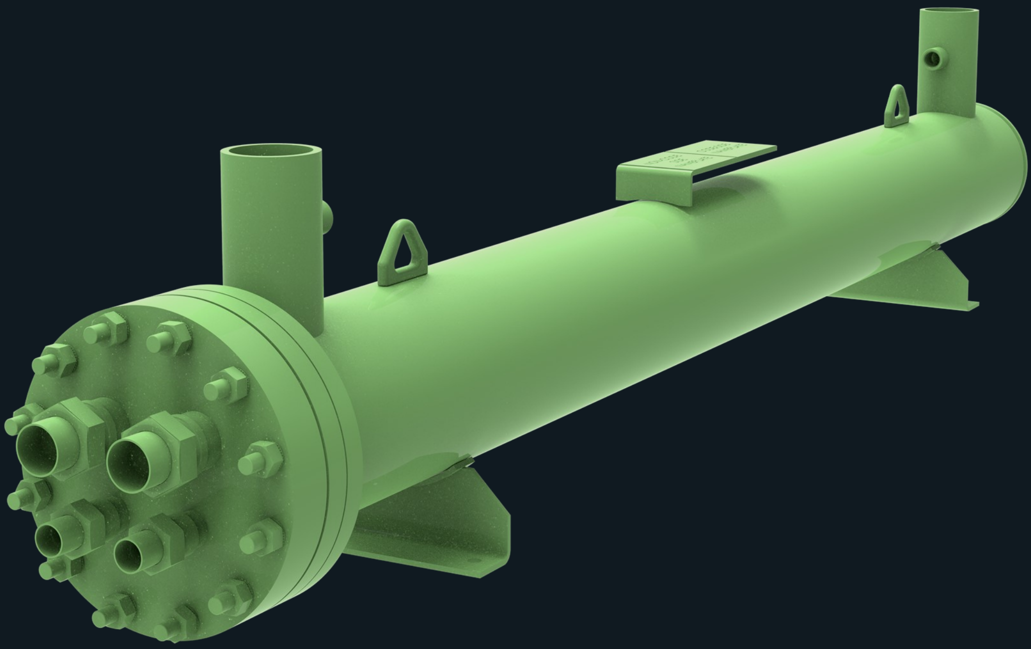
DRY-EXPANSION / U-TUBE

EVAPORATORS

DHA



DP-258-1 // ASME

HEAT EXCHANGERS

BITZER US Pressure Vessels

In addition to our shell and tube heat exchangers, receivers, and oil separators, BITZER US also delivers high quality pressure vessels that meet the demand for industrial Ammonia and CO_2 applications. These vessels are commonly used in cold storage facilities, ice makers, supermarkets, and other industrial processing systems.

BITZER US utilizes multiple welding stations that provide fast, consistent, and reliable welds which results in high quality vessels with short lead times. All vessels are manufactured in the USA and in accordance with the most recent edition of Section VIII, Division 1 of the ASME code or other certifications as required.

Design Capabilities

- Max Diameter: 96”
- Max Length: 290”
- Max Pressure: 3000 PSI
- Min Temperature: -55°F

Testing

- Ultrasonic
- Penetrant
- Decay Test

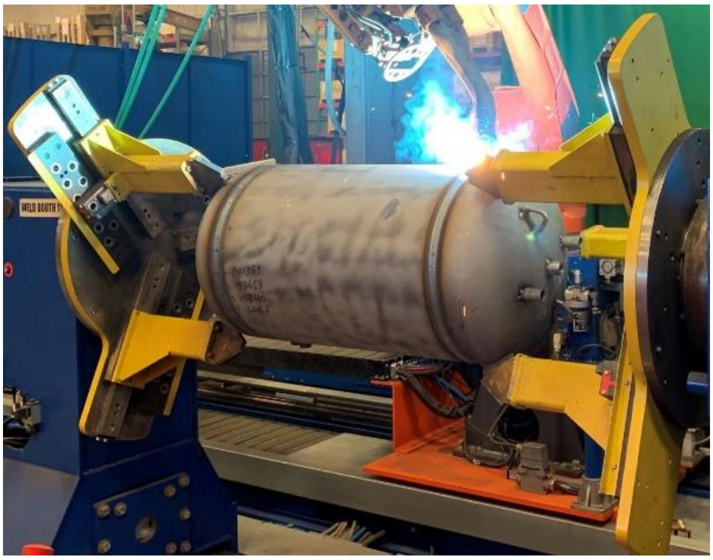
Certifications

- ASME
- PED
- CRN
- DOSH

Manufacturing

- Robotic Welding
- Water Jet
- Pipe Cutter
- Plasma Table
- CNC Machine Shop

Vessel Factory (USA)



NEW Shell-and-Tube Dry Expansion Evaporators

In keeping with the BITZER strategy of offering the most advanced design and technology, the DHA Evaporators utilize leading U-Tubes for maximum efficiency, reliability, and performance.

BITZER DHA Evaporators are ideal for water/brine chilling in commercial, industrial, and heat pump applications.

NEW Improvements to BITZER US Evaporators

- Innovative and patented distribution improves refrigerant heat transfer
- Optimized plastic baffles decrease leakage and improve brine side heat transfer
- Special inner grooved pattern of tubes maximizes heat transfer coefficient and limit negative effects of pressure drop

Performance Advantages

- Optimized for today's refrigerants including entire R407 Series, R448A, R449A, and R410A and with natural refrigerants such as R290 and R1270
  Also applicable with R134a, and lower GWP refrigerants like R450A, R513A, R1234yf, R1234ze (Note: Be sure to also check out the PURE COOLER Series of Evaporators optimized for these refrigerants)
- Maximum efficiency utilizing latest shell-and-tube technology to enhance heat transfer improvement
- Robotic welding technology used for optimum quality and product appearance
- Worldwide BITZER engineering and pressure vessel testing, design, and experience
- All products are made in the USA

U-Tube Design Advantages

- Elimination of one entire tube sheet
- 50% reduction in potential leak points
- Serviceable and cleanable
- Shell can be rotated for relocation of connections
- Allows for greater thermal expansion between tubes and shell
  - Minimizes tension and stress
  - Increases reliability → Maximizes lifespan

ASME Design Safety

Bitzer ASME evaporators are manufactured in accordance with the latest edition of ASME Section VIII, Division 1, and are designed for use in air-conditioning and refrigeration applications. CRN is available on majority of models. Consult factory for PED (CE) availability.

Design Specifications

- Refrigerant side:
  - Standard Models: 225 psi @ +14° to 200°F
  - High Pressure Models "P": 375 psi @ +14° to 200°F
- Shell / Water side:
  - All Models: 145 psi @ +14° to 200°F

Explanation of Model Number

D H A 2 - 3 2 3 H - T F K P

Product Series

DHA = Shell and Tube Evaporator (ASME Rated)

D H A **2** - 3 2 3 H - T F K P

Number of Circuits

1 = One
2 = Two
3 = Three
4 = Four

D H A 2 - **3 2** 3 H - T F K P

Shell Diameter Designation

16 = 6 NPS
19 = 8 NPS
21 = 8 NPS
27 = 10 NPS
32 = 12 NPS
40 = 16 NPS
50 = 20 NPS

D H A 2 - 3 2 **3** H - T F K P

Tube Designation (1,2,3,4)

D H A 2 - 3 2 3 **H** - T F K P

Flow Type / Baffle Spacing (Optional)

H = Low Flow
X = Very Low Flow

D H A 2 - 3 2 3 H - **T** F K P

Water Connection Location

T = Top (Standard)
L = Left
R = Right

D H A 2 - 3 2 3 H - T **F** K P

Water Connection Type

D = Threaded Connections (Standard: DHA 16)
F = Flange Connections (DHA 19-50)
J = Flexible Joint Connections (DHA 19-50)

D H A 2 - 3 2 3 H - T F **K** P

Additional Options

K = ¾ in. Thick insulation
M = 1 ½ in. Thick Insulation
P = High Pressure (Ref Side rating of 375 psi)
W = Low Temp (Min temp rating of -40°)

Selecting the Right Heat Exchanger

Selecting a heat exchanger by a table or chart can be challenging because many parameters and requirements are involved. These factors affect one another and lead to an iterative process to reach a suitable selection. Furthermore, one selection may be valid for a certain set of conditions; however, A/C and refrigeration systems operate a wide range of seasonal loads and conditions that must also be considered by the system designer.

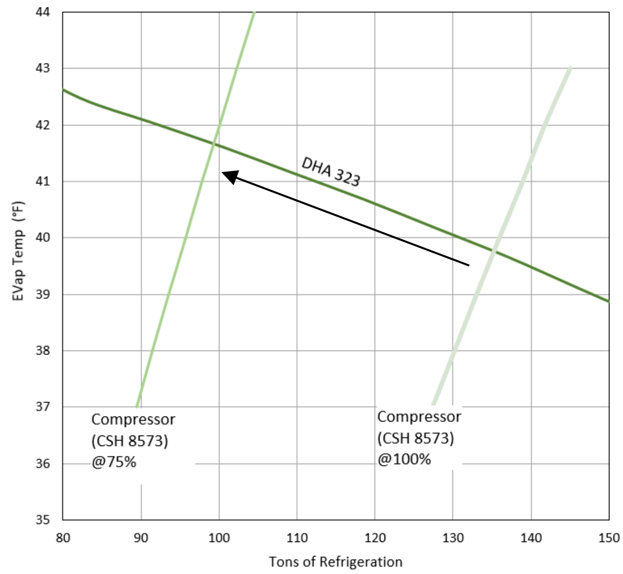
Therefore, it is strongly recommended to use the ***smarTube*** sizing software or consult BITZER USA for assistance. The following pages are provided as a guideline to help steer the decision process and better understand heat exchangers and the inputs that ***smarTube*** requires. Download s***marTube*** from **www.bitzerus.com**.

Heat Exchanger Operating Point

For a set of conditions, the evaporator will operate at a saturated evaporating temp (***Evap Temp***) that is balanced with the operation of the compressor.

If the cooling load is reduced and the compressor reduces its Capacity, the Flow Rate of the process fluid should also be reduced which results in a new operating point at the lower Capacity, but higher Evap Temp.

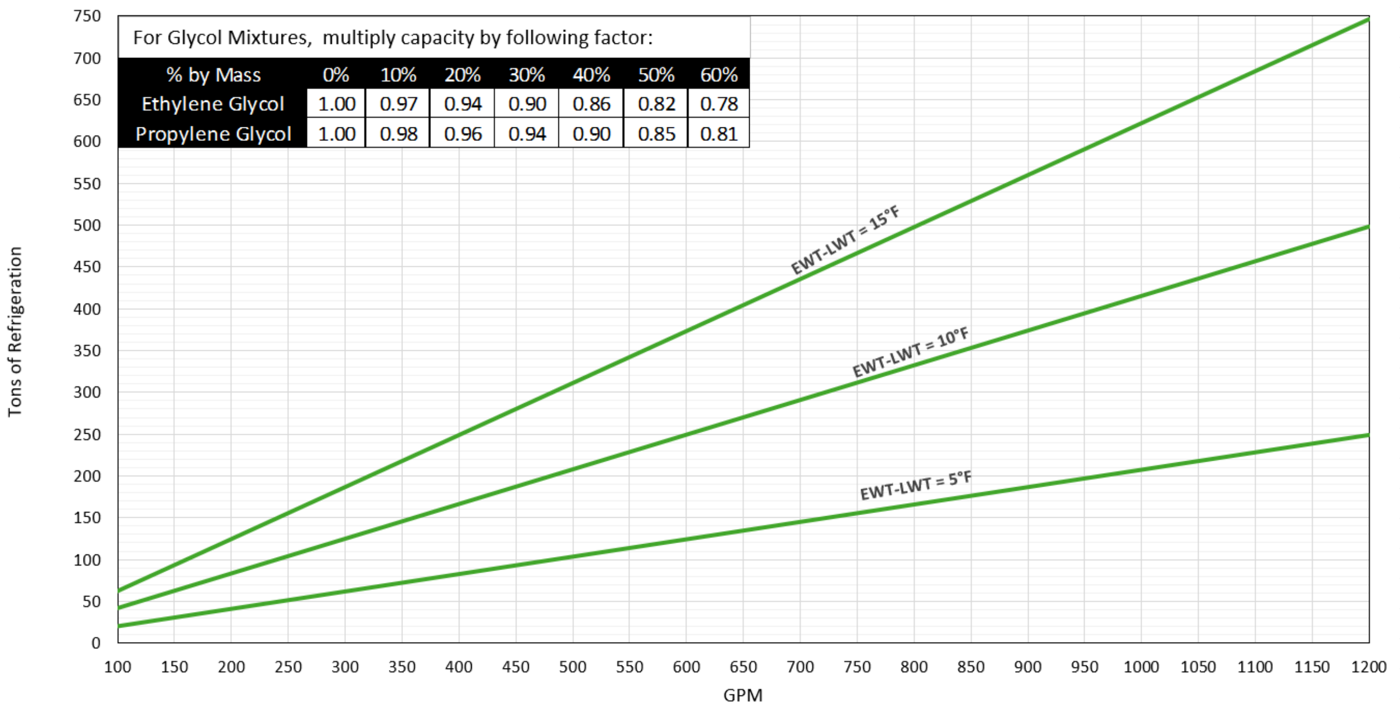
The difference in Leaving Water Temp and Evap Temp is called the ***Approach***. A lower Approach is desirable because it increases the Evap Temp; thus, the compressor will operate at a higher suction pressure with increased capacity and efficiency. For glide refrigerants, the dew point of the Evap Temp is implied when referenced in this document.



Capacity of Heat Exchangers (Fluid "Water" Side)

The ***Capacity*** of a shell and tube evaporator is calculated using the Flow Rate, the Range, and the specific heat of the process fluid. The ***Flow Rate*** is a measurement of the volumetric rate, often in gallons per minute (GPM). The ***Range*** refers to the temperature change of the process fluid and is calculated by subtracting the Leaving Water Temp (LWT) from the Entering Water Temp (EWT). For any given fluid, 3 of the following 4 requirements must be specified: Capacity, Flow Rate, EWT, and LWT. The result of the remaining parameter can then be calculated.

The following chart shows capacities for water at varying Flow Rates and Ranges with multipliers for glycol mixtures.



For Glycol Mixtures, multiply capacity by following factor:

% by Mass	0%	10%	20%	30%	40%	50%	60%
Ethylene Glycol	1.00	0.97	0.94	0.90	0.86	0.82	0.78
Propylene Glycol	1.00	0.98	0.96	0.94	0.90	0.85	0.81

Specifications (Fluid Side)

The DHA series of evaporators cover a broad range of capacities but have limitations due to maximum and minimum Flow Rates. A lower flow may reduce heat transfer while a higher flow may create undesirable pressure drop for pumps to overcome. In addition, an optimal velocity range is necessary to prevent fouling at the tube surface.

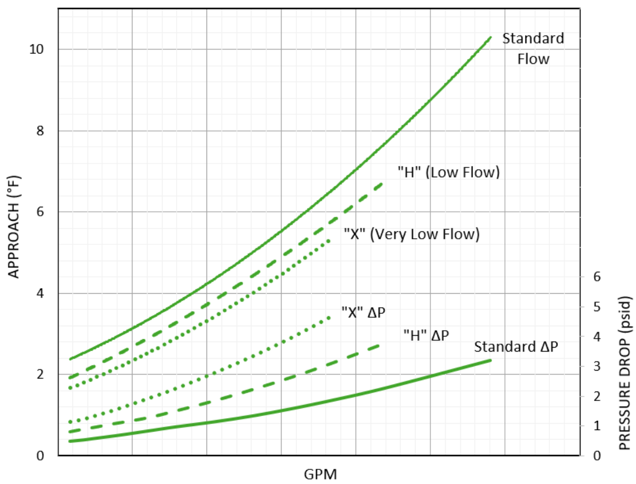
Model	Shell Dia. (NPS)	Available Circuits				Capacity at Max Flow Δ10°F (TR)	Capacity At Min Flow Δ10°F (TR)	Maximum Flow Rate (GPM)	Minimum Flow Rate (GPM)	Water Pressure Drop at Max Flow (psid)
		1	2	3	4					
DHA_-162	6	√	√			26.5	8.7	63.9	21.0	9.1
DHA_-164		√	√			40.5	11.6	97.6	28.0	12.1
DHA_-191	8	√	√			63.9	15.8	154.1	38.0	15.7
DHA_-193		√	√			63.9	20.7	154.1	50.0	8.3
DHA_-211		√	√	√	√	100.4	27.0	242.1	65.0	12.5
DHA_-212		√	√	√	√	100.4	29.0	242.1	70.0	10.9
DHA_-271	10	√	√	√	√	146.1	39.4	352.2	95.0	13.4
DHA_-273		√	√	√	√	146.1	52.3	352.2	126.0	8.1
DHA_-322	12	√	√	√	√	200.9	63.0	484.3	152.0	9.2
DHA_-323		√	√	√	√	200.9	60.1	484.3	145.0	9.8
DHA_-402	16		√	√	√	328.8	83.0	792.6	200.0	14.2
DHA_-404			√	√	√	321.5	83.0	775.0	200.0	15.5
DHA_-451	18		√	√	√	414.8	99.5	1000.0	240.0	15.6
DHA_-452			√	√	√	414.8	99.5	1000.0	240.0	15.1
DHA_-501	20		√	√	√	456.3	103.7	1100.0	250.0	15.9
DHA_-502			√	√	√	493.6	114.1	1190.0	275.0	15.8

- Max capacity may not be possible depending on refrigerant selection and limitation of refrigeration velocity
- Data calculated with 100% Water (Glycol mixtures will have higher pressure drops and lower capacity)
- Δ10°F is the Range = Entering Water Temp – Leaving Water Temp
- Flow Rates are established using a combination of max / min velocity and pressure drops (min p drop = ~1 psid)
- Lower Flow Rates possible using "H" and "X" models
- 1 TR = 12,000 BTU/h

Low Flow Models – "H" & "X" and Glycol Mixes

As the Flow Rate decreases for a given model, the Approach of the heat exchanger improves although water velocity may be too low for extended operation. In a low flow situation (usually >Δ10°F Range), a higher water velocity to reduce fouling is possible by adding additional baffles to the heat exchanger. These baffles increase pressure drop but also further improve heat transfer and efficiency.

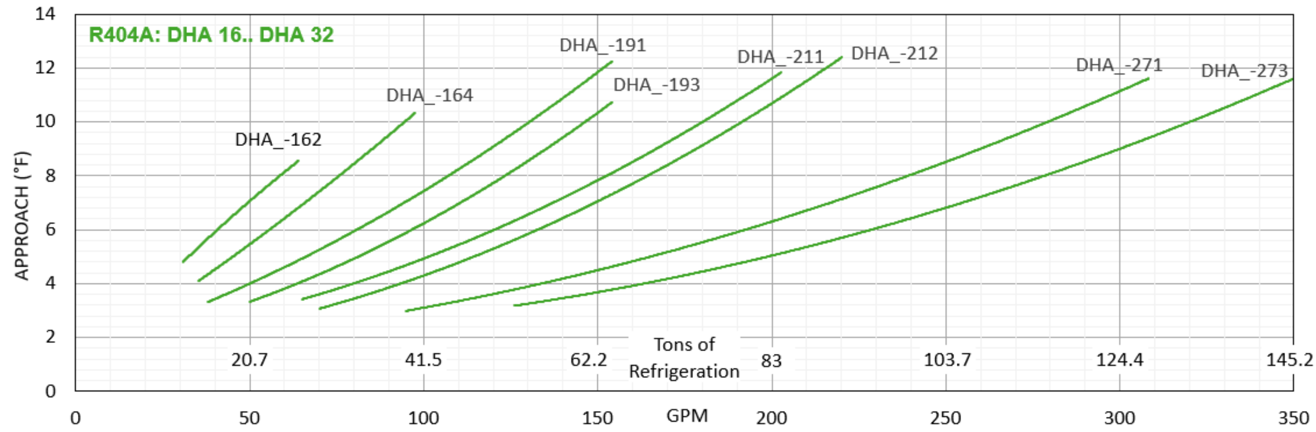
The addition of glycol to water increases viscosity and, thus, also increases the pressure drop.

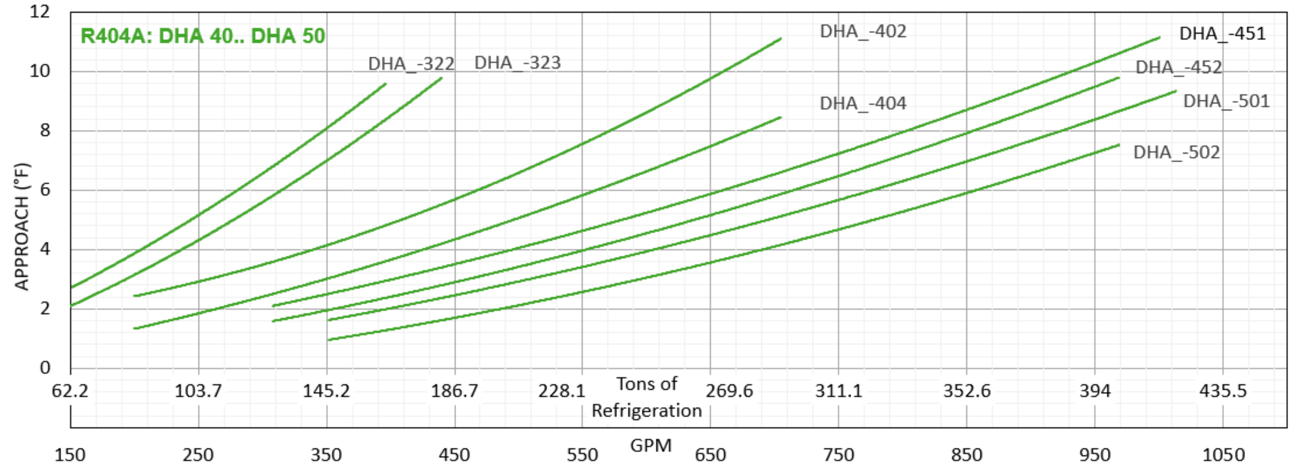


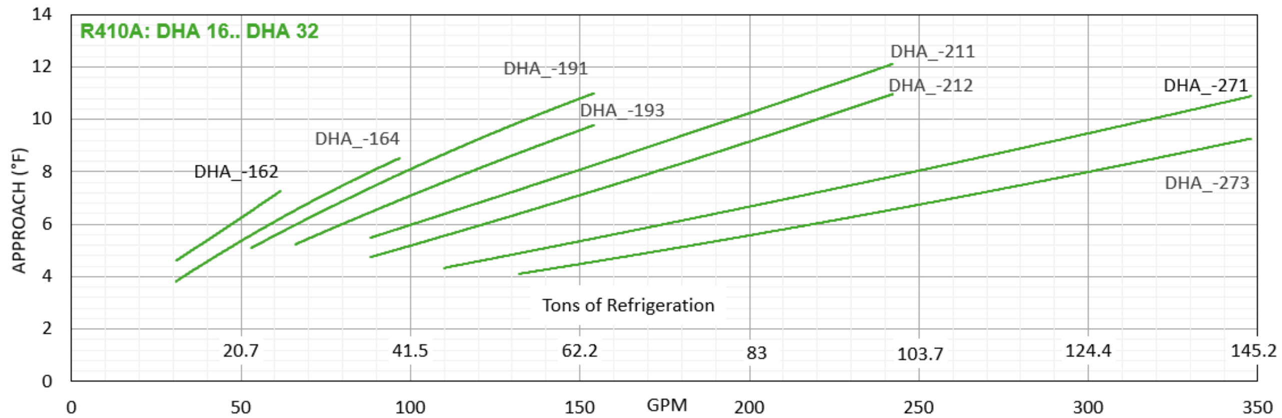
Performance Data: Capacity and Approach

The following page charts the performance of the DHA catalog using two refrigerants (note chart conditions). A larger heat exchanger will result in a smaller Approach but may have limitations in lower flowrates. Depending on the system, it is recommended to select a heat exchanger based on design conditions near the upper end (60 to 90%) of the curve so that in long periods of turndown (reduced capacity), the heat exchanger can operate with sufficient fluid flow.

In addition to Capacity, Approach, Flow Rate and refrigerant, many other factors will affect the rating of the heat exchange such as Range, Fouling Factor, Liquid Temp, and Superheat. Always be sure the Approach does not allow the saturation evaporating temperature to fall below the freezing point of the process fluid. Use ***smarTube*** sizing software or consult BITZER USA for final design.







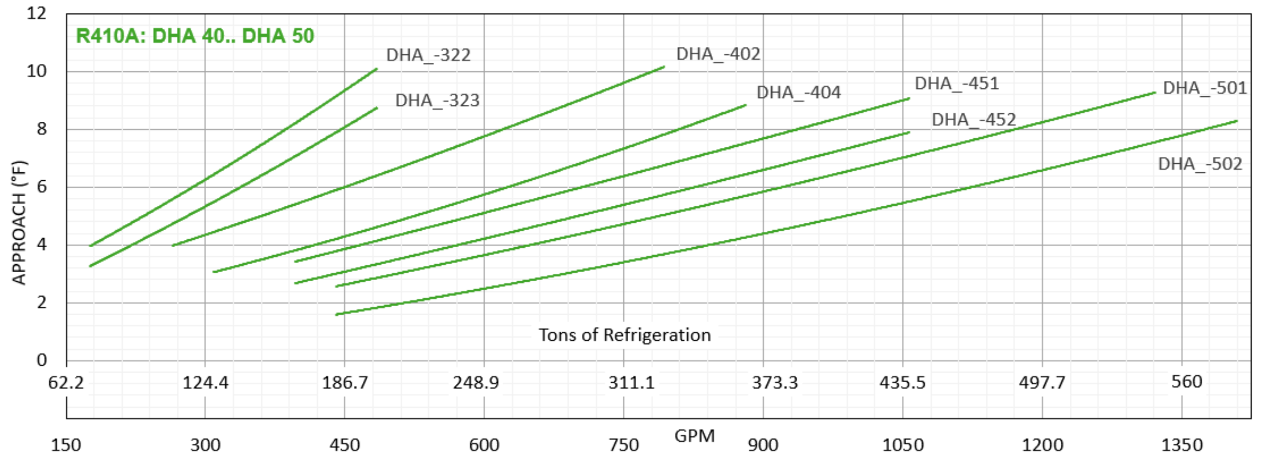


Chart Conditions: Water | EWT 54°F | LWT 44°F | Fouling .0001 ft²h°F/BTU | Liquid Temp 100°F | Superheat 7°ΔF

Performance Data – Refrigerants

The DHA series is capable of working with a wide variety of refrigerants. However, showing performance curves for all refrigerants is not practical.

In the displayed graph, a comparison of refrigerants (using the same heat exchanger and input factors) provides an idea of the difference between the refrigerants and the approximate impact on the Approach.

The calculation for Approach uses the dew point of the Evap Temp. For this reason, glide refrigerants have an Approach that is better in contrast with using the mean evaporating temperature.

Performance Data – Efficiency Factors

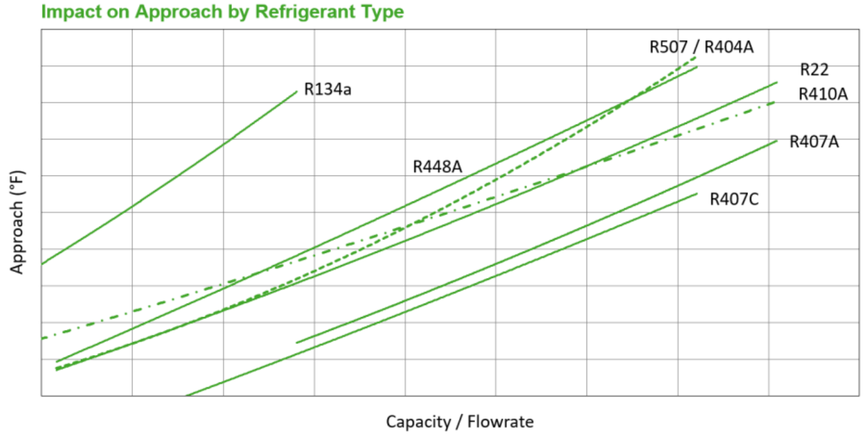
As mentioned previously, certain factors must be considered to appropriately select your heat exchanger. Some factors will change over seasons or time, such as liquid temp or fouling, while others are set at commissioning, such as superheat.

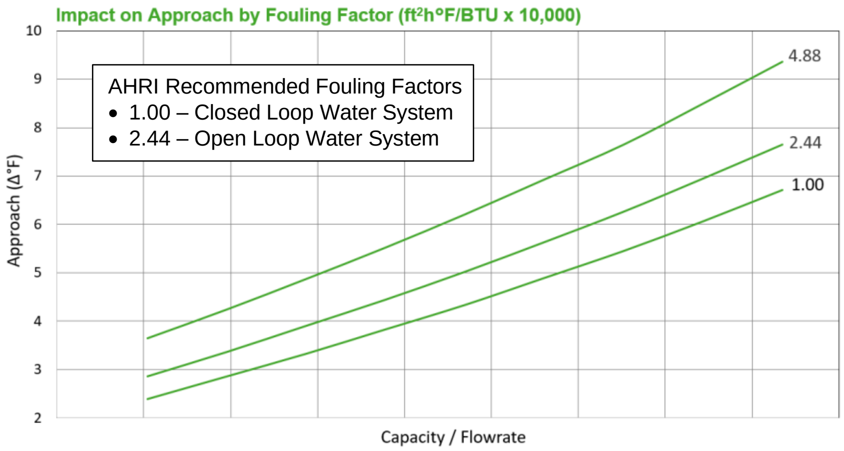
Each of these factors affect the efficiency of the heat exchanger which changes the Evap Temp and Approach. These three charts are provided to illustrate this change in Approach based on a factor, assuming other conditions are held constant.

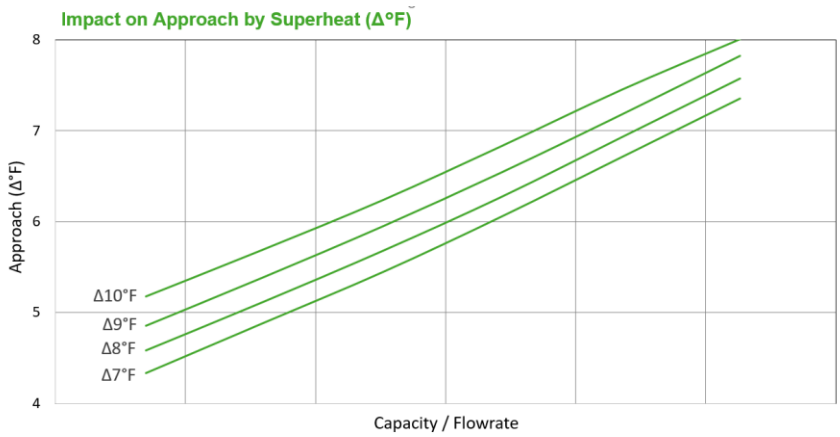
Fouling is the accumulation of dirt and deposits onto the heat exchange surface. Although this can occur on both inside and outside of tubes, usually the water side is the primary consideration. Fouling reduces heat transfer and therefore requires a lower Evap Temp (higher Approach) to maintain the same Capacity.

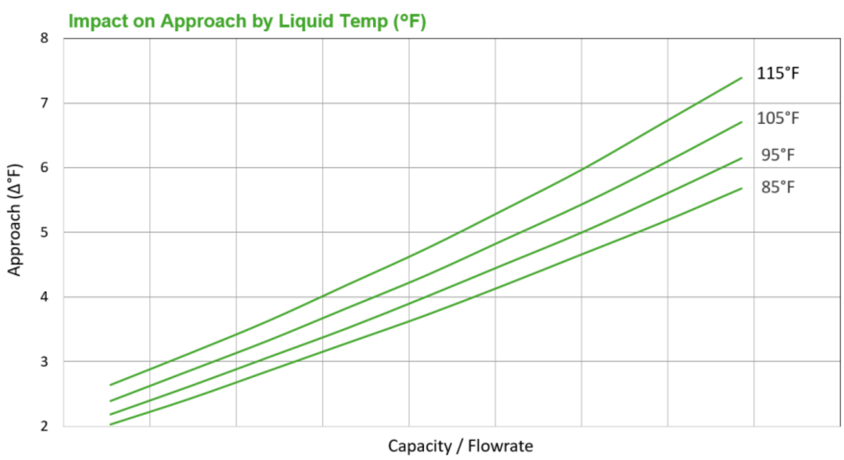
Superheat shrinks the area of the heat exchanger used for latent heat absorption. The decrease in heat exchange area requires a lower Evap Temp (higher Approach) to maintain the same Capacity.

Finally, an increase in **Liquid Temp** increases the quality (vapor content) of the refrigerant after the expansion valve resulting in reduction of capacity. Hence, the Evap Temp is lowered (or Approach increased) to maintain the same Capacity.

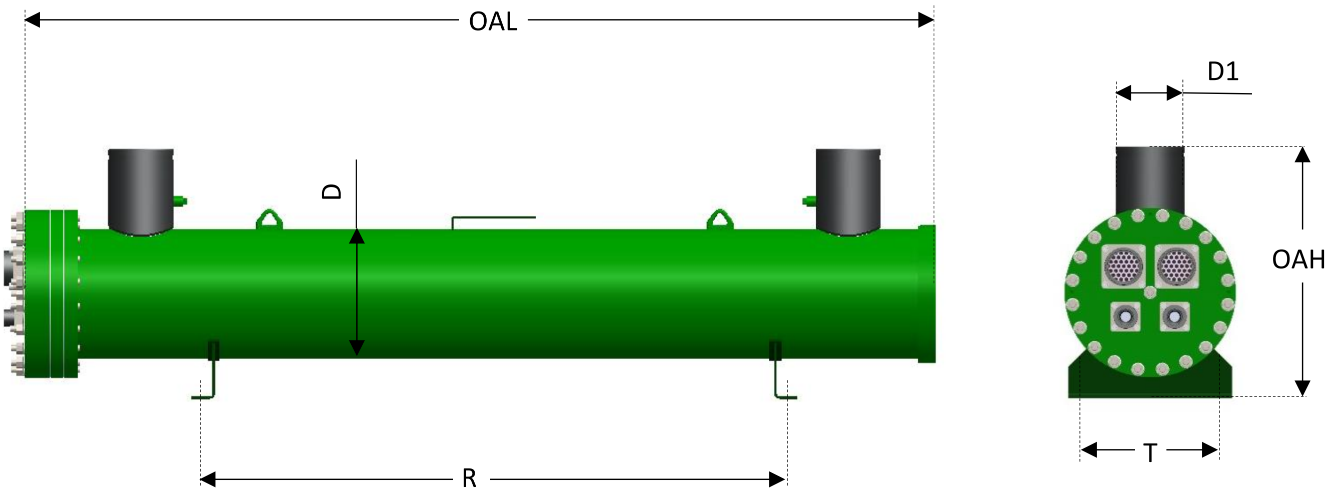








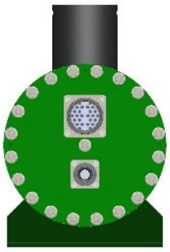
Dimensions



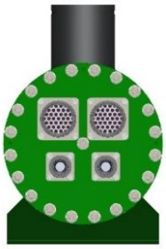
Model	Dimensions			Feet		Connection									Volumes-Weights		
	OAL	D	OAH	R	T	1 Circuit		2 Circuit		3 Circuit		4 Circuit		Water Conn. D1	Wt.	Vol. Tube side	Vol. Shell side
						Ref. Inlet	Ref. Outlet	Ref. Inlet	Ref. Outlet	Ref. Inlet	Ref. Outlet	Ref. Inlet	Ref. Outlet				
	in	in	in	in	in	in	in	in	in	in	in	in	in	NPS	Lbs.	ft^3	ft^3
DHA_-162	56	6-5/8	14 1/8	37 3/8	6 1/4	7/8	2 1/8	7/8	1 3/8	-	-	-	-	2.75	164	0.3	0.7
DHA_-164	70	6-5/8	14 1/8	47 1/4	6 1/4	7/8	2 1/8	7/8	1 3/8	-	-	-	-	2.75	188	0.4	0.8
DHA_-192	54	8-5/8	14 1/8	31 1/2	10 1/4	1 3/8	2 5/8	1 3/8	2 1/8	-	-	-	-	3	164	0.3	0.7
DHA_-193	60	8-5/8	14 1/8	37 3/8	10 1/4	1 3/8	2 5/8	1 3/8	2 1/8	-	-	-	-	3	164	0.3	0.7
DHA_-211	72	8-5/8	17 3/4	47 1/4	10 1/4	1 3/8	2 5/8	1 3/8	2 1/8	7/8	1 5/8	7/8	1 3/8	4	294	0.7	1.4
DHA_-212	80	8-5/8	17 3/4	55 1/8	10 1/4	1 3/8	2 5/8	1 3/8	2 1/8	7/8	1 5/8	7/8	1 3/8	4	313	0.7	1.6
DHA_-272	79	10-3/4	20 5/8	51 1/8	11 3/4	1 3/8	3 1/8	1 3/8	2 1/8	1 3/8	2 1/8	7/8	1 5/8	5	486	1.1	2.4
DHA_-273	79	10-3/4	20 5/8	51 1/8	11 3/4	1 3/8	3 1/8	1 3/8	2 1/8	1 3/8	2 1/8	7/8	1 5/8	5	503	1.2	2.2

Notes:
- All vessels are provided with a drain connection (G½”) on the opposite head from the refrigerant connections
- Dimensions are provided as a general and relative sizing guideline
- Individualized submittal drawings override dimensions and specifications shown here

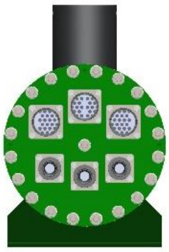
Dimensions



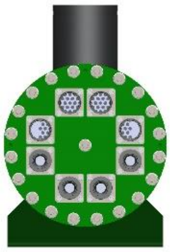
1 Circuit



2 Circuit



3 Circuit



4 Circuit*

Model	Dimensions			Feet		Connection									Volumes-Weights		
	OAL	D	OAH	R	T	1 Circuit		2 Circuit		3 Circuit		4 Circuit		Water Conn. D1	Wt.	Vol. Tube side	Vol. Shell side
						Ref. Inlet	Ref. Outlet	Ref. Inlet	Ref. Outlet	Ref. Inlet	Ref. Outlet	Ref. Inlet	Ref. Outlet				
	in	in	in	in	in	in	in	in	in	in	in	in	in	NPS	Lbs.	ft^3	ft^3
DHA_-322	92	12-3/4	24 5/8	59	11 3/4	1 3/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	1 3/8	2 1/8	6	715	1.8	3.9
DHA_-323	92	12-3/4	24 5/8	59	11 3/4	1 3/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	1 3/8	2 1/8	6	741	2.1	3.6
DHA_-402	88 5/8	16	28 5/8	55 1/8	15 3/4	-	-	1 3/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	8	1080	2.6	6.2
DHA_-404	109 1/8	16	28 5/8	70 7/8	15 3/4	-	-	1 3/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	8	1277	4.1	6.7
DHA_-451	94 1/2	18	30 5/8	59	12 1/4	-	-	1 3/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	8	1511	4.0	7.7
DHA_-452	94 1/2	18	30 5/8	59	12 1/4	-	-	1 3/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	8	1630	4.5	7.1
DHA_-501	112	20	34 5/8	70 7/8	13 3/4	-	-	1 5/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	10	1969	5.1	12.3
DHA_-502	112	20	34 5/8	70 7/8	13 3/4	-	-	1 5/8	3 1/8	1 3/8	3 1/8	1 3/8	2 5/8	10	2075	6.0	11.0

*DHA4-21_ and DHA4-27_ vary slightly from picture

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