



HEAT EXCHANGERS



The overall heat transfer co-efficient of Borosilicate glass equipment is comparatively favourable with many alternative materials because of its smooth surface which improves the thermal coefficient & reduce the tendency of fouling.

HEAT EXCHANGERS ARE AVAILABLE IN 2 BASIC DESIGNS:

- 1 Conventional Coil Type Condensers.
- 2 Shell & Tube Type.

SHELL AND TUBE HEAT EXCHANGERS

INTRODUCTION

Shell & tube heat exchangers offer large surface area in combination with efficient heat transfer and compactness. These are widely used in industries for various duties like cooling, heating, condensation, evaporation etc. GOEL are the pioneers in the field of glass shell and tube heat exchangers in India and their product has a wide market acceptability.

SALIENT FEATURES

- Universal corrosion resistance — an excellent alternative to expensive MOCs like graphite, hastelloy, copper titanium, tantalum and other exotic metals.
- Excellent heat transfer as fouling does not occur on smooth glass surfaces.
- Flexibility of installation vertical / horizontal.
- Easy replacement of tubes for repair and cleaning.
- Available in wide range of HTAs.
- Ease of installation due to light weight.
- Economical.
- Suitable for applications where large HTAs are required in limited space.

ADVANTAGES OVER CONVENTIONAL COIL TYPE

- The overall heat transfer coefficient in shell and tube heat exchanger is about 3 times higher than in coil type heat exchanger.
- The pressure drop in shell and tube heat exchanger is minimal compared to 2–3 kg/cm² in coil side of coil type heat exchanger.
- For requirement of higher heat transfer areas shell and tube heat exchanger is the only alternative.

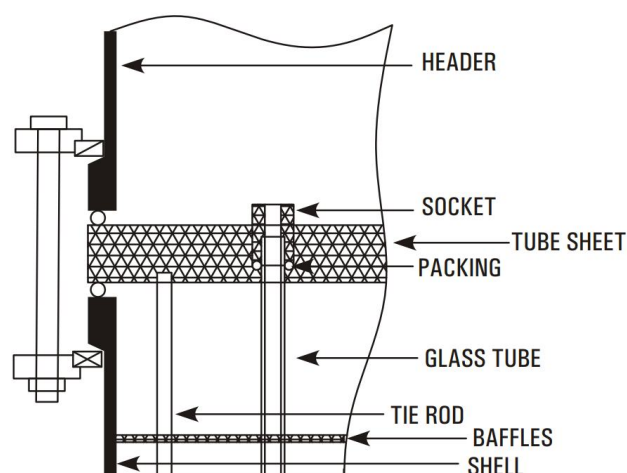
CONSTRUCTION FEATURES

The glass tubes are sealed individually into PTFE tube sheet with special PTFE sockets and packing. This unique ferrule type sealing arrangement permits easy replacement and cleaning of tubes. Baffles on shell side ensure improved heat transfer by increased turbulence. Further details of construction can be seen in the diagram.

- Made from SCHOTT DURAN.
- Joint less tubes offer better pressure rating.

TYPE

Three basic versions * are available:



MATERIAL OF CONSTRUCTION

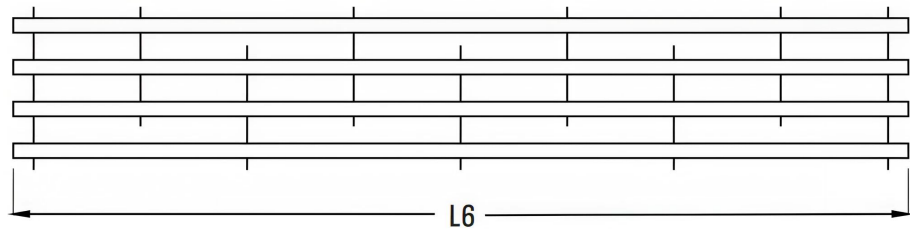
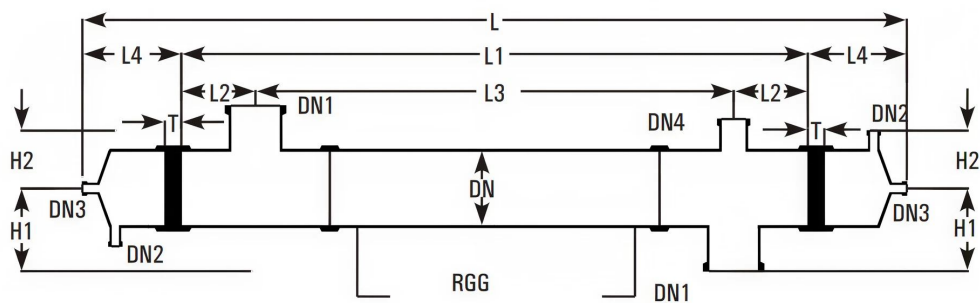
Model	Shell	Tube	Header	Duty
RGG	Glass	Glass	Glass	For heat transfer between two aggressive media.
RGM	Glass	Glass	Steel / FRP	For heat transfer between aggressive media in shell & non-aggressive media in tubes.
RMG	Steel / FRP	Glass	Glass	For heat transfer between aggressive media in tubes & non-aggressive media in shell.

* GOEL provides assistance to clients for selecting the right model for specific duty.

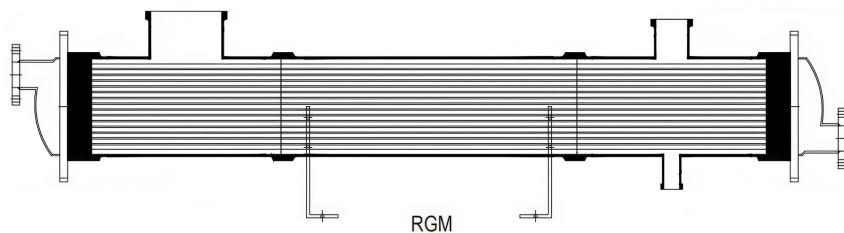


DIMENSIONAL SPECIFICATIONS

Cat. Ref. RGG/RMG	DN 150				DN 225				DN 300				DN 400	
	6/3	6/4	6/5	6/6	9/6	9/8	9/10	9/12	12/12	12/16	12/21	12/25	16/21	16/25
Area (m ²)	3	4	5	6	6	8	10	12	12	16	21	25	21	25
DN	150				225				300				400	
DN1	80				100				150				225	
DN2	50				80				80				100	
DN3	25				40				40				50	
DN4	50				50				50				80	
H1	175				250				300				450	
H2	150				200				250				300	
L	2500	3100	3700	4300	2620	3220	3820	4520	2550	3150	3950	4550	3100	3500
L1	1900	2500	3100	3700	1900	2500	3100	3800	1800	2400	3200	3800	2000	2400
L2	150				225				225				400	
L3	1600	2200	2800	3400	1450	2050	2650	3350	1350	1950	2750	3350	1200	1600
L4	250				300				300				550	
L5	125				175				175				225	
L6	1980	2580	3180	3780	2000	2600	3200	3900	1930	2530	3330	3930	2185	2585
T	50				60				75				100	
No. of Tubes	37				73				151				241	
No. of Baffles	11	15	19	23	7	9	13	17	5	7	9	11	5	7



TUBE BUNDLE



RANGE OF APPLICATIONS

- Permissible temperature range for both shell & tube sides -40°C to 150°C.
- Maximum permissible temperature difference between shell & tube sides 120°C.
- All sizes & models are suitable for full vacuum on both side.
- Maximum limiting pressures are tabulated here below:

The above ranges of application are admissible limiting values. For each specific case GOEL recommends the admissible operating data based on the relations between pressure and temperature, size and model.



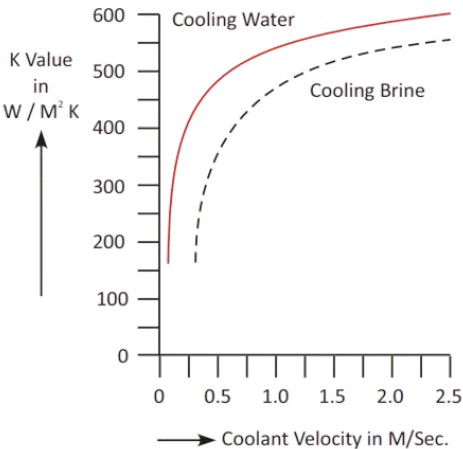
MAXIMUM LIMITING PRESSURES (KG/CM²)

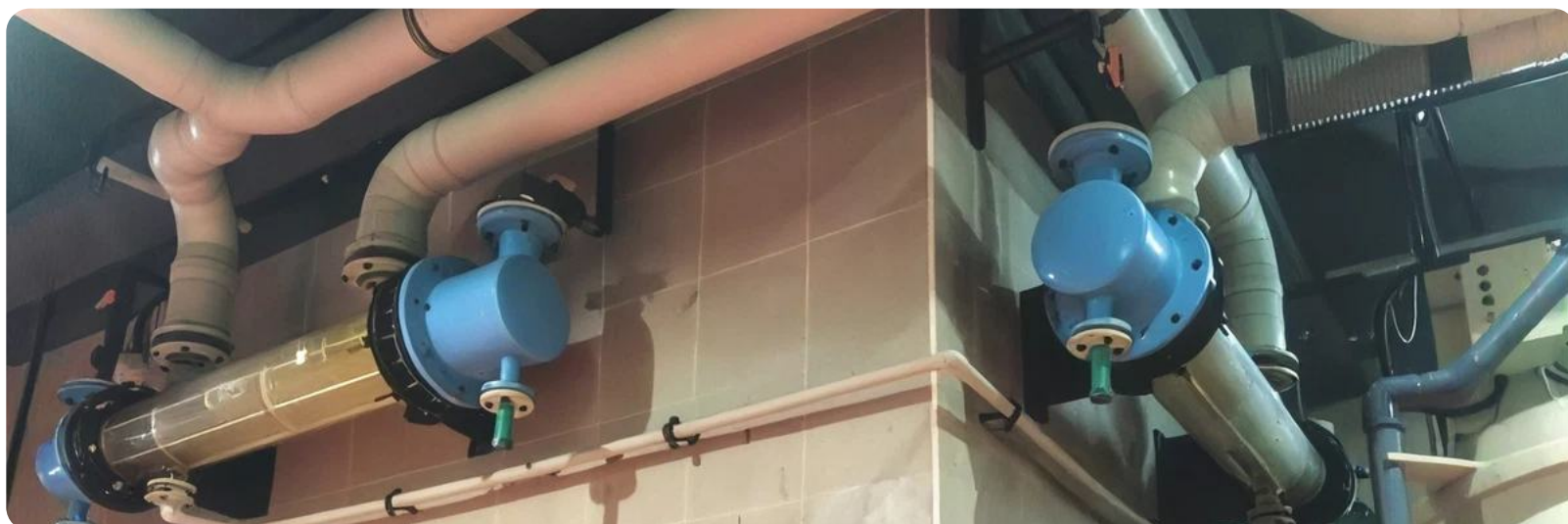
Model	Side	150 DN	225 DN	300 DN
	Shell-Glass	2.0	1.0	1.0
	Tube-Glass	2.0	1.0	1.0
	Dome-Glass			
RGM	Shell-Glass	2.0	1.0	1.0
	Tube-Glass	3.5	3.5	3.5
	Dome-Metal			
RMG	Shell-Metal	3.5	3.5	3.5
	Tube-Glass	2.0	1.0	1.0
	Dome-Glass			

PERFORMANCE & DESIGN DATA

The particular advantage of shell & tube heat exchanger is high heat transfer performance. The relation between heat transfer and velocity of flow can be easily seen in the diagram. On receipt of the operating data from client the most favourable shell and tube heat exchanger is selected. This accurate design combined with most reliable quality assurance ensure economy and operational reliability for the user. For approximate sizing some typical heat transfer coefficients are given here below:

U-VALUES			
Media	Use	kcal/m ² hr k	W/m ² k
Steam – Water	Condensation	350–550	410–640
Water – Water	Cooling	250–350	290–410
Water – Air	Cooling	30–60	35–70



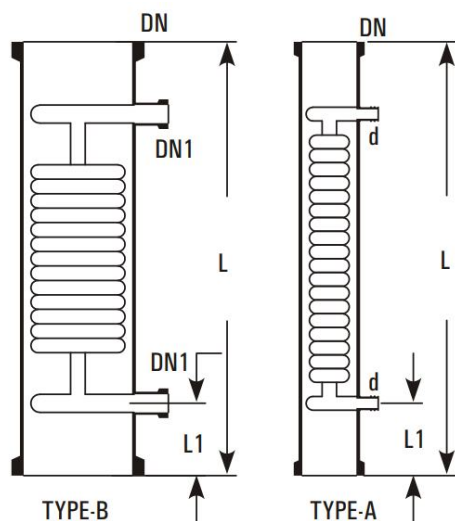


CONDENSERS

These condensers are used to condense vapours from distillation assemblies, reaction vessels, reboilers and other process equipment. The coil-type design provides efficient heat transfer and is available in three basic types: A (straight coil), B (spiral coil), and C (double-coil). The glass construction offers high chemical resistance with excellent visibility. All condensers are constructed using SCHOTT DURAN borosilicate glass with PTFE fittings.

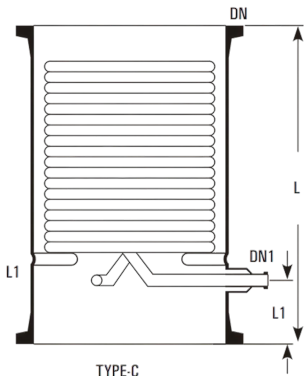
Condensation: 200-270 Kcal/m²·hr, °C approx.

Cooling: 100-150 Kcal/m²·hr, °C approx.



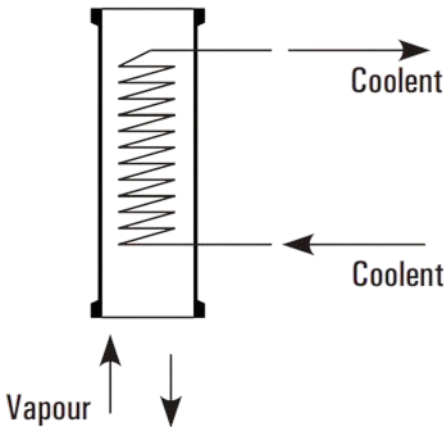
PRECAUTIONS TO BE TAKEN IN USE OF CONDENSERS

- Ensure the coolant flow rate is sufficient before starting vapour feed.
- Avoid sudden temperature shock on glass surface — pre-cool gradually.
- Check all PTFE joints and connections for tightness before pressurizing.
- Do not operate above rated pressure or temperature limits.
- Use only compatible coolants — avoid chlorinated solvents in coolant circuit.
- Support the condenser adequately to avoid mechanical stress on glass.



Cat. Ref.	DN	d / DN1	L	L1	Type	Actual H.T.A. (m ²)	Cross Area (Cm ²)	Free Coolant Rate (Kg/hr.)	Max. Jacket Cap. (Litre)
HE3/3.5*	80	16	600	75	A	0.35	5	1300	2
HE4/5*	100	19	600	75	A	0.50	30	2400	4
HE4/6*	100	19	750	100	A	0.60	30	2400	6
HE6/10	150	25	600	100	B	1.00	52	2600	9
HE6/15*	150	25	850	100	B	1.50	52	2600	11
HE9/25*	225	25	800	110	B	2.50	125	3300	18
HE12/25	300	25	600	125	B	2.50	175	5700	25
HE12/40*	300	25	900	125	B	4.00	175	5700	35
HE16/40	400	25	600	125	B	4.00	450	6200	60
HE16/50	400	25	700	125	B	5.00	450	6200	70
HE18/60	450	40	750	150	C	6.00	820	4800	100
HE18/80	450	40	900	150	C	8.00	820	6200	110
HE24/120	600	50	1250	300	C	12.00	1520	6200	265

METHODS OF USE

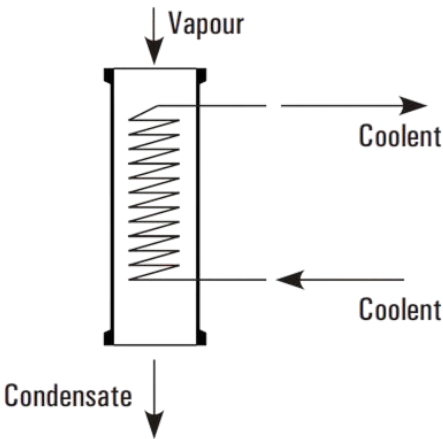


VAPOURS FROM BOTTOM

This method is simple to install over a reactor. However this results in condensate returning substantially at its condensing temperature. In this method care must be taken that condensate is not excessive that it can lead to "logging" the coils and create back pressure in the system.

Generally a reflux divider is used below the condenser to take out the distillate.

VAPOURS FROM TOP — Top Vapour Flow



This method produce a cool condensate using the entire cooling surface area.
This method should be used where the condensate can lead to "logging" of coils.

* marked items are available fast.

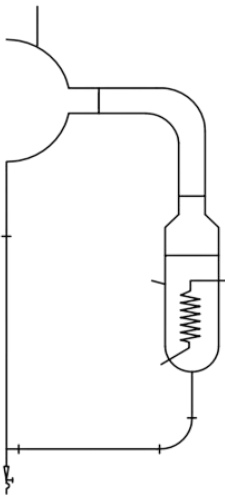
BOILERS

Boilers are used for generating vapour or hot liquid streams within glass process systems. The coil or tube arrangement inside a glass shell provides efficient heat transfer with excellent corrosion resistance. GOEL boilers are available in Type-A (immersion coil) and Type-B (tube bundle) configurations to suit different process duties and heat load requirements.

NOTES ON USE OF BOILERS

- Always establish coolant flow before applying heat source.
- Never operate with dry vessel — maintain minimum liquid level.
- Check all connections before start-up.
- For steam heating use steam trap on condensate return line.
- Avoid thermal shock — preheat gradually.

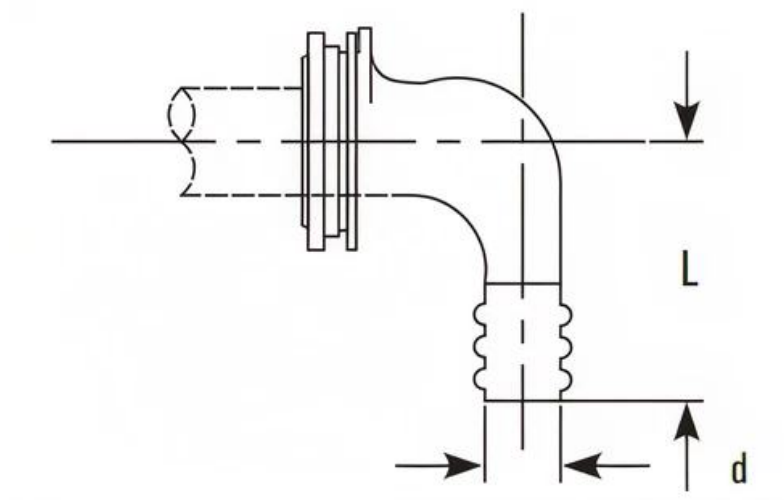
Cat. Ref.	DN	DN1	DN2	L	L1	Type	Actual HTA (m²)	Free Cross Area (cm²)	Jacket Cap (L)
HEB4	100	25	25	375	100	A	0.15	40	2
HEB4/4	100	100	25	400	100	B	0.15	40	3
HEB6	150	40	25	450	100	A	0.35	50	5
HEB6/6	150	150	25	500	100	B	0.35	50	7
HEB9	225	40	25	700	100	A	1.00	150	16
HEB9/9	225	225	25	700	100	B	1.00	180	20
HEB12/12	300	300	25	700	125	B	1.30	330	40



ANGLED HOSE CONNECTOR ASSEMBLIES

Metal / Plastic angled hose connector assemblies are available to connect the flexible hose to the condensers. These are provide with a mating flange, a rubber gasket and nut bolts.

Cat.Ref.	DN	d (mm)	L (mm)
PMC1	25	22	70

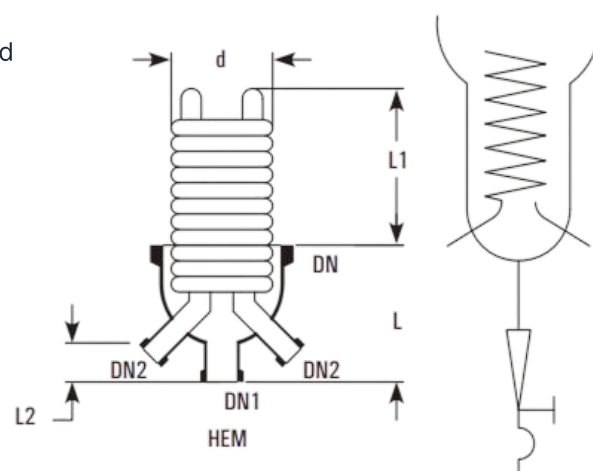


IMMERSIONS

Immersion heat exchangers are designed to be immersed directly into process vessels, tanks or containers for indirect heat transfer. The coil-type construction in borosilicate glass provides excellent chemical resistance while allowing visual inspection of the heat transfer surface. They are particularly suitable for jacketed reactor heating/cooling duties where a separate shell is not required.

Available with single or double coil construction. PTFE end connections are standard. Custom lengths and connection sizes available on request.

Cat.Ref.	DN	DN1	DN2	L	L1	L2	d (mm)	Actual HTA (m ²)
HEM6	150	40	25	200	200	75	145	0.4
HEM9	225	40	25	300	200	75	200	0.16

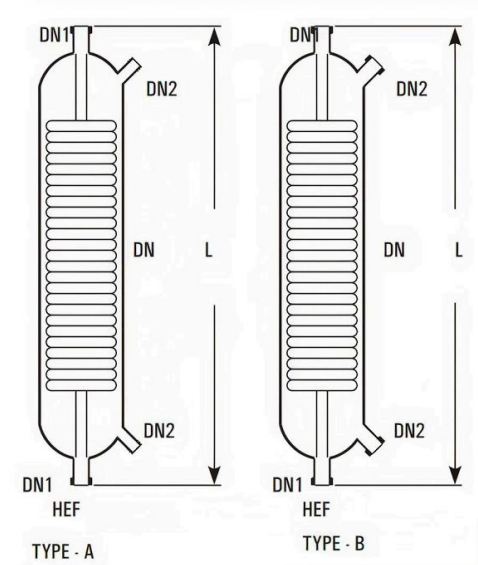


PRODUCT COOLERS

Product coolers are used for cooling of liquids, typically, for the cooling of distillates from the distillation columns.

Unlike coil condensers, in product coolers, product travels through the coil battery and coolant through shell. This provides more resident time to the product to be cooled. For direct connection with distillate lines, all the product coolers are provided with 25 DN connections.

Product Cooler Specification Table

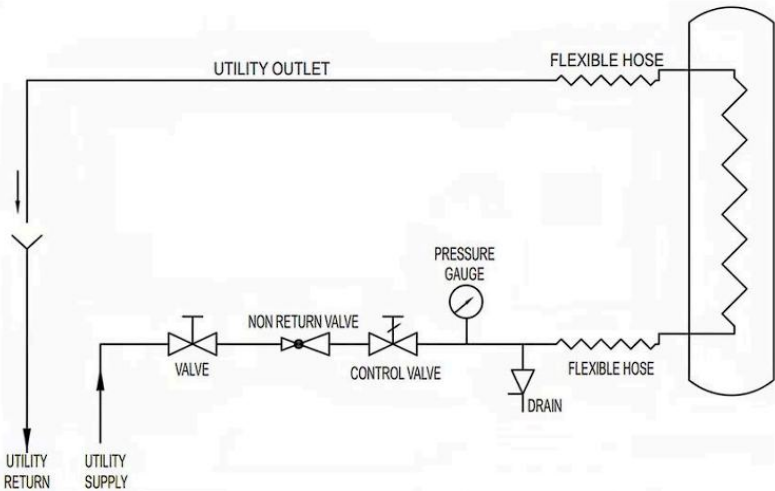


Cat. Ref.	DN	DN1	DN2	L	Actual HTA (m ²)	Type
HEF1/1*	50	25	12	450	0.10	A
HEF1/2*	50	25	12	600	0.20	A
HEF1/3.5*	80	25	16	600	0.35	A
HEF1/5*	100	25	19	600	0.50	A
HEF1/10	150	25	25	600	0.70	B
HEF1/15	150	25	25	850	1.25	B

* marked items are available fast. HTA = Heat Transfer Area

UTILITY CONNECTION FOR CONDENSER

When installing coil type heat exchangers appropriate precautions should be taken. The main points to be taken into account when planning to use these items as coolers are (See also flow chart below).



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