PENBERTHY SERIES CTE2 FOR IN-TANK MIXING

Low-cost alternatives to mechanical mixing methods which provide a more thorough mixing action than either mechanical mixing or air sparging.

MODEL CTE2

FEATURES

- Simple design with no moving parts to wear out.
- Enable the use of a smaller recirculating/transfer pump.
- Inherently non-clogging.
- No lubrication required.
- Virtually maintenance-free.
- Easy to install without special structures or foundations.
- Cast, fabricated or non-metallic constructions.
- Variety of materials to suit specific characteristics of the process liquids.

GENERAL APPLICATION

Applications include hazardous waste and waste water processing, cooling tower circulations, tank truck agitation, additive infusion, blended solution agitation, plating tank agitation and separation prevention of non-mixable liquids or stratification of dissimilar liquids.

TECHNICAL DATA

Materials:	Bronze, carbon steel, 316SS, PVC, PP, PVDF
Sizes:	3/8” to 8”
Pressure :	10 – 100 psig (.7 to 6.9 barg)
Temperature (max):	to 220°F (104°C)

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PRODUCT OVERVIEW

Penberthy Circulating Tank Eductors (CTE) provide an effective way to mix, improve the agitation and circulation of liquids or slurries in open or closed tanks. They produce an intimate mixing action between the components of a liquid, while keeping the contents of the tank in constant motion. In many cases, they produce a mixing action that cannot be duplicated using mechanical methods.

The CTE2 is available in a broad range of materials and in eight model sizes.

TABLE 1 - MODEL CONSTRUCTION DATA

Model	CTE2	Standard materials
Sizes available	⅜"-4"	Cast: Bronze, carbon steel, 316 STS
	4" and up	Fabricated: Carbon steel, 316 STS
	⅜"-3"	Non-metallic: PVC, PP PVDF [Kynar®]

TABLE 2 - MODEL SPECIFICATIONS

Model	CTE2 - Circulating Tank Eductor
Pressure differential of inlet to tank pressure	10-100 psig [70-690 kPag]
Mixing ratio	4:1
Max. operating liquid viscosity	up to 2,000 cPs

OPERATION

A predetermined amount of liquid (called operating fluid) is pumped through a header to one or more CTE2s submerged inside the tank. Depending on the application, the operating fluid can be liquid drawn from the tank or it can be a secondary liquid from another source that is to be mixed with the tank contents. As the operating fluid leaves the nozzle of the CTE2, it entrains material from the tank. The operating fluid and entrained material are mixed thoroughly inside the parallel section of the CTE2 before being discharged. The discharge flow, or plume, continues the mixing, agitation and circulation of the liquid throughout the tank.

MODEL CTE2

CTE2s can handle a variety of viscosities and types of liquid, including slurries and suspensions. Their thorough mixing action makes them especially useful for maintaining uniform liquid characteristics such as temperature, pH or solids distribution throughout the tank contents. The CTE2 is also used to prevent separation of non-mixable liquids or stratification of liquids having different specific gravities.

They allow the use of a smaller recirculating pump that normally would be needed to move a given volume of liquid. This saves energy while providing more effective mixing and circulation. Theya re available in materials to suit a variety of applications in food, chemical, refining and other process industries.

DESIGN CONSIDERATIONS

Turnover rate

The rate at which the fluid in the tank must be turned over completely will determine the overall capacity of the CTE2s needed. When the inlet pressure supplied to the CTE2 is within a range of 20 to 70 psi (138 to 483 kPa), four gallons of tank contents can be mixed for every gallon of operating fluid passing through the CTE2. That is, the volume of fluid discharged from the CTE2 will be five times greater than the volume of operating fluid entering the CTE2 inlet.

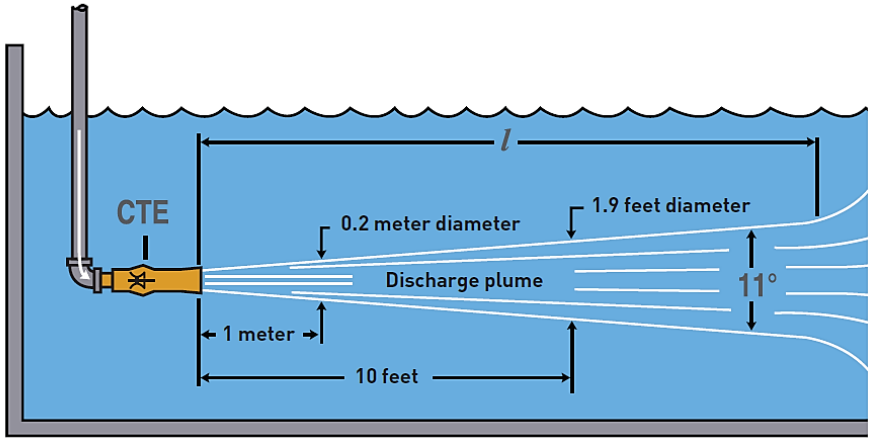
The ratio of tank contents can be mixed for each gallon of operating fluid decreases as pressure increases (see Table 3).

Fluid viscosity

In fluids such as water or mineral oil (Newtonian fluids), the length of the CTE2 discharge plume increases proportionally with increased operating fluid pressure. See Table 3 for plume length details.

In dilatant fluids, the length of the discharge plume decreases as the operating fluid pressure is increased. In thixotropic fluids, very little flow will be evident at the CTE2 discharge until the operating fluid pressure is increased beyond a critical value, after which flow increases rapidly. If necessary, contact the factory for assistance when dealing with such fluids.

DISCHARGE PLUME



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Tank shape and size

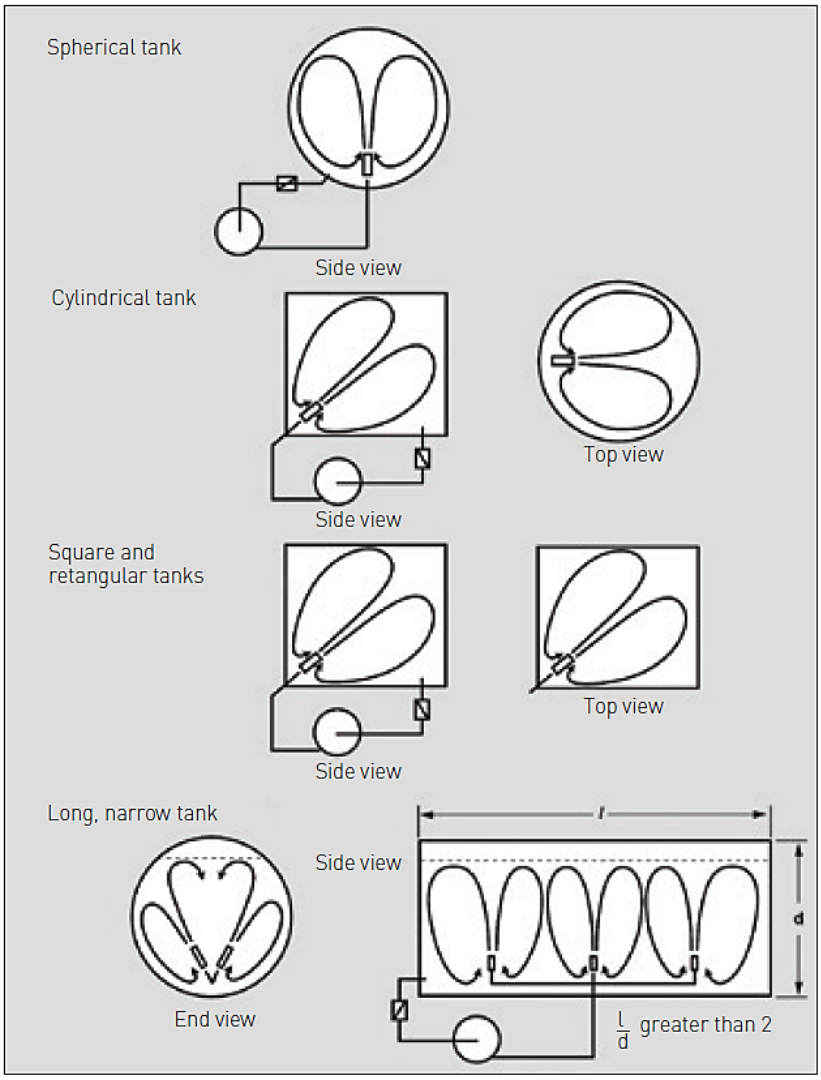
Tank shape and size influence the placement and number of CTE2s required to assure even agitation of the entire volume of the fluid. A spherical tank with a single CTE2 mounted as shown below makes the best use of the mixing and flow characteristics of the CTE2. With no corners to impede fluid flow, the fluid circulates evenly and naturally. A single CTE2 will often be sufficient to circulate the entire tank contents.

The angular intersection of surfaces in cylindrical, square or rectangular tanks can interrupt fluid flow patterns and cause fluid stagnation in these areas. A single CTE2 mounted as shown will tend to minimize this effect. However, multiple CTE2s can often produce more efficient mixing when using these tank shapes.

Long, narrow tanks such as tank trucks or railroad cars normally require multiple CTE2s when their ratio of length to diameter is greater than 2:1. This applies to horizontal or vertical tanks and for any shape of tank cross-section.

Larger tanks of any shape may require multiple CTE2s to maintain agitation in all parts of the tank.

PLAN AND ELEVATION VIEWS OF SPHERICAL, CYLINDRICAL AND SQUARE TANKS



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SELECTION

Select the capacity of the CTE2 in Table 3 based on the turnover rate required. The total volume of liquid mixed per minute will be approximately four times the capacity of the CTE2 shown in the table.

One CTE2 handling the entire capacity can be used or the total capacity can be divided among several CTE2s, as appropriate.

Example

Capacity required: 1200 gpm (4.54 m^3/min) operating fluid flow

Use six CTE2 3 at 30 psi (207 kPa) or
Use six CTE2 2 at 100 psi (689 kPa) (yields longer plume)

The use of multiple CTE2s should be considered when one or more of the following conditions is present:

- Dilatant fluids are involved and operating fluid pressure exceeds 50psi (345 kPa).
- The tank sides meet at 90° or less
- The tank is large and the required length of discharge plume exceeds the capacity of the CTE2s available
- A long, narrow tank has a length to diameter ratio greater than 2:1

TABLE 3 – CAPACITIES OF CIRCULATING TANK EDUCTORS

Size	*Sizing Factor*	Pressure Difference PSI (kPa)	10 (69)	20 (138)	30 (207)	40 (276)	50 (345)	60 (414)	70 (483)	80 (552)	90 (621)	100 (690)	120 (828)	140 (966)
3/8	0.23	Inlet Flow GPM (cuM/m)	7.1 (0.027)	10.0 (0.038)	12.3 (0.047)	14.2 (0.054)	15.8 (0.060)	17.4 (0.066)	18.7 (0.071)	20.1 (0.076)	21.3 (0.081)	22.4 (0.085)	24.6 (0.093)	26.5 (0.100)
		Outlet Flow GPM (cuM/m)	35.0 (0.132)	50.0 (0.189)	61.0 (0.231)	71.0 (0.269)	79.0 (0.299)	87.0 (0.329)	88.0 (0.333)	98.0 (0.371)	91.0 (0.344)	92.0 (0.348)	94.0 (0.356)	96.0 (0.363)
		Max. Length Feet (Meters)	4.0 (1.22)	8.0 (2.44)	12.0 (3.66)	16.0 (4.88)	15.8 (4.82)	17.4 (5.30)	18.7 (5.70)	20.1 (6.13)	21.3 (6.49)	22.4 (6.83)	24.6 (7.50)	26.5 (8.08)
3/4	0.50	Inlet Flow GPM (cuM/m)	15.4 (0.058)	21.8 (0.083)	26.7 (0.101)	30.8 (0.117)	34.5 (0.131)	37.8 (0.143)	40.8 (0.154)	43.6 (0.165)	46.3 (0.175)	48.8 (0.185)	53.4 (0.202)	57.7 (0.218)
		Outlet Flow GPM (cuM/m)	77.0 (0.291)	109 (0.413)	134 (0.507)	154 (0.583)	172 (0.651)	189 (0.715)	192 (0.727)	195 (0.738)	197 (0.746)	200 (0.757)	204 (0.772)	209 (0.791)
		Max. Length Feet (Meters)	5.0 (1.52)	11.0 (3.35)	17.0 (5.18)	24.0 (7.31)	33.0 (10.1)	42.0 (12.8)	53.0 (16.2)	64.0 (19.5)	74.0 (22.6)	85.0 (25.9)	106 (32.3)	127 (38.7)
11/2	1.00	Inlet Flow GPM (cuM/m)	30.8 (0.117)	43.6 (0.165)	53.4 (0.202)	61.6 (0.233)	68.9 (0.261)	75.5 (0.286)	81.5 (0.309)	87.2 (0.330)	95.5 (0.361)	97.5 (0.369)	107 (0.405)	115 (0.435)
		Outlet Flow GPM (cuM/m)	154 (0.583)	218 (0.825)	267 (1.011)	306 (1.158)	345 (1.306)	378 (1.431)	384 (1.454)	389 (1.472)	395 (1.495)	400 (1.514)	409 (1.548)	417 (1.578)
		Max. Length Feet (Meters)	7.5 (2.29)	16.0 (4.88)	24.0 (7.31)	34.0 (10.4)	46.0 (14.0)	60.0 (18.3)	75.0 (22.9)	90.0 (27.4)	105 (32.0)	120 (36.6)	150 (45.7)	180 (54.9)
2	2.00	Inlet Flow GPM (cuM/m)	61.6 (0.233)	87.2 (0.330)	107 (0.405)	123 (0.466)	138 (0.522)	151 (0.572)	163 (0.617)	174 (0.659)	185 (0.700)	195 (0.738)	214 (0.810)	231 (0.874)
		Outlet Flow GPM (cuM/m)	308 (1.166)	436 (1.650)	534 (2.021)	616 (2.332)	689 (2.608)	755 (2.858)	767 (2.903)	778 (2.945)	789 (2.987)	799 (3.024)	818 (3.096)	835 (3.161)
		Max. Length Feet (Meters)	11.0 (3.35)	23.0 (7.01)	34.0 (10.4)	48.0 (14.6)	65.0 (19.8)	85.0 (25.9)	106 (32.3)	127 (38.7)	148 (45.1)	170 (51.8)	212 (64.6)	255 (77.7)
3	4.60	Inlet Flow GPM (cuM/m)	142 (0.538)	201 (0.761)	246 (0.931)	283 (1.071)	317 (1.200)	347 (1.313)	375 (1.419)	401 (1.518)	426 (1.613)	449 (1.700)	491 (1.859)	531 (2.010)
		Outlet Flow GPM (cuM/m)	708 (2.680)	1003 (3.797)	1228 (4.648)	1417 (5.364)	1585 (6.000)	1737 (6.575)	1764 (6.677)	1790 (6.776)	1815 (6.870)	1836 (6.950)	1880 (7.116)	1920 (7.268)
		Max. Length Feet (Meters)	16.0 (4.88)	34.0 (10.4)	51.0 (15.5)	73.0 (22.2)	99.0 (30.2)	129 (39.3)	161 (49.1)	193 (58.8)	225 (68.6)	257 (78.3)	322 (98.1)	386 (118)

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MODEL CTE2

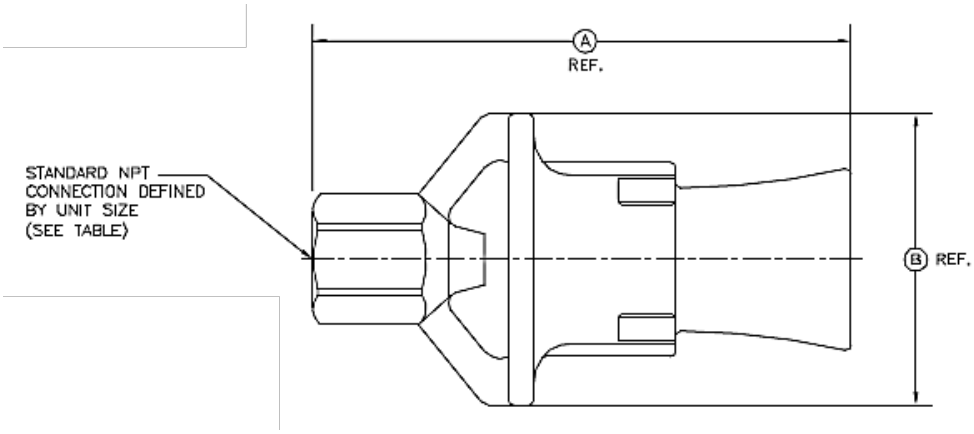

TABLE 7 – CTE2 DIMENSIONS IN INCHES (mm)

Size	NPT	Part No.	Material	A	B
3/8"	MALE	PB03922-TII	316 SS	4.35	2.47
3/4"	MALE	TB-3923-A27	Carbon Steel	7.30	3.67
		TB-3923-T11	316 SS		
1-1/2"	FEMALE	TB-3924-A27FNPT	Carbon Steel	10.94	5.54
		TB-3924-AT11FNPT	316 SS		
2"	FEMALE	TB-3925-A27FNPT	Carbon Steel	14.56	7.68
		TB-3925-T11FNPT	316 SS		
3"	FEMALE	TB-3926-A27FNPT	Carbon Steel	22.06	11.73
		TB-3926-T11FNPT	316 SS		

TABLE 8 - MAX. PARTICLE CLEARANCE IN INCHES

Size	Max. particle clearance
3/8	3/8
1/2	1/2
3/4	1/2
1	3/4
1 1/2	7/8
2	1 1/8
3	1 3/4
4	2 7/8
6	4 1/2
8	5 7/8

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SELECTION CRITERIA

To determine the correct in-tank mixer for a specific application, make note of the required specification data listed below. Consult the tables within this datasheet, then contact your sales representative who will be able to help select the optimum in-tank mixer based on the data you provide.

Motive

- Operating liquid(s) involved
- Pressure (available)
- Flow rate (volume available)
- Temperature
- Specific gravity/viscosity

Tank

- Tank size (dimensions)
- Tank shape
- Maximum volume (total amount to be mixed)

Time

- Time required to achieve uniformity (Turnover rate)

Other

- Solids that are involved for suspension

PART NUMBER FOR NPT UNITS | **EXTENDED PART NUMBER FOR FLANGED UNITS**

Model	Size	Wetted Metal	Flange Class

Connections: NPT (Standard)

Model	Code
CTE	PCTE2-

Flanged

Model Code Suffix

F

Example: PCTE2F-

** 4" body is madde with flanges

--> Use "F" for 4" and Larger

Size	Code	Size	Code	Size	Code	Size	Code
3/4"	10	2"	18	4" **	24	8" **	30
1 1/2"	16	3"	22	6" **	28		

Note: Unit size is dictated by the body size. Standard units have the suction and outlet the same size.

Body Material	Code	Special Materials	Code	Plastic Materials	Code
Carbon Steel (WCB)	C	Hastelloy C (CW12MW)	H	PVC	P
316 SS (CF8M)	S	Alloy 20 (CN7M)	A	CPVC	CP
Bronze (B62)	B	Monel (M-35-1)	M	Polypropylene	PP
				PVDF (formerly Kynar)	K

Flange Class	Code	
CL150 ASME (B16.5)		(Blank)
CL300 ASME (B16.5)	3	

Note: Part combinations that cannot be defined here will be deisgnated as "Special" and will have either an order based part number or a base part with "SP" included in the part number.

Examples:

1) 3/4" Model CTE2 in bronze, standard connections
   Part number: **PCTE2-10-B**
2) 1-1/2" Model CTE2 in carbon steel with CL150 flanges, 1-1/2" connection size
   Part number: **PCTE2-16-C**
3) 2" Model CTE2 in 316SS with CL300 flanges, with standard 2" connection size
   Part number: **PCTE2-18-S-3**
4) 3" Model CTE2 in 316 SS with CL150 flanged connection size
   Part number: **PCTE2F-22-S**
5) 4" Model CTE2 in carbon steel CL150 flanged connection size
   Part number: **PCTE2F-24-C**

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