



BULK HANDLING & STORAGE OF LIQUID CHLORINATED ALKANES PAROIL[®] & CHLOROFLO

For reasons of convenience or economy, it sometimes is advantageous to receive bulk shipments of chlorinated alkanes by either railcar or tank truck.

The unloading, storage and handling system should be designed by an on-site engineer who is familiar with the objectives of the system, and who can design a safe system conforming to applicable building and design codes.

The following information was compiled by Dover Chemical's technical, engineering and operating personnel and is offered to aid in design.

Specific questions for special cases should be directed to Dover Chemical's technical service or engineering departments.

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BULK STORAGE

Capacity

Chlorinated alkanes generally are viscous when cool. Normally they are handled about 70°F; ideally at 100-120°F. Prolonged storage at or above 125°F in steel tanks will darken the material and should be avoided.

If color darkening is of concern, consideration should be given to locating:

1. A tank indoors where the temperature would be about 70°F with pump and line designed to handle 2,000-13,000cps viscosity; or
2. An insulated tank outside with a heater to provide water at 145-150°F, or electric traced with self-limiting tapes controlled by thermostats; or
3. A tank outside with insulation and heaters where atmospheric steam is used under close supervision to heat the tank only to above 100°F, and then making the transfer and shutting off the heat. Agitation is recommended here.

If the tank is located in an area where the temperature of the tank wall could drop below its interior dew point, a dryer should be provided on tank breathers. This will prevent condensation on the inside of the tank, which would run down the walls and rust the tank, and would introduce particles of ferric chloride, leading to product instability.

Details on accessories for bulk storage systems and an attached drawing of a typical storage handling system layout follow.

STORAGE TANKS AND ACCESSORIES

Careful consideration should be given to the vessel's capacity. Normal tank truck deliveries are 4,000 gallons, and Dover Chemical always attempts to anticipate customer needs so a bulk order can be delivered in about one week.

For example, if consumption is one tank truck per month, and allowing for one week lead-time, a 6,000-gallon tank should be installed. A Dover Chemical representative should be consulted before the final decision is made.

If delivery by 20,000-gallon railcar is anticipated, storage facilities should be evaluated carefully in the same manner as above. Generally one and one-half times car size is adequate.

Materials of Construction

Common mild steel can be used and is recommended for Paroil storage. Other materials which can be used include polyester fiberglass, stainless steel, or glass-lined steel. One very fine choice would be a brewery-grade, glass-lined tank; this is very easy to clean and frequently is available on the used market.

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Configuration

This usually is dictated by plant layout considerations. Either horizontal or vertical tanks can be used. The typical tank shown on the attached drawing is horizontal to permit transporting in most open-top vans or flatbeds, and in some closed vans.

Tank Heating

Ideally the tank should be located inside a heated building so no heating coils would be required. Materials up through Chloroflo 40 or Paroil 10 can be pumped easily at 70°F. More viscous materials require heating.

Externally clamped-on plate-type heating coils can be used with warm water, or, carefully with atmospheric steam using agitation.

Internal coils or bayonets are acceptable with 145° water.

Recent advances in electric tracing of tanks warrant consideration of this method so details on electric tracing are attached.

The heating coil size should be large enough to:

1. Overcome heat losses if heating is continuous, and
2. Heat the tank to 100-120°F in a reasonable period of time if the heating is intermediate.

The amount of insulation and the climate (for outside tanks) are other factors.

For a storage ΔT of 100°F (100°F storage temperature and 0°F ambient temperature, the heat loss is about 2.7/watts foot², or 9.2 BTU/hour per foot² with 3" of fiberglass insulation. See steam or electric tracing details.

Tank Level Indication

Some means to measure the contents of the tank must be provided. This can be a dip stick, sight glass (with large tubes), float and gauge, or manometer with bubbler.

Tank Nozzles

The following schedule can be used to select nozzle openings:

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Item	Description	Size	Type
A	Outlet	3"	Flanged
B	Inlet from tank truck or circulating lines	3"	Screwed box
C	Vent	3'	Screwed
D	Tank level	¾"	Screwed
E	Temperature controller thermowell	¾"	Screwed
F	Thermometer thermowell	½"	Screwed
G	Drain	2:	Screwed
H	Manway	18"	Flanged 150-lb. Drilling 3/8 Plate

Tank Insulation

Heat losses calculated under tank heater details indicate 3" of fiberglass insulation is acceptable for electric tracing. Less (such as 2") could be used for steam heating. Materials other than fiberglass also could be used. A protective covering (weatherproof if outdoors) should be put over insulation.

ELECTRIC TRACING DETAILS*

Tank Heating

▲ T	100°F (tank @100°F, ambient @ 0°F)
Insulation	3"
Heat Loss	2.7 watts/foot ² (from Chemelex literature)
Thermal output of 10 PTV	11.5 watts/foot
Tank size	6' in diameter x 29', or 603 feet ²
	$\frac{603 \times 2.7}{7.2} = 226 \text{ feet}$

Note: An electric tracing supplier recommended 305 feet of 10 PTV-2.

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Pipe Heating

▲ T	100°F
Heat Loss (use 10 PTV-1 with thermostat)	
With 2" Pipe	5.2 watts/foot
With 3" pipe	6.8 watts/foot

*These data were obtained in 1982 and verified in 2007; manufacturers' model numbers may have changed.

STEAM TRACING DETAILS*

Tank Heating

▲ T	100°F (tank @100°F, ambient @ 0°F)
Insulation	3"
Heat loss	2.7 watts/foot ² or 9.2 BTU/hour foot ²
Tank size	6' in diameter x 29', or 603 feet ²
	Q = 603 x 9.2: 5,548 BTU/hour
Water temperature	140°F
	▲ T = 40 °F
	U = assume 10 BTU/hour/foot ² °F
	Q = UA ▲ T
	$A = \frac{Q}{U \Delta T} = \frac{5,549}{(10)(40)} = 14 \text{ feet}^2$
	Use two Panelcoll pattern 301, 18" x 119", or 14.9 foot ² each heaters, to cover a total of 30 foot ² .

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Pipe Heating

Use 3/8" copper steam tracing with no steam trap and 10 psig steam. Maximum tracer lengths:

1" pipe	140'
1.5" pipe	110'
2" pipe	100'
3" pipe	90'

Note: Steam tracing is to be controlled by a thermostat.

*These data were obtained in 1982 and verified in 2007; manufacturers' model numbers may have changed.

PRESSURE DROP IN PIPELINES (Pounds per square inch per foot of pipe) (2116 cps/13000 cps)*

Flow Rate Gallons/Minute	Pipe Sizes			
	1.5"	2"	3"	4"
0	.86/5.3	.03/1.9	0.06/0.4	0.02/0.13
10		0.63/3.9	0.13/0.8`	0.04/0.26
20		0.94/5.8	0.19/1.2	0.06/0.40
30			0.26/	0.08/0.53
40			0.32/	0.10/0.66
50			0.30/	0.12/0.79
60			0.45/	0.15/0.93
70			0.52/	0.17/1.06
80			0.58	0.19/
90			0.65/	0.2 /
100			0.71/	0.23/
110			0.78/	0.27/
120			0.84/	0.28/
130			0.9 /	0.30/

Note: Reynolds number indicates all cases are laminar flow. Normal pressure drops are limited to 100psi total due to relief valve settings on gear pumps.

$$\Delta P = 0.000273 \frac{\mu Q}{d^4} \text{ in psi/foot of pipe}$$

*Viscosities are for Paroil 1650 @100°F, 2116 cps; and at 77° at 13000 cps).

Pumps and Piping

Positive displacement pumps are recommended for Paroil. The pump should be able to handle material with 13000 cps (46000 SUS) viscosity. This viscosity is well within the operating range of most gear pumps if the proper rotation speed is selected.

Care should be taken to locate the pump close to the tank outlet so a minimum of pipe and fittings are in the pump suction line. See the pipeline pressure-drop chart attached.

Discharge piping also should be planned carefully to keep the pressure drop to a minimum. This pressure drop must be estimated when sizing the pump to determine the relief valve setting for the pump (normally 50 to 100 psig).

Dover Chemical successfully has used steel pumps and piping for years, taking proper precautions not to overheat them with steam or electric tracing. Other types of piping, such as stainless steel, Saran-lined or others, can be used.

Valves

Dover Chemical prefers to use ball valves for Paroil service because they are quick-opening and provide low pressure drops. Other types of valves also can be used to accomplish the same purpose.

Bronze is a suitable material of construction for ball valves.

See the print of typical layout for details, attached.

VISCOSITY vs TEMPERATURE

Product	Poise/25°C	Stokes/25°C	Stokes/40°C	Stokes/100°C
P10NR	0.3	0.3	0.2	0.1
P152	17	14	3	0.1
P140	31	26	7	0.3
P142LV	38	32	9	0.3
P142	64	53	13	0.4
P145	102	83	20	0.5
P150LV	151	120	27	0.5
P53NR	14	11	3	0.1
P53HV	46	35	7	0.2
P54NR	18	14	4	0.2
P5510	63	48	10	0.2
P56NR	113	85	15	0.3

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REVISIONS			
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TYPICAL PARCEL STORAGE TRAIL

DOVER CHEMICAL CORPORATION

SECTION NO. JN

SHEET NO. 42-10

DATE 8-28-78

DESIGNED BY JD

CHECKED BY I-73

