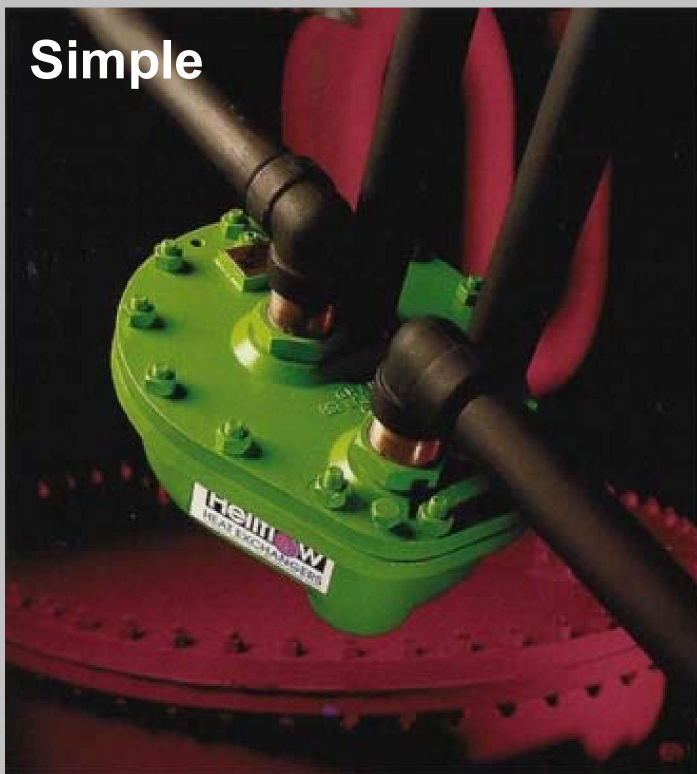
GRAHAM

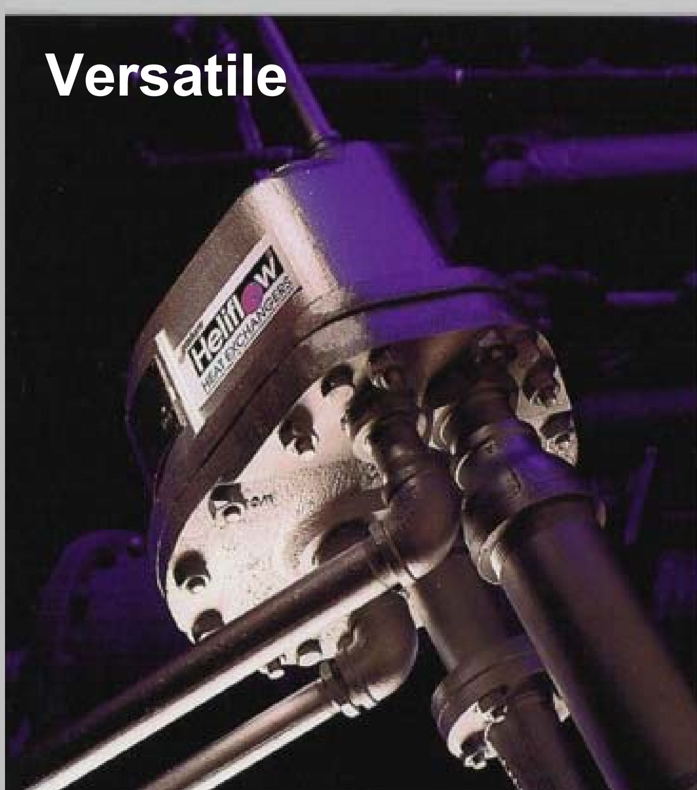
Heliflow®

HEAT EXCHANGERS

The optimum heat exchanger as:

- Vent Condensers
- Reboilers/Vaporizers
- Liquefied Gas Vaporizers
- Process Condensers
- High Pressure Exchangers
- Hydraulic/Lube Oil Coolers
- High Temperature Exchangers
- Cryogenic Exchangers
- Compressor Inter/After Coolers
- Sample Coolers
- Hot Water Heaters





Graham Corporation – a world leader.
Graham Corporation is a leader in heat transfer and vacuum equipment used worldwide in the process, power, marine, and commercial industries.
We offer complete single-source reliability with our in-house research and development, design engineering, manufacturing and testing facilities – plus a worldwide sales force.

We guarantee the performance of our Heliflow Heat Exchangers, Plate Heat Exchangers, MicroMix®II Water Heaters, Steam Surface Condensers, Steam Jet Ejectors, Steam Vacuum Refrigeration, Liquid Ring Vacuum Pumps, Fume Scrubbers, Desuperheaters, and Atmospheric Relief Valves.

We build to the highest quality standards and the world's most exacting codes.

Graham is headquartered in Batavia, New York, has another plant in Great Britain, and associated fabricators worldwide.

GRAHAM
ENGINEERING ANSWERS

Heliflow®

HEAT EXCHANGERS

Exclusive, state-of-the-art design. A unique design that makes HELIFLOW Heat Exchangers exceptionally compact, strong, efficient, reliable, versatile, and able to handle a wide range of flow, pressure and temperature requirements. They have had years of proven service in thousands of applications throughout the world, with high quality performance always guaranteed.

Simplicity. The Heliflow encompasses a spiral coil, comprised of multiple parallel tubes mounted within a casing and baseplate. The case/coil construction creates a spiral flow path for both the fluid inside and outside of the tube coil, providing true counterflow.

An accurate, constant velocity is maintained. Coil spacing between tubes may be varied for an optimal balance of thermal and hydraulic requirements. This provides maximum, more consistent heat transfer efficiency.

COMPACT, LIGHTWEIGHT VERSATILITY: Heliflows function in any position – up, down, sideways, or in between – in a fraction of the space of typical shell and tube exchangers. Mount on columns, nozzles, engines, walls, ceilings, or in-line without additional support. A Heliflow can fit where others can't, with no draining problem.

HIGH EFFICIENCY: True counter- flow and improved heat transfer rates allow heat exchange up to 40% greater than comparable shell and tube designs. Close temperature approach can be maintained even with temperatures crossed. No baffles or sharp turns can interrupt flow velocity. No matter how small the design rate of flow, correct velocity can be designed and maintained.

BROAD CAPABILITIES: The Heliflow Heat Exchanger with its spring-like coils, absorbs mechanical and thermal stresses, minimizing strain on the tube connections. This feature enables the Heliflow to operate in pressure services exceeding 10,000 psig, and temperature gradients of 500 °F between the two fluids.

SIMPLE RELIABILITY: Heliflow's design, simplicity, and strength enhance its performance, reliability and lasting value. It's more trouble-free. Coils can be cleaned or changed easily. There's less maintenance and downtime.

COST SAVINGS: Considerable time and money are saved due to Heliflow's simple, compact, light-weight, versatile, and trouble-free design – and their ease of installation and maintenance.

WIDE CHOICES: Heliflows are readily available in 80 standard models. Heat transfer surfaces can range from 1 to 650 sq. ft.

EASILY CUSTOMIZED: For special, unique or lethal applications, Graham can custom-design Heliflows in a wide range of designs, construction codes and materials, including non-ferrous, stainless steel, titanium, and many high-nickel and specialty alloys.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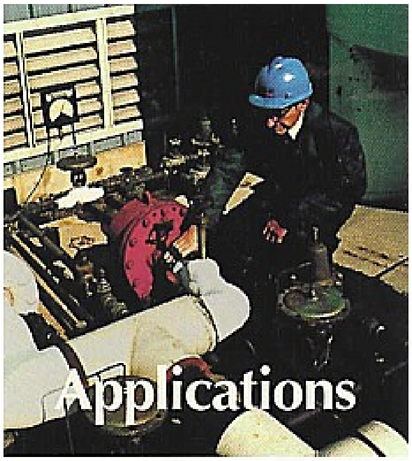


Standard or Customized
Thousands of GRAHAM HELIFLOW Heat Exchangers have been in service for years throughout the world.

High-pressure, high-temperature Heliflow's unique coil design allows it to operate under extremes of both pressure and temperature.
Due to this proven capability, Heliflows are frequently used as:

- Vent Condensers
- Sample Coolers
- Hot Water Heaters
- Reboilers/Vaporizers
- Process Condensers
- Liquefied Gas Vaporizers
- High Pressure Exchangers
- Hydraulic/Lube Oil Coolers
- High Temperature Exchangers
- Cryogenic Exchangers
- Compressor Inter/After Coolers
- Seal Coolers

GRAHAM ENGINEERING ANSWERS

Heliflow®

HEAT EXCHANGERS

Vent Condensers
Heliflow's unique, compact features make it ideal for vent condensing applications. With simple design modifications, it's ideal for:

- internal or external mounting
- condensate return, recovery or
- removal
- solvent recovery
- overcoming environmental concerns

Sample Coolers
Heliflows have long demonstrated their ability to meet the demands of:

- extreme temperature and pressure variations
- low flow, and on/off or continuous operation

Instantaneous Water Heaters
Heliflow's compactness and high efficiency make it an ideal heat exchanger for the GRAHAM Micro-Mix II steam-water heater. High output capacities are achieved using less than 6 sq. ft. of floor space.

Heating and Cooling
Heliflows are well-proven as compact, economical designs ideal for most industrial heat exchanger needs – extensively used for:

- pharmaceuticals, paints, solvents, organics, acids, oils, heat transfer fluids, gases, steam, etc.

Vaporizers
Heliflows have proven to be superior vaporizers – extensively used for vaporization of deionized water, aqueous solutions, ammonia, nitrogen, oxygen, liquefied gases, and solvents – using steam, water, solvents, glycols and heat transfer fluids as the heating medium.

Cryogenic Coolers
The Heliflow's ability to absorb thermal stresses proves ideal in low-temperature operation. Heliflows can utilize the vaporization of liquefied gases, refrigerants or other cryogenic fluids of sub-zero cooling of process fluids, solvent recovery, vent gas condensation, and other low-temperature industrial cooling operations.

Interchangers
The Heliflow's spiral coil design provides for temperature extremes. Heat recovery efficiencies are maximized and many process applications – including oil reprocessing, heat transfer fluid systems, and others – where extremes of temperature are frequently encountered.

Pure/Deionized Steam Generators
Heliflows can use boiler steam to produce pure, uncontaminated water vapor for humidification systems and other processes requiring chemically pure steam.

Process Condensers
The Heliflow's reverse and through manifold design provides a condenser of multiple orientation, utilization, compactness, and an ideal condensing surface for:

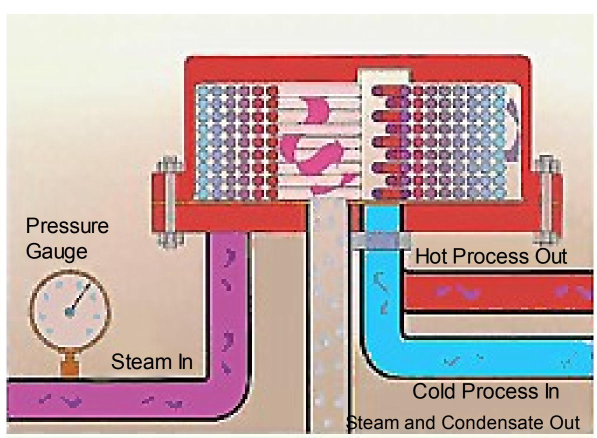
- reflux condensing, solvent recovery condensation and separation of
- condensibles from noncondensibles

Pump Seal Coolers
Mechanical seals used on medium- and high-temperature pumps require that the seal fluid be cooled to ensure proper seal operation. Heliflows provide this cooling – efficiently, economically, and in less space.

HELIFLOW OPERATION

The simple logic of heat transfer.

The unique spiral coil design provides a constant flow pattern with uninterrupted velocity throughout the entire flow path around and through each tube. This assures maximum heat transfer efficiencies.



Bare Tube Heliflow

For heat transfer from one fluid to another. Unique design includes a spiral coil (in commercially available tube materials from ¼" to ¾" diameter) mounted within a casing and baseplate. Components are oriented so the casing/coil configuration creates a spiral flow path for the fluid outside the coil, which flows counter to the fluid inside the coil. There are no inactive areas. With the spiral coil design, dead spaces do not exist and an accurate, constant velocity is maintained throughout the path of flow through and around each coil. The coil spacing between the tubes can be varied to provide specific fluid velocities for the fluid outside the coil, optimizing heat transfer and pressure drop. An outstanding feature is the inherent strength of the manifold design. With the elimination of the typical tube sheet and bonnet construction, the Heliflow heat exchanger economically provides for extremes of pressure and temperature.

Custom Heliflows

Guaranteed to meet specifications for any unique, special or lethal applications. Our wide range of standard Heliflows are available in most commercial tube materials to satisfy 90 percent of industry's pressures to 7,500 psig. Special design can accommodate design pressure to at least 10,000 psig. Multi-pass tube side, reverse and through manifolds, special fittings, pipe connections and other special arrangements are available.

Vented Double-Wall Heliflows

Ideal for detection and prevention of cross contamination. This vented, double-wall and double-manifold "tube-in-a-tube" design has a vented pathway between the hot and cold fluids. High thermal efficiency is maintained while providing protection and detection against cross contamination. Ideal where process purity is mandatory and when required by state and local regulations for the protection of domestic and potable waters.

Static Mixer Heliflows

For high-viscosity fluids, the Heliflow's efficiency is enhanced by use of static mixers. Elements in each tube increase fluid mixing and maximize heat transfer, thereby reducing the required surface area.

Polished Tube Heliflows

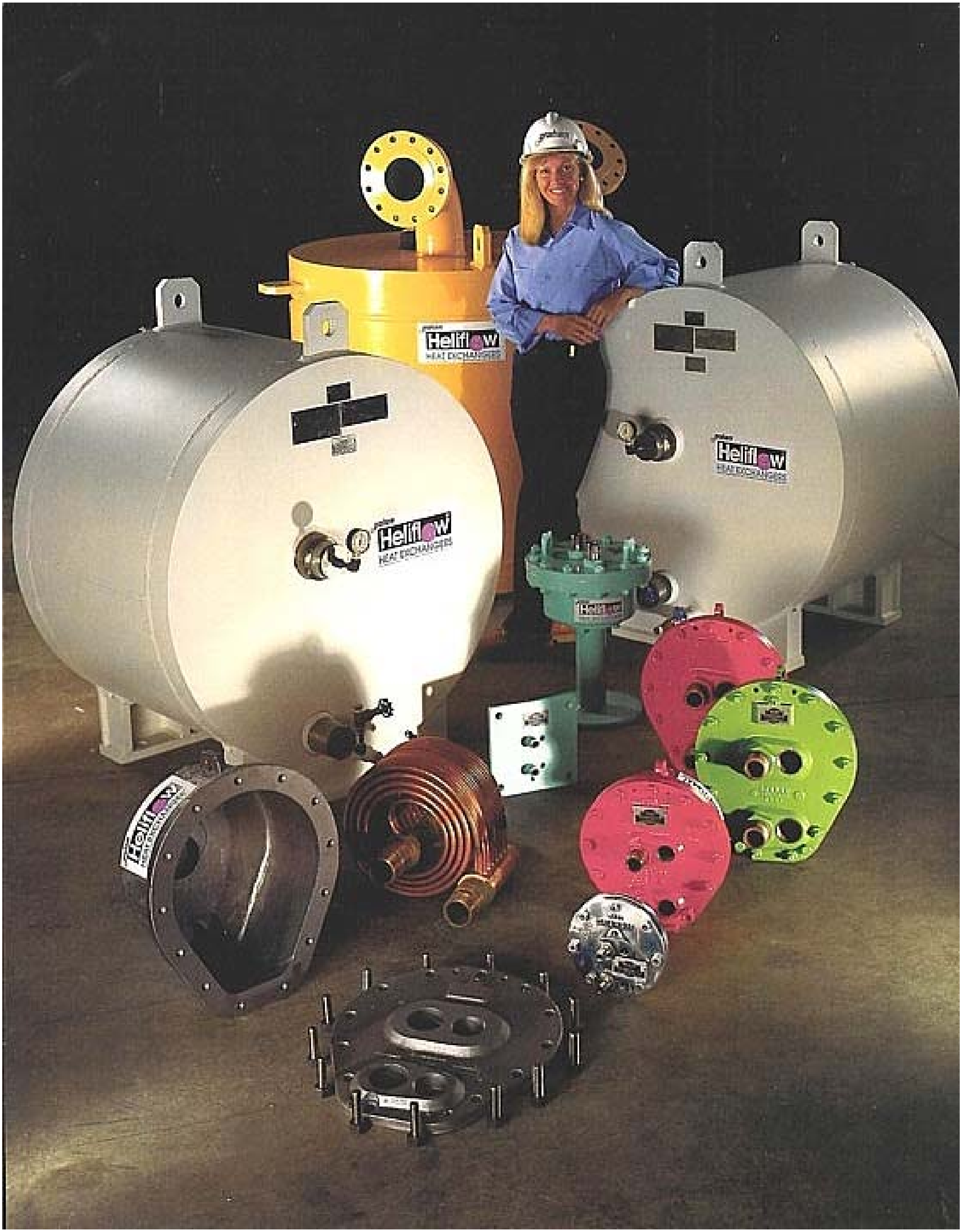
All internal surfaces are highly polished. This makes it an ideal exchanger for applications requiring clean heat transfer – pharmaceutical, computer/electronics, deionized water and other clean operations.

Replacements and Shipments

No Graham product ever becomes an orphan. Replacement parts and assistance are always available. Anywhere. Parts and complete standard units are available off-the-shelf. And a stock of finished and semi-finished parts for special sizes are always available. Prompt shipment is assured. And we airfreight to any part of the world when necessary.

More Information

A Heliflow Operation & Maintenance Manual is available on request. It contains detailed instructions on how to best install, operate, and maintain Heliflows for optimum and lasting heat transfer. It also includes tips to speed up disassembly and re-assembly. For a free copy, see your Graham representative or contact Graham Corporation.


Heliflow
HEAT EXCHANGERS

HELIFLOW CONSTRUCTION

Simple reliability

1. **Base Plate Nuts** secure the single flanged joint. ***Typical shell and tube units have four such joints.***
2. **Heavy-duty Manifold Holding Nuts** and locking rings tightly secure both manifolds to hold the coil assembly to the base plate.
3. **Gaskets** insure tightly sealed joint between manifold and base plate.
4. **Upper and Lower Manifold** precision-made for rigid, heavy-duty performance.
5. **Coil Manifold Assembly** precision-built to assure high heat transfer efficiency, 100% effective counterflow, and more trouble-free performance.
6. **Single-piece Gasket** available in any material that best meets operating conditions.
7. **Heavy-Duty Casing Studs** for high-pressure reliability.
8. **One-Piece Casing** can be removed for easy cleaning without breaking any pipe connections.
9. **Threaded Vent and Drain Plugs** designed and located for easy use and access.
10. **Support Bracket** can be placed in several positions for convenience.

MAINTENANCE & SERVICE

Reliable simplicity

Cleaning a Heliflow is as simple as its construction. No special tools or fixtures are required. It takes only 1/4th the time, and there is little or no risk of damage compared to cleaning requirements for straight-tube exchangers. Operation is based on the premise that the fluid circulating in the casing will have fouling tendencies, while the fluid circulating inside the coils is cleaner. If the fluid inside the coils eventually fouls, and chemical cleaning cannot be used, replacing coils is fast and easy. The outside of the coils can be inspected and cleaned easily by removing the casing.

To disassemble, follow these steps:

A. **Disconnect all pipes.**
B. **Remove all base plate nuts.**
C. **Separate the case from the base, being careful not to damage the casing gasket.**
D. **Remove manifold holding nuts. Remove the integral manifolds and coil assembly from the base plate.**
E. **When re-assembling, remember the spark plug type gaskets between the manifold collars and the base plate … and the lock rings between the manifold nuts and base plate. These locking nuts prevent manifolds from turning when pulling up gaskets and re-piping.**

Heliflow®

HEAT EXCHANGERS

Graham designed, manufactured, tested and guaranteed.

A Real Graham Advantage.

Process vacuum condensers

Vacuum refrigeration systems

Heliflow® heat exchangers

Building engineered solutions

Vacuum pump packaged systems

Vacuum ejectors systems

MicroMix® II instantaneous steam water heaters

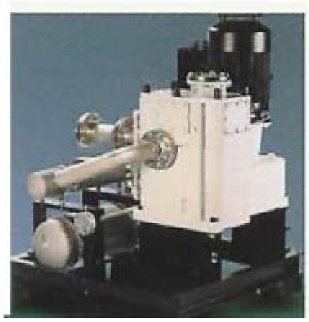
for the process, power, pharmaceutical and

Liquid ring vacuum pumps

Plate heat exchangers

Steam surface condensers

commercial industries, worldwide.



Dry vacuum pumps

Graham VacWorks II^{tm} Design Program.
A CD-ROM loaded with comprehensive vacuum system design software and technical support information.
Providing many engineered solutions for your vacuum system needs.

GRAHAM
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ONE SOURCE –
DESIGNED, BUILT AND TESTED.

Graham Corporation
20 Florence Ave., Batavia, NY 14020 USA
Phone: 585-343-2216
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Heliflow®

HEAT EXCHANGERS

HOW TO RATE HELIFLOW FOR LIQUID TO LIQUID SERVICE

This example will be worked out to illustrate use of the data on the following pages:

Cool 20 gpm of 100% Ethylene Glycol from 200°F. to 175°F. with 20 gpm of 70°F. water

First, determine the properties of the fluid.

100% Ethylene Glycol's thermal conductivity is 0.137, specific heat .64, specific gravity, 1.064

Now calculate the duty.

Q = (gpm) (500) (sp. gr.) (sp. ht.) (temp. diff.)
Q = (20) (500) (1.064) (.64) (200 - 175) = 170,240 btu/hr

Next, calculate water temperature rise.

$$\frac{170{,}240}{(20)(500)(1)(1)} = 17.0°$$ Water outlet temperature will be 87.0°F.

Now calculate LMTD =

$$\frac{\text{(Greater temp. diff.)} - \text{(Lesser temp. diff.)}}{\text{Log}\,\dfrac{\text{(Greater temp. diff.)}}{\text{(Lesser temp. diff.)}}}$$

$$\text{LMTD} = \frac{(200 - 87.0) - (175 - 70)}{\text{Log}\,\dfrac{(200 - 87.0)}{(175 - 70)}} = 108.9$$

It is now necessary to assume a heat transfer rate and calculate an approximate heat transfer surface requirement. Since 100% Ethylene Glycol's thermal conductivity is about 0.4 times that of water. U will be assumed as (0.4) (500) = 200. An overall heat transfer rate for water to water service is assumed to be 500.

$$\text{Heat transfer surface} = \frac{Q}{(\text{LMTD})(U)} = \frac{170{,}240}{(108.9)(200)} = 7.8\ \text{ft}^2$$

From the pages 2 and 3, select the Heliflow with the next-largest heat transfer surface: 9-14S, with 9.6 ft² heat transfer surface.

To check this selection, read across the table opposite 9-14S and find that at 20 gpm with 18 BWG tubes, tube velocity is 5.63 ft. sec.

Next, determine the fluid viscosity at film temperature. Film temperature is the average temperature plus one-half LMTD for heating, or minus one-half LMTD for cooling.

$$\text{Film temperature} = \frac{200 + 175}{2} - \frac{108.9}{2} = 133°\text{F.}$$

*From the flow chart (**A.**) page 4,* 100% Ethylene Glycol at 133°F. has a viscosity of 5.6 centistokes. From 5.63 ft/sec velocity and 5.6 centistokes the tube side film rate is 510. This must be corrected for specific heat, thermal conductivity, and tube diameter. In this case, with ½ inch. tubes, the diameter correction factor is 1.0. From chart (**D.**), and (**E.**) page 5, for a specific heat of 0.64 the correction is 0.86 for thermal conductivity of 0.137 the correction is .54.

Corrected tube side rate = (510) (.86) (.54) = 237

The preceding steps are now repeated for the shell side of the unit. From the tables opposite 9-14S, at 20 gpm shell velocity is 6.09 ft/sec. Film temperature is 133°F. From flow chart (**B.**) page 4, at 6.09 ft/sec and 133°F. film rate is 1500. Water rates do not have to be corrected. With the ½ inch tubes of the 9-14S, shell side factor is 1.0.

Now U can be calculated: $\frac{237\ (1500)}{237 + 1500} = 205$ btu/hr

This is the clean transfer rate. A design factor of 85% of the clean rate is used unless the fouling properties of the fluids indicate a lower value. For highly-fouling materials a factor as low as 50% would be used.

Design heat transfer rate =
(0.85) (205) = 174 btu/hr % ft²

The required heat transfer:

$$\frac{170{,}240}{(108.9)(174)} = 8.93\ \text{ft}^2.$$

Thus, the 9-14S provides adequate surface.

Next, pressure drops must be checked. The maximum allowable drop is usually specified. If not, a maximum of 10 to 15 psi is assumed.

From flow chart (**C.**) pages 4 and 5, Curve II, the pressure drop for water at 20 gpm in a 9-14S is 3.0 psi. From flow chart (**F.**) at 5.63 ft/sec and 5.6 centistokes, 100% Ethylene Glycol's pressure drop will be 1.70 times the water pressure drop of 5.1 psi. The shell side pressure drop is read from flow chart (**C.**), Curve II as 3.0 psi.

If a higher pressure drop is acceptable, a smaller unit could be considered, and checked. It would have higher velocities and transfer rates, but also higher pressure drops.

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HEAT EXCHANGERS

ENGINEERING DATA, Sizes 3-10 to 45-20LL

Size	Number of Coils	Surface Sq. Feet	Tube Diam. Inches	Coil Spacing Inches	Coil Length Feet	Free Shell Area Sq. Inches
3-10	3	1.06	½	3/32	2.71	.302
4-10	4	1.44	⅜	⅛	3.67	.309
8-10	8	2.56	¼	⅛	4.92	.358
4-12	4	2.75	½	⅛	5.25	.466
6-12	6	4.13	½	⅛	5.25	.699
8-12	8	4.40	⅜	⅛	5.51	.618
12-12	12	6.31	¼	⅛	8.11	.537
9-14S	9	9.63	½	⅛	8.16	1.04
12-14S	12	11.6	⅜	⅛	9.90	.93
18-14S	18	11.5	¼	3/16	9.77	1.08
12-14L	12	13.0	⅝	⅛	6.6	1.94
15-14L	15	16.0	½	⅛	8.16	1.75
20-14L	20	19.4	⅜	⅛	9.90	1.55
30-14L	30	19.2	¼	3/16	9.77	1.8
30-14LL	30	32.08	½	⅛	8.16	3.50
9-16S	9	12.7	½	⅛	10.88	1.04
12-16S	12	17.4	⅜	⅛	14.79	.93
18-16S	18	17.66	¼	3/16	15.06	1.08
10-16L	10	15.9	¾	3/16	8.12	2.62
12-16L	12	16.6	⅝	3/16	8.46	2.42
15-16L	15	20.9	½	3/16	10.62	2.23
20-16L	20	21.5	⅜	¼	10.98	2.48
30-16L	30	29.5	¼	3/16	15.06	1.80
30-16LL	30	41.72	½	3/16	8.46	4.45
10-18S	10	19.4	¾	¼	9.92	3.09
12-18S	12	24.0	⅝	¼	12.20	2.88
15-18S	15	24.5	½	¼	12.4	2.68
20-18S	20	25.2	⅜	5/16	12.87	2.95
20-18L	20	39.2	¾	¼	9.87	6.16
24-18L	24	48.0	⅝	¼	12.20	5.76
30-18L	30	48.9	½	¼	12.38	5.37
45-18LL	45	73.02	½	¼	12.38	8.03
10-20S	10	27.0	¾	¼	13.78	3.09
12-20S	12	31.3	⅝	¼	15.93	2.88
15-20S	15	31.9	½	¼	16.25	2.68
20-20S	20	32.2	⅜	5/16	16.42	2.95
20-20L	20	54.0	¾	¼	13.78	6.16
24-20L	24	62.6	⅝	¼	15.93	5.76
30-20L	30	63.8	½	¼	16.25	5.37
45-20LL	45	95.72	½	¼	16.25	8.03

Size	Shell Equiv. Flow Length Feet	Con-nections Casing Coil	GPM at Velocity of 10 FPS		
			Casing	Coil - BWG 16	18
3-10	3.0	½	9.4	10.0	11.9
4-10	5.35	½	9.6	5.9	7.5
8-10	5.7	½	11.1	2.8	4.5
4-12	6.5	1 1¼	14.5	13.4	15.8
6-12	6.5	1 1¼	21.8	20.1	23.7
8-12	7.9	1 1¼	19.3	11.7	15.0
12-12	9.4	1 1¼	16.8	4.3	6.8
9-14S	9.75	1¼	32.8	30.1	35.5
12-14S	11.5	1¼	29.0	17.6	22.5
18-14S	11.5	1¼	33.8	6.4	10.2
12-14L	8.25	1¼	61.0	72.1	82.0
15-14L	9.75	1¼	56.4	50.2	59.3
20-14L	11.5	1¼	48.3	29.3	37.4
30-14L	11.5	1¼	56.9	10.7	17.0
30-14LL	9.75	1¼	109.0	100.0	118.0
9-16S	13.0	2	32.8	30.1	35.5
12-16S	15.5	2	29.0	17.6	22.5
18-16S	17.5	2	33.8	6.4	10.2
10-16L	9.7	2	81.5	94.3	104.0
12-16L	11.6	2	75.5	72.1	82.0
15-16L	12.75	2	69.5	50.2	59.3
20-16L	13.1	2	77.4	29.3	37.4
30-16L	17.3	2	56.9	10.7	17.0
30-16LL	11.6	2	139.0	100.0	118.0
10-18S	12.3	2½	96.3	94.3	104.0
12-18S	14.5	2½	89.7	72.1	82.0
15-18S	14.9	2½	83.5	50.2	59.3
20-18S	15.5	2½	92.0	29.3	37.4
20-18L	12.3	2½	193.0	188.0	208.0
24-18L	14.5	2½	180.0	145.0	163.0
30-18L	14.9	2½	168.0	101.0	119.0
45-18LL	14.9	2½	250.0	150.0	178.0
10-20S	17.1	2½	96.3	94.3	104.0
12-20S	18.95	2½	89.7	72.1	82.0
15-20S	19.5	2½	83.5	50.2	59.3
20-20S	16.6	2½	92.0	29.3	37.4
20-20L	17.1	2½	193.0	188.0	208.0
24-20L	18.95	2½	180.0	145.0	163.0
30-20L	19.5	2½	168.0	101.0	119.0
45-20LL	19.5	2½	250.0	150.0	178.0

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HEAT EXCHANGERS

ENGINEERING DATA, Sizes 10-22S to 45-34LLL

Size	Number of Coils	Surface Sq. Feet	Tube Diam. Inches	Coil Spacing Inches	Coil Length Feet	Free Shell Area Sq. Inches
10-22S	10	29.8	¾	5/16	15.20	3.59
12-22S	12	35.5	⅝	5/16	18.13	3.35
15-22S	15	37.5	½	5/16	19.25	3.16
20-22L	20	59.6	¾	5/16	15.20	7.10
24-22L	24	70.3	⅝	5/16	18.13	6.68
30-22L	30	75.0	½	5/16	19.14	6.30
45-22LL	45	112.6	½	5/16	19.14	9.43
10-24S	10	40.3	¾	5/16	20.61	3.59
12-24S	12	46.8	⅝	5/16	23.87	3.35
15-24S	15	54.0	½	5/16	27.50	3.16
20-24L	20	80.6	¾	5/16	20.61	7.10
24-24L	24	93.6	⅝	5/16	23.87	6.68
30-24L	30	108.0	½	5/16	27.50	6.30
36-24LL	36	140.6	⅝	5/16	23.87	10.05
10-26S	10	50.76	¾	5/16	25.81	3.59
12-26S	12	57.66	⅝	5/16	29.36	3.35
15-26S	15	66.07	½	5/16	33.41	3.16
20-26L	20	101.52	¾	5/16	25.81	7.10
24-26L	24	115.32	⅝	5/16	29.36	6.68
30-26L	30	132.15	½	5/16	33.41	6.30
36-26LL	36	166.5	⅝	5/16	29.36	10.05
10-28S	10	66.29	¾	5/16	33.75	3.59
12-28S	12	74.95	⅝	5/16	38.05	3.35
15-28S	15	84.87	½	5/16	43.20	3.16
20-28L	20	132.58	¾	5/16	33.75	7.10
24-28L	24	149.9	⅝	5/16	38.05	6.68
30-28L	30	169.74	½	5/16	43.20	6.30
30-28LL	30	198.9	¾	5/16	33.75	10.62
45-28LLL	45	298.2	¾	5/16	33.75	15.9
10-30S	10	79.0	¾	5/16	40.30	3.54
20-30L	20	158.0	¾	5/16	40.30	7.08
30-30LL	30	237.0	¾	5/16	40.30	10.62
45-30LLL	45	355.9	¾	5/16	40.3	15.9
10-32S	10	94.0	¾	5/16	47.72	3.54
20-32L	20	188.0	¾	5/16	47.72	7.08
30-32LL	30	282.0	¾	5/16	47.72	10.62
45-32LLL	45	423.0	¾	5/16	47.72	15.9
10-34S	10	109.0	¾	5/16	55.58	3.54
20-34L	20	218.0	¾	5/16	55.58	7.08
30-34LL	30	327.0	¾	5/16	55.58	10.62
45-34LLL	45	490.5	¾	5/16	55.58	15.9

Size	Shell Equiv. Flow Length Feet	Con-nections Casing Coil	GPM at Velocity of 10 FPS		
			Casing	Coil-BWG 16	18
10-22S	18.25	2½	112.0	94.3	104.0
12-22S	21.2	2½	104.0	72.1	82.0
15-22S	22.2	2½	98.5	50.2	59.3
20-22L	18.25	2½	222.0	188.0	208.0
24-22L	21.2	2½	209.0	145.0	163.0
30-22L	22.2	2½	196.0	101.0	119.0
45-22LL	22.2	2½	294.0	150.0	178.0
10-24S	24.0	2½	112.0	94.3	104.0
12-24S	27.25	2½	104.0	72.1	82.0
15-24S	30.8	2½	98.5	50.2	59.3
20-24L	24.0	2½	222.0	188.0	208.0
24-24L	27.25	2½	209.0	145.0	163.0
30-24L	30.8	2½	196.0	101.0	119.0
36-24LL	27.25	2½	314.0	215.0	244.0
10-26S	29.5	2½	112.0	94.3	104.0
12-26S	33.4	2½	104.0	72.1	82.0
15-26S	37.2	2½	98.5	50.2	59.3
20-26L	29.5	2½	222.0	188.0	208.0
24-26L	33.4	2½	209.0	145.0	163.0
30-26L	37.2	2½	196.0	101.0	119.0
36-26LL	33.4	2½	314.0	215.0	244.0
10-28S	38.0	3	112.0	94.3	104.0
12-28S	42.1	3	104.0	72.1	82.0
15-28S	47.9	3	98.5	50.2	59.3
20-28L	38.0	3	222.0	188.0	208.0
24-28L	42.1	3	209.0	145.0	163.0
30-28L	47.9	3	196.0	101.0	119.0
30-28LL	38.0	3	332.0	282.0	312.0
45-28LLL	38.0	3	498.0	424.0	470.0
10-30S	45.3	3	112.0	94.3	104.0
20-30L	45.3	3	222.0	188.0	208.0
30-30LL	45.3	3	332.0	282.0	312.0
45-30LLL	45.3	3	498.0	424.0	470.0
10-32S	53.4	3	112.0	94.3	104.0
20-32L	53.4	3	222.0	188.0	208.0
30-32LL	53.4	3	332.0	282.0	312.0
45-32LL	53.4	3	498.0	424.0	470.0
10-34S	62.2	3	112.0	94.3	104.0
20-34S	62.2	3	222.0	188.0	208.0
30-34LL	62.2	3	332.0	282.0	312.0
45-34LLL	62.2	3	498.0	424.0	470.0

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ENGINEERING DATA, Sizes 3-10 to 45-20LL

Size	Number of Coils	Surface Sq. Feet	Tube Diam. Inches	Coil Spacing Inches	Coil Length Feet	Free Shell Area Sq. Inches
3-10	3	1.06	½	3/32	2.71	.302
4-10	4	1.44	⅜	⅛	3.67	.309
8-10	8	2.56	¼	⅛	4.92	.358
4-12	4	2.75	½	⅛	5.25	.466
6-12	6	4.13	½	⅛	5.25	.699
8-12	8	4.40	⅜	⅛	5.51	.618
12-12	12	6.31	¼	⅛	8.11	.537
9-14S	9	9.63	½	⅛	8.16	1.04
12-14S	12	11.6	⅜	⅛	9.90	.93
18-14S	18	11.5	¼	3/16	9.77	1.08
12-14L	12	13.0	⅝	⅛	6.6	1.94
15-14L	15	16.0	½	⅛	8.16	1.75
20-14L	20	19.4	⅜	⅛	9.90	1.55
30-14L	30	19.2	¼	3/16	9.77	1.8
30-14LL	30	32.08	½	⅛	8.16	3.50
9-16S	9	12.7	½	⅛	10.88	1.04
12-16S	12	17.4	⅜	⅛	14.79	.93
18-16S	18	17.66	¼	3/16	15.06	1.08
10-16L	10	15.9	¾	3/16	8.12	2.62
12-16L	12	16.6	⅝	3/16	8.46	2.42
15-16L	15	20.9	½	3/16	10.62	2.23
20-16L	20	21.5	⅜	¼	10.98	2.48
30-16L	30	29.5	¼	3/16	15.06	1.80
30-16LL	30	41.72	½	3/16	8.46	4.45
10-18S	10	19.4	¾	¼	9.92	3.09
12-18S	12	24.0	⅝	¼	12.20	2.88
15-18S	15	24.5	½	¼	12.4	2.68
20-18S	20	25.2	⅜	5/16	12.87	2.95
20-18L	20	39.2	¾	¼	9.87	6.16
24-18L	24	48.0	⅝	¼	12.20	5.76
30-18L	30	48.9	½	¼	12.38	5.37
45-18LL	45	73.02	½	¼	12.38	8.03
10-20S	10	27.0	¾	¼	13.78	3.09
12-20S	12	31.3	⅝	¼	15.93	2.88
15-20S	15	31.9	½	¼	16.25	2.68
20-20S	20	32.2	⅜	5/16	16.42	2.95
20-20L	20	54.0	¾	¼	13.78	6.16
24-20L	24	62.6	⅝	¼	15.93	5.76
30-20L	30	63.8	½	¼	16.25	5.37
45-20LL	45	95.72	½	¼	16.25	8.03

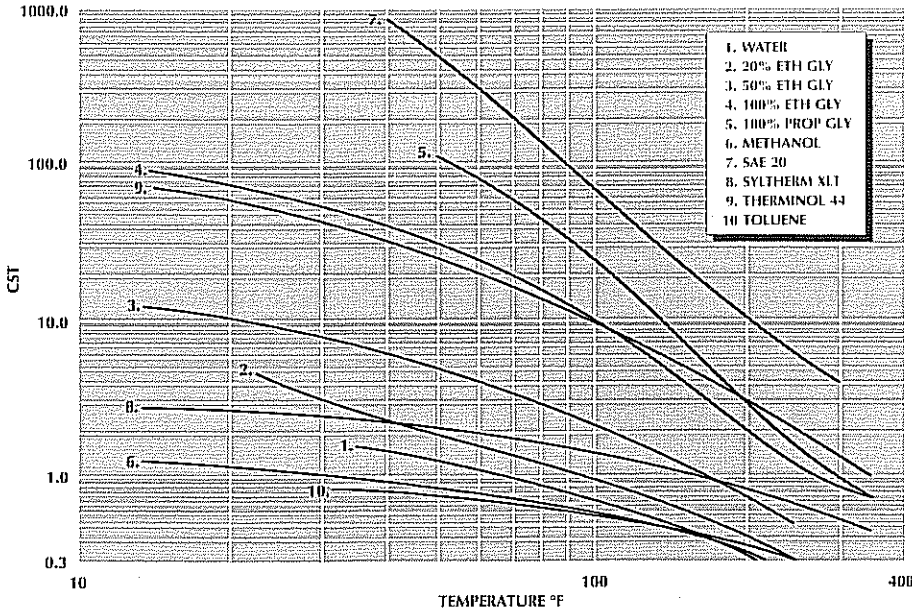
Size	Shell Equiv. Flow Length Feet	Connections Casing Coil	GPM at Velocity of 10 FPS		
				Coil - BWG	
			Casing	16	18
3-10	3.0	½	9.4	10.0	11.9
4-10	5.35	½	9.6	5.9	7.5
8-10	5.7	½	11.1	2.8	4.5
4-12	6.5	1 1¼	14.5	13.4	15.8
6-12	6.5	1 1¼	21.8	20.1	23.7
8-12	7.9	1 1¼	19.3	11.7	15.0
12-12	9.4	1 1¼	16.8	4.3	6.8
9-14S	9.75	1¼	32.8	30.1	35.5
12-14S	11.5	1¼	29.0	17.6	22.5
18-14S	11.5	1¼	33.8	6.4	10.2
12-14L	8.25	1¼	61.0	72.1	82.0
15-14L	9.75	1¼	56.4	50.2	59.3
20-14L	11.5	1¼	48.3	29.3	37.4
30-14L	11.5	1¼	56.9	10.7	17.0
30-14LL	9.75	1¼	109.0	100.0	118.0
9-16S	13.0	2	32.8	30.1	35.5
12-16S	15.5	2	29.0	17.6	22.5
18-16S	17.5	2	33.8	6.4	10.2
10-16L	9.7	2	81.5	94.3	104.0
12-16L	11.6	2	75.5	72.1	82.0
15-16L	12.75	2	69.5	50.2	59.3
20-16L	13.1	2	77.4	29.3	37.4
30-16L	17.3	2	56.9	10.7	17.0
30-16LL	11.6	2	139.0	100.0	118.0
10-18S	12.3	2½	96.3	94.3	104.0
12-18S	14.5	2½	89.7	72.1	82.0
15-18S	14.9	2½	83.5	50.2	59.3
20-18S	15.5	2½	92.0	29.3	37.4
20-18L	12.3	2½	193.0	188.0	208.0
24-18L	14.5	2½	180.0	145.0	163.0
30-18L	14.9	2½	168.0	101.0	119.0
45-18LL	14.9	2½	250.0	150.0	178.0
10-20S	17.1	2½	96.3	94.3	104.0
12-20S	18.95	2½	89.7	72.1	82.0
15-20S	19.5	2½	83.5	50.2	59.3
20-20S	16.6	2½	92.0	29.3	37.4
20-20L	17.1	2½	193.0	188.0	208.0
24-20L	18.95	2½	180.0	145.0	163.0
30-20L	19.5	2½	168.0	101.0	119.0
45-20LL	19.5	2½	250.0	150.0	178.0

ENGINEERING DATE, Sizes 10-22S to 45-34LLL

Size	Number of Coils	Surface Sq. Feet	Tube Diam. Inches	Coil Spacing Inches	Coil Length Feet	Free Shell Area Sq. Inches
10-22S	10	29.8	¾	5/16	15.20	3.59
12-22S	12	35.5	⅝	5/16	18.13	3.35
15-22S	15	37.5	½	5/16	19.25	3.16
20-22L	20	59.6	¾	5/16	15.20	7.10
24-22L	24	70.3	⅝	5/16	18.13	6.68
30-22L	30	75.0	½	5/16	19.14	6.30
45-22LL	45	112.6	½	5/16	19.14	9.43
10-24S	10	40.3	¾	5/16	20.61	3.59
12-24S	12	46.8	⅝	5/16	23.87	3.35
15-24S	15	54.0	½	5/16	27.50	3.16
20-24L	20	80.6	¾	5/16	20.61	7.10
24-24L	24	93.6	⅝	5/16	23.87	6.68
30-24L	30	108.0	½	5/16	27.50	6.30
36-24LL	36	140.6	⅝	5/16	23.87	10.05
10-26S	10	50.76	¾	5/16	25.81	3.59
12-26S	12	57.66	⅝	5/16	29.36	3.35
15-26S	15	66.07	½	5/16	33.41	3.16
20-26L	20	101.52	¾	5/16	25.81	7.10
24-26L	24	115.32	⅝	5/16	29.36	6.68
30-26L	30	132.15	½	5/16	33.41	6.30
36-26LL	36	166.5	⅝	5/16	29.36	10.05
10-28S	10	66.29	¾	5/16	33.75	3.59
12-28S	12	74.95	⅝	5/16	38.05	3.35
15-28S	15	84.87	½	5/16	43.20	3.16
20-28L	20	132.58	¾	5/16	33.75	7.10
24-28L	24	149.9	⅝	5/16	38.05	6.68
30-28L	30	169.74	½	5/16	43.20	6.30
30-28LL	30	198.9	¾	5/16	33.75	10.62
45-28LLL	45	298.2	¾	5/16	33.75	15.9
10-30S	10	79.0	¾	5/16	40.30	3.54
20-30L	20	158.0	¾	5/16	40.30	7.08
30-30LL	30	237.0	¾	5/16	40.30	10.62
45-30LLL	45	355.9	¾	5/16	40.3	15.9
10-32S	10	94.0	¾	5/16	47.72	3.54
20-32L	20	188.0	¾	5/16	47.72	7.08
30-32LL	30	282.0	¾	5/16	47.72	10.62
45-32LLL	45	423.0	¾	5/16	47.72	15.9
10-34S	10	109.0	¾	5/16	55.58	3.54
20-34L	20	218.0	¾	5/16	55.58	7.08
30-34LL	30	327.0	¾	5/16	55.58	10.62
45-34LLL	45	490.5	¾	5/16	55.58	15.9

Size	Shell Equiv. Flow Length Feet	Con-nections Casing Coil	GPM at Velocity of 10 FPS		
			Casing	Coil-BWG 16	18
10-22S	18.25	2½	112.0	94.3	104.0
12-22S	21.2	2½	104.0	72.1	82.0
15-22S	22.2	2½	98.5	50.2	59.3
20-22L	18.25	2½	222.0	188.0	208.0
24-22L	21.2	2½	209.0	145.0	163.0
30-22L	22.2	2½	196.0	101.0	119.0
45-22LL	22.2	2½	294.0	150.0	178.0
10-24S	24.0	2½	112.0	94.3	104.0
12-24S	27.25	2½	104.0	72.1	82.0
15-24S	30.8	2½	98.5	50.2	59.3
20-24L	24.0	2½	222.0	188.0	208.0
24-24L	27.25	2½	209.0	145.0	163.0
30-24L	30.8	2½	196.0	101.0	119.0
36-24LL	27.25	2½	314.0	215.0	244.0
10-26S	29.5	2½	112.0	94.3	104.0
12-26S	33.4	2½	104.0	72.1	82.0
15-26S	37.2	2½	98.5	50.2	59.3
20-26L	29.5	2½	222.0	188.0	208.0
24-26L	33.4	2½	209.0	145.0	163.0
30-26L	37.2	2½	196.0	101.0	119.0
36-26LL	33.4	2½	314.0	215.0	244.0
10-28S	38.0	3	112.0	94.3	104.0
12-28S	42.1	3	104.0	72.1	82.0
15-28S	47.9	3	98.5	50.2	59.3
20-28L	38.0	3	222.0	188.0	208.0
24-28L	42.1	3	209.0	145.0	163.0
30-28L	47.9	3	196.0	101.0	119.0
30-28LL	38.0	3	332.0	282.0	312.0
45-28LLL	38.0	3	498.0	424.0	470.0
10-30S	45.3	3	112.0	94.3	104.0
20-30L	45.3	3	222.0	188.0	208.0
30-30LL	45.3	3	332.0	282.0	312.0
45-30LLL	45.3	3	498.0	424.0	470.0
10-32S	53.4	3	112.0	94.3	104.0
20-32L	53.4	3	222.0	188.0	208.0
30-32LL	53.4	3	332.0	282.0	312.0
45-32LL	53.4	3	498.0	424.0	470.0
10-34S	62.2	3	112.0	94.3	104.0
20-34S	62.2	3	222.0	188.0	208.0
30-34LL	62.2	3	332.0	282.0	312.0
45-34LLL	62.2	3	498.0	424.0	470.0

(A.) VISCOSITY vs TEMPERATURE °F



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Graham Manufacturing Co., Inc.
20 Florence Avenue, P.O. Box 719
Batavia, New York 14021-0719
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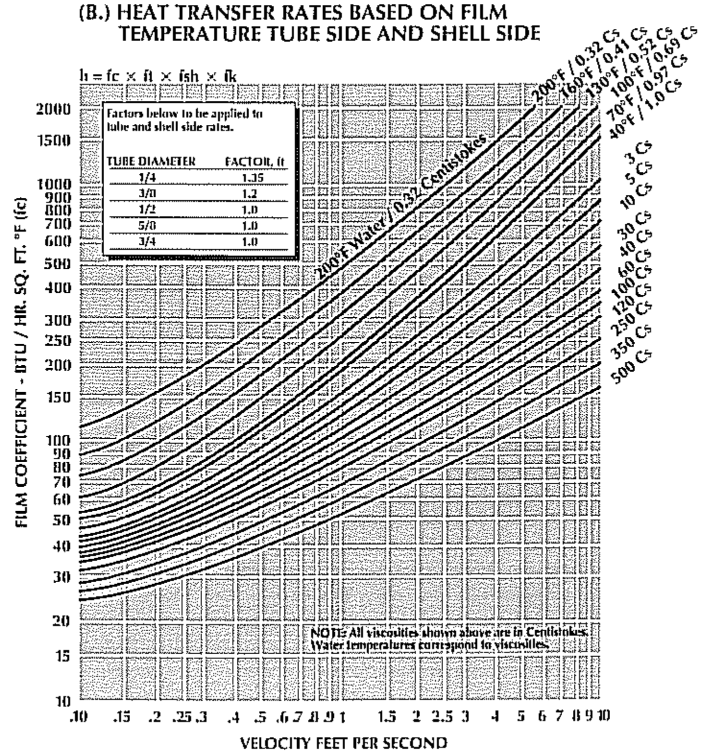
FAX: 1-716-343-1097
Website: http://www.graham-mfg.com
Email: equipment@graham-mfg.com

(B.) HEAT TRANSFER RATES BASED ON FILM TEMPERATURE TUBE SIDE AND SHELL SIDE

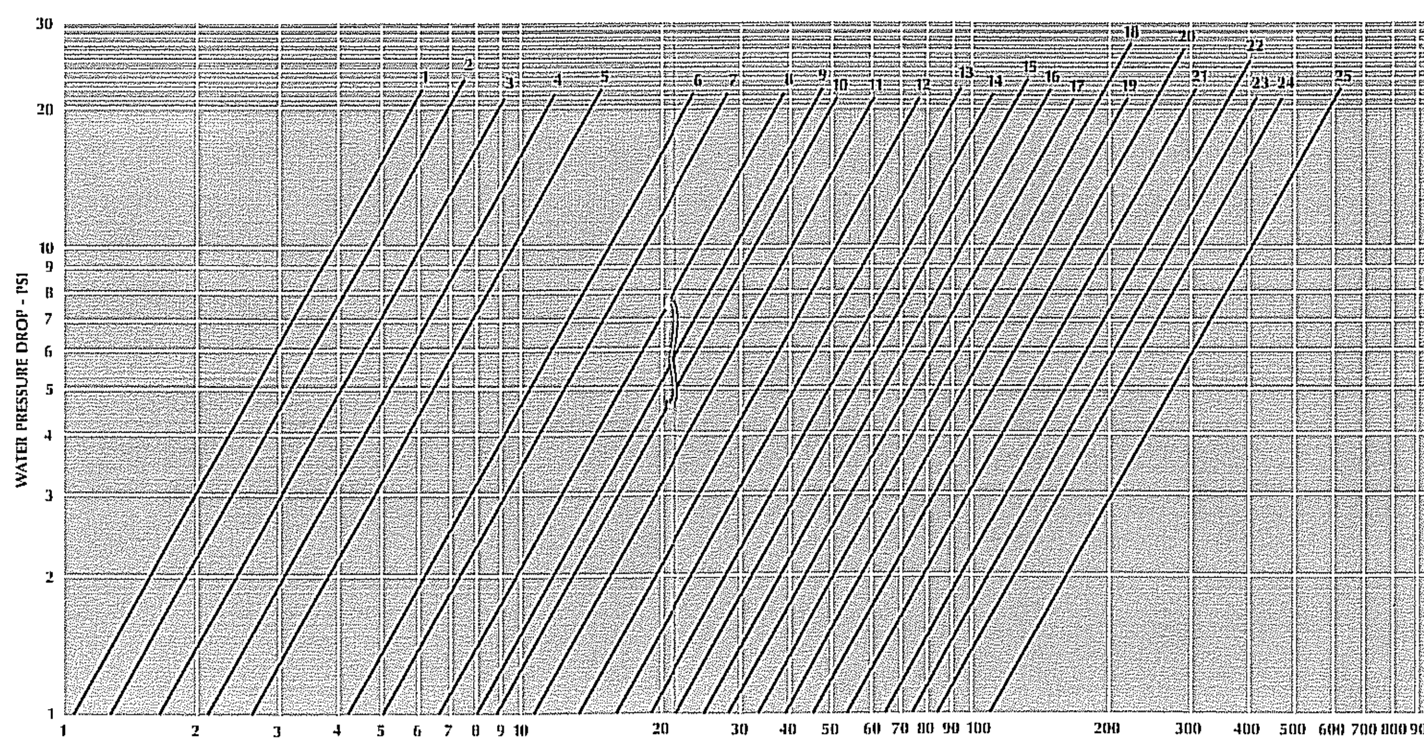
$h = fc \times ft \times fsh \times fk$



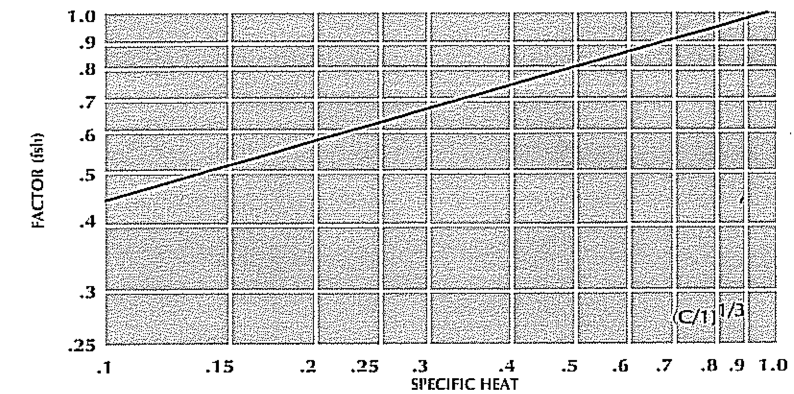
(C.) DETERMINATION OF PRESSURE DROP

HELIFLOW SIZE	CURVE NO. TUBE	CURVE NO. CASING
3-10	6	6
4-10	5	6
8-10	1	6
4-12	8	8
6-12	10	10
8-12	7	9
12-12	2	7
9-14S	11	11
12-14S	7	10
18-14S	3	11
12-14L	14	15
15-14L	13	14
20-14L	10	12
30-14L	5	14
30-14LL	14	17
9-16S	11	11
12-16S	6	8
18-16S	2	10
10-16L	18	19
12-16L	17	18
15-16L	13	16
20-16L	10	17
30-16L	4	13
30-16LL	17	20
10-18S	19	20
12-18S	16	19
15-18S	13	18
20-18S	9	19
20-18L	22	24
24-18L	20	22
30-18L	17	22
45-18LL	19	24
10-20S	18	19
12-20S	15	18
15-20S	12	17
20-20S	8	18
20-20L	21	23
24-20L	19	22
30-20L	17	21
45-20LL	19	23
10-22S	18	20

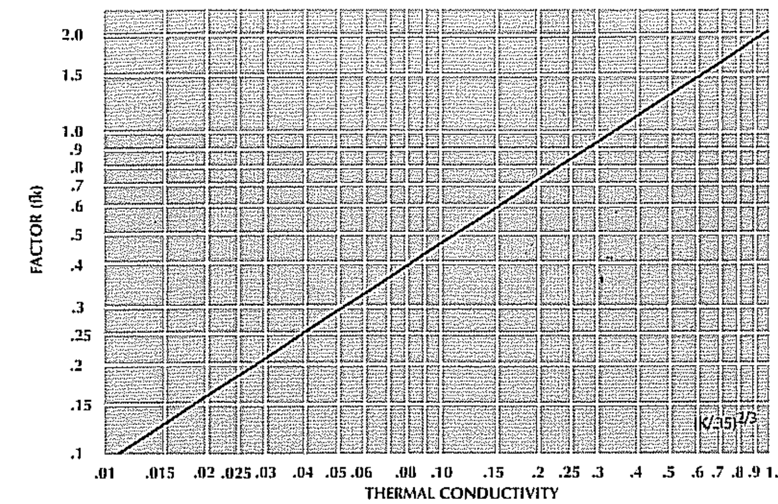
HELIFLOW SIZE	CURVE NO. TUBE	CURVE NO. CASING
12-22S	15	19
15-22S	12	18
20-22L	21	24
24-22L	19	23
30-22L	16	22
45-22LL	18	24
10-24S	17	19
12-24S	14	18
15-24S	11	17
20-24L	20	23
24-24L	18	22
30-24L	14	21
36-24LL	20	24
10-26S	16	18
12-26S	13	17
15-26S	10	16
20-26L	20	22
24-26L	19	21
30-26L	14	20
36-26LL	20	23
10-28S	15	17
12-28S	12	16
15-28S	9	15
20-28L	20	22
24-28L	17	21
30-28L	13	20
30-28LL	22	24
45-28LLL	24	25
10-30S	15	17
20-30L	19	21
30-30LL	21	24
45-30LLL	23	25
10-32S	14	16
20-32L	19	21
30-32LL	21	23
10-34S	14	15
20-34L	18	20
30-34LL	21	22
45-32LLL	23	25
45-34LLL	22	24



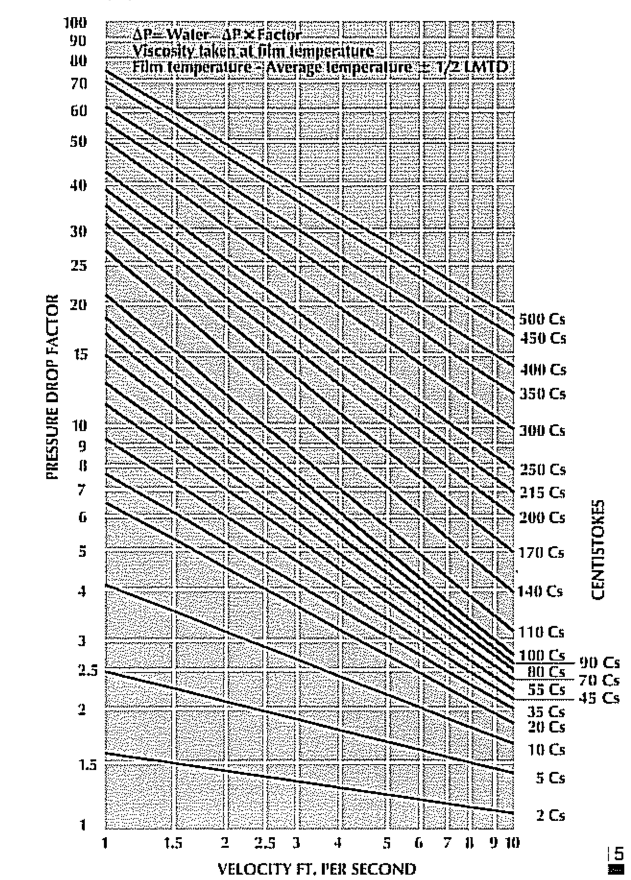
(D.) SPECIFIC HEAT CORRECTION



(E.) THERMAL CONDUCTIVITY CORRECTION



(F.) PRESSURE DROP



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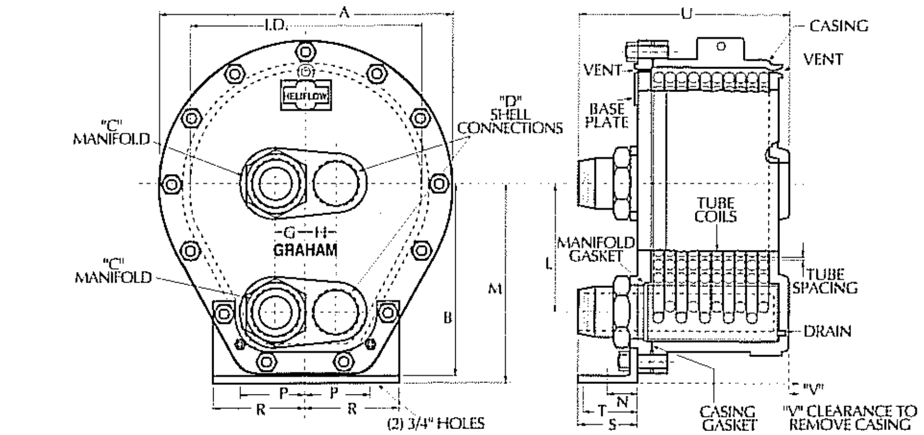
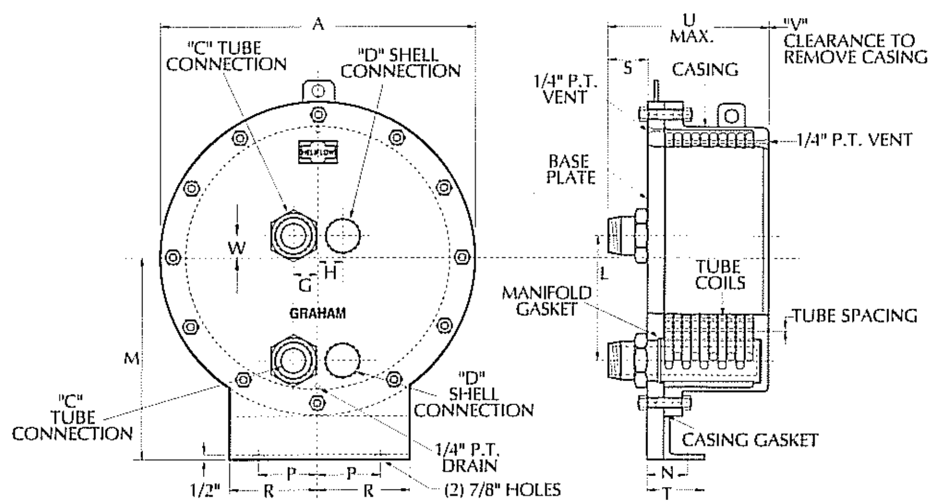
DIMENSIONS FOR UNITS WITH CAST SHELLS



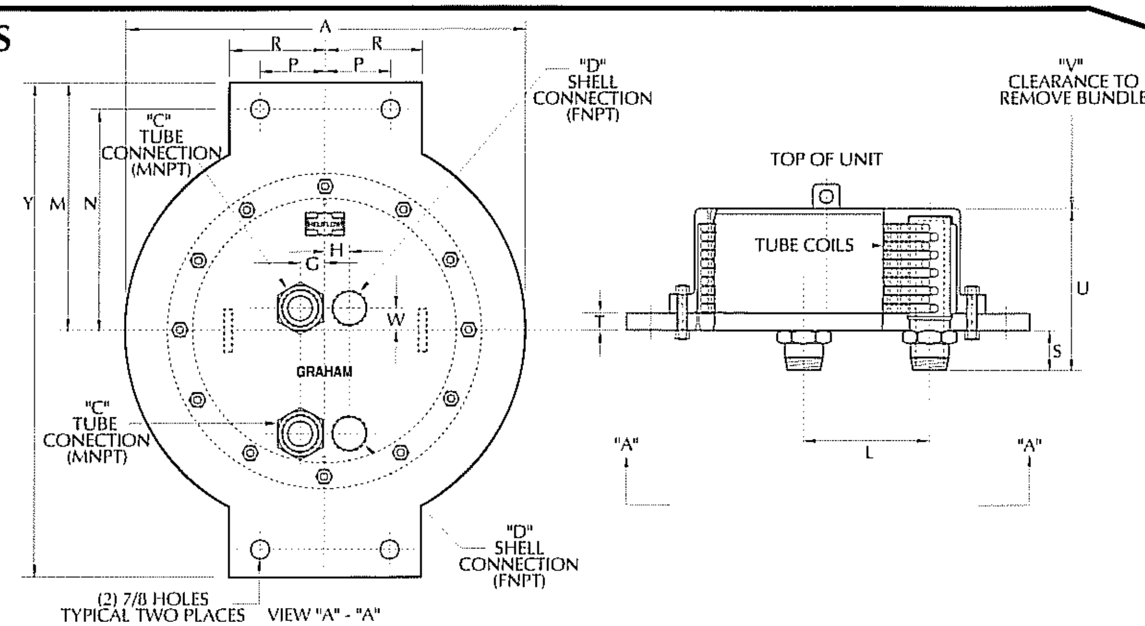
UNIT SIZE				I.D.	A	B	C	D*	G	H	L	M	N	P	R	S	T	U	V
4-10	3-10			6	8¼	4⅜	½	½	⅝	⅞	3 1/16	5 7/16	1¾	2	2 27/32	2	3	4 11/16	3½
8-10				6	8¼	4⅜	½	½	⅝	⅞	3 1/16	5 7/16	1¾	2	2 27/32	2	3	5 5/16	4
4-12				8	11	7	1¼	1	1	1 1/16	4¼	7 7/16	1¾	2½	3⅝	3	3	6 9/16	4
6-12	8-12	12-12		8	11	7	1¼	1	1	1 1/16	4¼	7 7/16	1¾	2½	3⅝	3	3	7½	5
9-14S	12-14S	18-14S		10	13¼	8⅛	1¼	1¼	15/16	1 5/16	5⅜	9	2⅜	3	4	3	3½	9⅝	6
12-14L	15-14L	20-14L	30-14L	10	13¼	8⅛	1¼	1¼	15/16	1 5/16	5⅜	9	2⅜	3	4	3	3½	12⅝	9
9-16S	12-16S	18-16S		12¼	15½	10 9/16	2	2	1 7/16	1 9/16	6⅞	11	2⅜	3½	5	3½	3½	10½	7
10-16L	12-16L	15-16L	20-16L	12¼	15½	10 9/16	2	2	1 7/16	1 9/16	6⅞	11	2⅜	3½	5	3½	3½	13½	10
30-16LL				12¼	15½	10 9/16	2	2	1 7/16	1 9/16	6⅞	11	2⅜	3½	5	3½	3½	21	18
10-18S	12-18S	15-18S	20-18S	14¼	18½	11 15/16	2½	2½	1 13/16	1 13/16	8	13	2½	4	6⅛	4¼	3½	14⅜	10
20-18L	24-18L	30-18L		14½	18½	11 15/16	2½	2½	1 13/16	1 13/16	8	13	2½	4	6⅛	4¼	3½	21⅞	18
10-20S	12-20S	15-20S	20-20S	16½	20½	12 15/16	2½	2½	1 13/16	1 13/16	9	14	2½	4½	6	4	3½	14 7/16	10
20-20L	24-20L	30-20L		16½	20½	12 15/16	2½	2½	1 13/16	1 13/16	9	14	2½	4½	6	4	3½	22	18
10-22S	12-22S	15-22S	20-22S	18	22½	14⅜	2½	2½	2⅛	2	10⅜	15¼	2½	4½	6⅜	4	3½	14 11/16	10
20-22L	24-22L	30-22L		18	22½	14⅜	2½	2½	2⅛	2	10⅜	15¼	2½	4½	6⅜	4	3½	22⅛	18
10-24	12-24	15-24	20-24	20½	25	16⅛	2½	2½	2⅛	2⅛	12	17	2½	4½	6⅜	4	3½	14½	10
20-24	24-24L	30-24L		20½	25	16⅛	2½	2½	2⅛	2⅛	12	17	2½	4½	6⅜	4	3½	22 5/16	18
10-26S	12-26S	15-26S		22½	27	17⅛	2½	2½	2⅛	2⅛	1⅛	18 1/16	2¾	5	6¼	3⅞	4	14⅞	10
20-26L	24-26L	30-26L		22½	27	17⅛	2½	2½	2⅛	2⅛	13	18 1/16	2¾	5	6¼	3⅞	4	22¼	18
10-28S	12-28S	15-28S		25½	30	19⅝	3	3	2⅝	2⅝	14½	21½	2¾	6	7½	4	4	14 13/16	10
20-28L	24-28L	30-28L		25½	30	19⅝	3	3	2⅝	2⅝	14½	21½	2¾	6	7½	4	4	21 15/16	18

DIMENSIONS FOR UNITS WITH FABRICATED SHELLS



UNIT SIZE				A	C	D*	G	H	L	M	N	P	R	S	T	U	V	W
4-10	3-10			12⅛	½	½	⅝	⅞	3 1/16	9¼	3¼	3½	4⅝	1⅝	4¾	5⅝	4	1
8-10				12⅛	½	½	⅝	⅞	3 1/16	9¼	3¼	3½	4⅝	1⅝	4¾	5⅝	5	1
4-12				14⅜	1¼	1	1	1 1/16	4¼	10½	3⅜	4	5½	2 7/16	4⅞	7 7/16	5	1
6-12	8-12	12-12		14⅜	1¼	1	1	1 1/16	4¼	10½	3⅜	4	5½	2 7/16	4⅞	8 7/16	6	1
9-14S	12-14S	18-14S		16⅞	1¼	1¼	15/16	1 5/16	5⅜	11¼	2⅞	3½	5	2 5/16	4⅞	9 15/16	8	1
12-14L	15-14L	20-14L	30-14L	16⅞	1¼	1¼	15/16	1 5/16	5⅜	12¼	2⅞	3½	5	2 5/16	4⅞	12 15/16	11	1
30-14LL				16⅞	1¼	1¼	15/16	1 5/16	5⅜	12¼	2⅞	3½	5	2 5/16	4⅞	20 7/16	19	1
9-16S	12-16S	18-16S		20	2	2	1 7/16	1 9/16	6⅞	13¾	3	4	6¼	2 11/16	5	10 1/16	8	1½
10-16L	12-16L	15-16L	20-16L	20	2	2	1 7/16	1 9/16	6⅞	13¾	3	4	6¼	2 11/16	5	13 1/16	11	1½
30-16LL				20	2	2	1 7/16	1 9/16	6⅞	13¾	3	4	6¼	2 11/16	5	20 9/16	19	1½
10-18S	12-18S	15-18S	20-18S	22⅜	2½	2½	1 13/16	1 13/16	8	15	3¼	4	6⅜	3¼	5¼	14	12	1 7/16
20-18L	24-18L	30-18L		22⅜	2½	2½	1 13/16	1 13/16	8	15	3¼	4	6⅜	3¼	5¼	21½	19	1 7/16
10-20S	12-20S	15-20S	20-20S	25	2½	2½	1 13/16	1 13/16	9	16	3¼	4½	6⅞	3¼	5¼	14¼	12	1½
20-20L	24-20L	30-20L		25	2½	2½	1 13/16	1 13/16	9	16	3¼	4½	6⅞	3¼	5¼	21¼	19	1½
10-22S	12-22S	15-22S	20-22S	26⅞	2½	2½	2⅛	2	10⅜	17	3 13/16	4½	7⅜	3 3/16	5 5/16	14¼	12	1⅞
20-22L	24-22L	30-22L		26⅞	2½	2½	2⅛	2	10⅜	17	3 13/16	4½	7⅜	3 3/16	5 5/16	21¼	19	1⅞
45-22LL				26⅞	2½	2½	2⅛	2	10⅜	17	3 13/16	4½	7⅜	3 3/16	5 5/16	29¼	27	1⅞
20-24S	12-24S	15-24S	20-24S	29¾	2½	2½	2⅛	2⅛	12	18½	3 15/16	4½	7 7/16	3 1/16	5 7/16	14⅝	12	2¼
20-24L	24-24L	30-24L		29¾	2½	2½	2⅛	2⅛	12	18½	3 15/16	4½	7 7/16	3 1/16	5 7/16	22⅝	19	2¼
10-26S	12-26S	15-26		31½	2½	2½	2⅛	2⅛	13	19½	4 1/16	5½	8 7/16	2 15/16	5 9/16	14⅝	12	2¼
20-26L	24-26L	30-26L		31½	2½	2½	2⅛	2⅛	13	19½	4 1/16	5½	8 7/16	2 15/16	5 9/16	22⅝	19	2¼
10-28S	12-28S	15-28S		36⅛	3	3	2⅝	2⅝	14½	21¼	4 5/16	6	8¾	3 5/16	5 11/16	15⅝	12	2¼
20-28L	24-28L	30-28L		36⅛	3	3	2⅝	2⅝	14½	21¼	4 5/16	6	8¾	3 5/16	5 11/16	22⅞	19	2¼

DIMENSIONS FOR VERTICAL MOUNTED UNITS



UNIT SIZE			A	C	D*	G	H	L	M	N	P	R	S	T	U	V	W	Y
45-18LL			22⅜	2½	2½	1 13/16	1 13/16	8	15	13	4	6⅜	3¼	1⅛	29	24	1 7/16	30
45-20LL			25	2½	2½	1 13/16	1 13/16	9	16	14	4½	6⅞	3¼	1¼	29¼	24	1½	32
45-22LL			26⅞	2½	2½	2⅛	2	10⅜	17	15	4½	7⅜	3 3/16	1⅜	29¼	24	1⅞	34
24-24L	20-24	L30-24L	29¾	2½	2½	2⅛	2⅛	12	18½	16¾	4½	7 7/16	3 1/16	1 7/16	21¾	17	2¼	37
36-24LL			29¾	2½	2½	2⅛	2⅛	12	18½	16¾	4½	7 7/16	3 1/16	1 7/16	29¼	25	2¼	37
24-26L	20-26L	30-26L	31½	2½	2½	2⅛	2⅛	13	19½	17¾	5½	8 7/16	2 15/16	1 9/16	21¾	17	2¼	39
36-26LL			31½	2½	2½	2⅛	2⅛	13	19½	17¾	5½	8 7/16	2 15/16	1 9/16	29¼	25	2¼	39
24-28L	20-28L	30-28L	36⅛	3	3	2⅝	2⅝	14½	22	19½	6	8¾	3⅜	2	22⅞	18	2¼	44
30-28LL			36⅛	3	3	2⅝	2⅝	14½	22	19½	6	8¾	3⅜	2	30⅜	25	2¼	44
45-28LLL			36⅛	3	3	2⅝	2⅝	14½	22	19½	6	8¾	3⅜	2	41⅝	38	2¼	44
20-30L			38½	3	3	2⅝	2⅝	15½	23	21½	6	8¾	3¾	2	23½	18	1⅝	46
30-30LL			38½	3	3	2⅝	2⅝	15½	23	21½	6	8¾	3¾	2	31	25	1⅝	46
45-30LLL			38½	3	3	2⅝	2⅝	15½	23	21½	6	8¾	3¾	2	38½	38	1⅝	46
20-32L			40	3	3	2⅝	2⅝	16½	24¼	22¾	6¼	9¼	3¾	2	23¾	18	2⅛	48½
30-32LL			40	3	3	2⅝	2⅝	16½	24¼	22¾	6¼	9¼	3¾	2	30⅜	25	2⅛	48½
45-32LLL			40	3	3	2⅝	2⅝	16½	24¼	22¾	6¼	9¼	3¾	2	38½	39	2⅛	48½
20-34L			45	3	3	2⅝	2⅝	18¼	26	24½	6¼	9¼	3¾	2¼	24	18	1⅞	52
30-34LL			45	3	3	2⅝	2⅝	18¼	26	24½	6¼	9¼	3¾	2¼	31	26	1⅞	52
45-34LLL			45	3	3	2⅝	2⅝	18¼	26	24½	6¼	9¼	3¾	2¼	38½	40	1⅞	52

*Female threads.

All dimensions are in inches. Dimensions are subject to change, depending on customer requirements and design conditions.

PHYSICAL PROPERTIES FOR MISCELLANEOUS COMPOUNDS.

Organic Liquids

Name	M.W.	M.P	B.P.	Sp. Gr	Sp. Ht	L.H.	k	Viscosity 4.44°C 40°F	Viscosity 26.7°C 80°F	Viscosity 48.9°C 120°F	Viscosity 71.1°C 160°F
Water	18	32	212	1 00	1.00	970	356	1 55	861	56	40
Acetaldehyde	44	–191 3	71.6	783	—	246	—	.27	—	—	—
Acetic Acid	60	62	245	1 05	48	175	095	1 65	1 18	85	65
Acetone	58	–137	133	789	514	225	.096	.4	32	26	—
Benzaldehyde	106	–70	355	1 043	43	156	—	—	—	—	—
Benzene	78	21 8	176	.872	.45	170	.087	—	62	.46	30
Benzyl Alcohol	108	5	401	1 04	52	203	—	12 0	4 8	2 7	1.7
Butyl Alcohol—n	74	–130	244	.806	56	256	.095	4 6	2 6	1.55	93
Carbon Disulphide	76	–170	115 5	1 263	24	152	091	42	.36	—	—
Carbon Tetrachloride	154	–9.5	170	1.584	21	84	.095	1 3	.95	.7	53
Chlorobenzene	112.5	–49	269	1.101	31	140	.083	1.16	83	.62	.46
Chloroform	119.4	–83	142	1.48	.24	107	08	68	55	45	—
Cyclohexane	84	20 5	177 5	774	.44	155	—	1 25	86	61	—
Cyclohexanone	98	–49	311	947	.431	—	—	—	—	—	—
Decane	142	–22	345	73	.43	109	083	—	75	—	—
Diethyl Aniline	149	–30	421	934	.452	140	—	—	—	—	—
Diethyl Phthalate—o	222	—	569	1 121	—	—	—	—	—	—	—
Dimethyl Aniline	121	36 5	379	956	.403	144	—	—	—	—	—
Diphenyl	154	157	491	992	450	120	08	—	—	—	—
Dipropyl Ether	102	–76	156	725	—	—	—	—	—	—	—
Dowtherm—A	166	54	500	995	63	123	08	—	—	—	—
Dowtherm—SR-1	—	—	600	1 10	35- 65	—	08	—	—	—	—
Ethyl Acetate	88	–119	171	895	46	185	.101	.58	45	35	28
Ethyl Alcohol	46	–174	173	785	54	370	.087	1.7	1 1	.74	51
Ethyl Benzene	106	–137	277	867	41	147	082	.92	7	.54	43
Ethyl Bromide	109	–182	101	1.45	22	109	07	.48	38	—	—
Ethyl Chloride	64 5	–218	54	921	38	167	08	.32	—	—	—
Ethyl Ether	74	–177	94	.708	55	152	08	28	22	—	—
Ethylene Dichloride	99	–31	183	1.246	31	140	—	1 06	.77	59	46
Ethylene Glycol	62	12 5	387	1 11	58	346	153	44 0	19.0	9.0	4.5
Glycerol	92	–0.4	554	1.26	58	340	164	—	490.0	130.0	56 0
Heptane	100	–130	209	684	52	138	.081	5	.4	32	26
Hexane	86	–137	156	66	.54	144	.08	39	.31	.26	—
Isobutane	58	–229	14	603	.550	150	—	—	—	—	—
Isobutyl Acetate	116	–146	244	871	.459	132	—	—	—	—	—
Isobutyl Alcohol	74	–163	226	798	60	250	.091	7.2	3.6	1 9	1.0
Isopropyl Alcohol	60	–130	180	781	64	288	09	3 6	2 0	1.13	68
Maleic Anhydride	98	136	395	1 5	—	—	—	—	—	—	—
Methyl Acetate	74	–146	139	924	468	178	—	.48	38	.30	—
Methyl Alcohol	32	–142	148	786	60	476	114	.78	.56	.42	—
Methyl Ethyl Ketone	72	–123	175	.80	55	192	—	.52	4	.33	26
Mobiletherm Light	—	—	—	0 959	43	—	0 069	14.38	6 713	3.35	2 3
Naphthalene	128	180	424	1.145	.402	135	.08	—	—	—	—
Nitro Benzene	123	21 5	410	1 2	34	143	09	—	1 9	1 3	9
Nitromethane	61	–19 3	215	1 138	.42	244	.12	—	—	—	—
Nitrotoluene—o	137	3	432	1 163	—	—	—	33	2 2	1 5	1 05
Octane	114	–70	258	703	.58	128	.081	69	52	42	.34
Pentane—n	72	–201	97	630	—	150	.08	28	23	—	—
Phenol	94	105 6	360	1 07	.56	—	—	—	—	3 9	2.1
Phthalic Anhydride	148	267	544	1 527	—	—	—	—	—	—	—
Propane	44	–304	–44	585	.576	160	08	—	—	—	—
Propyl Alcohol—n	60	–197	208	804	590	296	—	3 6	2.10	1.3	8
Syltherm XLT	—	—	—	0 83	0 396	—	0.0614	1 9	1 35	0 98	0 75
Tetrachlorethylene	166	–2	249	1 624	215	90	—	1 1	85	.70	55
Tetranitromethane	196	55	258	1 65	—	—	—	—	—	—	—
Therminal 44	—	—	—	0.918	0.473	—	0.0797	29.75	12 8	8.78	3.51
Toluene	92	–139	231	.862	42	157	084	75	.57	45	36
Trichlorethylene	131 5	–99	188	1.456	23	104	08	.72	58	49	.41
Xylene—o	106	–16.6	289	.874	.42	150	.09	1.0	.78	.61	.48

M.W. (Molecular Weight); M.P. (Melting Point, °F); B.P. (Boiling Point –°F—atmos.); Sp. Gr. (Specific Gravity at room temp.); Sp. Ht. (Specific Heat at room temp.); L. H. (Latent Heat in BTU/#—atmos (Increase 10%-20% for high vacuum); k—(Thermal Conductivity in BTU/hr./sq ft./°F/ft at room temp.); Viscosity (Centipoises)

Water Solutions

Name	Sp. Gr.	Sp. Ht.	k	Viscosity –12.2°C 10°F	Viscosity 4.44°C 40°F	Viscosity 26.7°C 80°F	Viscosity 48.9°C 120°F	Viscosity 71.1°C 160°F
26% Ammonia	905	1 0	.26	—	1.8	1.2	—	—
Brine—25% CaCl2	1 23	7	.28	8 0	4 5	2.1	—	—
Brine—25% NaCl	1 19	8	.24	4 8	3.3	2.1	—	—
40% Ethyl alcohol	94	95	.22	9 6	5 2	2 5	1 23	65
31.5% Hydrochloric Acid	1 15	6	—	—	2.5	1 85	1.42	1.1
50% Glycerine	1 13	8	.23	—	11.0	5 4	2 8	1 5
40% Methyl Alcohol	.94	92	.23	5 5	3.4	1 8	1 0	57
95% Nitric Acid	1 503	—	—	1 9	1.5	1.1	.83	65
60% Nitric Acid	1 375	—	—	4 7	3 4	2.2	1.5	1.05
50% Sodium Hydroxide	1 53	78	—	—	—	60	19	8
30% Sodium Hydroxide	1 33	84	—	—	—	9.6	4 5	2.5
60% Sucrose (cane sugar)	1 29	—	—	—	—	41	14	7
40% Sucrose	1 18	—	—	—	12	5	2 5	1 6
20% Sucrose	1 08	—	—	—	3 2	1.6	.98	68
98% Sulfuric Acid	1 84	35	.15	—	46	23	11 5	6 4
60% Sulfuric Acid	1 50	58	.24	—	9.5	6 0	3 9	2.7
Water	1.00	1.00	.34	—	1.55	0.861	0.56	0.40

Sp. Gr.—Specific Gravity (approx.) at room temperature Sp. Ht.—Specific Heat (approx.) at room temperature k—Thermal Conductivity in BTU/hr/sq ft./°F/ft. (room temp)
Viscosity—Expressed in centipoises

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