charge for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but it is not defective, the minimum charge will apply.

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