

THERMALINE



CORRUGATED TUBULAR HEAT EXCHANGERS INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Thermaline

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Description

1.1 Safety precautions:

- Always read the installation instructions thoroughly. (See chapter, installation)
- Always use a lifting crane or device when handling the heat exchanger.

Operation

- Always read the operation section thoroughly (See chapter 3, operation)
- Never introduce hot fluid suddenly when heat exchanger is empty or cold.
- Never shock the heat exchanger with cold fluid when hot.

Transportation

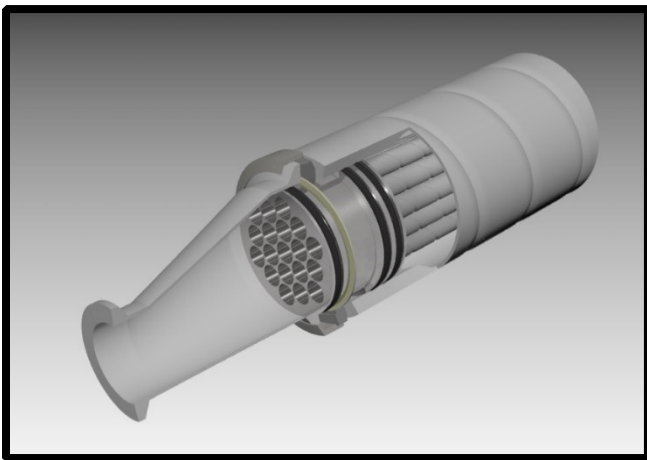
- Always transport the heat exchanger in its upright position.
- Always ensure that the unit is securely fixed during transportation.
- Never lift or elevate in any way other than described in this manual.

1.2 Application

- Thermaline corrugated tubular heat exchangers are designed to process a wide range of fluids with or without particulates and are hygienic in design meeting FDA and 3-A guidelines for food processing as well as rugged design for industrial uses. Corrugations on the tubes may vary in pitch and depth and are optimized to create turbulence.

1.3 Working principle

- Double tube, triple tube and multi tube heat exchangers all function similarly in that product flows through a tube with heating/cooling media in the shell and/or inner core tube.
- All floating series corrugated tubular heat exchangers are designed to accommodate for thermal expansion and contraction by moving independently via elastomer seals between the joints making the individual tubes serviceable. Multi tubes are only serviceable as a tube bundle. All elastomers are designed to leak to atmosphere in the event of a failure eliminating the potential for cross contamination due to seal failure.



Cut away view of a typical multi tube heat exchanger. O ring seals positioned to prevent intermixing in the event of a leak.

- All welded tubular designs utilize an expansion bellow to accommodate for thermal expansion and are only serviceable as an assembly.

Installation

Thermaline corrugated tubular systems are designed to be freestanding, wall mount or ceiling mounted with provisions for lifting and transportation. Frames are built to customer specifications with either adjustable feet or mounting plates with bolting holes.

2.1 Clearance

-When installing the heat exchanger, be sure to provide sufficient clearance at one or both ends to permit dismantling of the u bends, jumpers and possible future inspection and removal of the tubes.

Caution: Both double tube heat exchangers and triple tube heat exchangers are directional in which the inner tubes can only be removed in the direction of the removable header.

2.2 Foundations

-Foundations must be adequate so that the exchanger will not settle and impose excessive strains on the exchanger. Foundation bolts should be set to allow for setting inaccuracies.

2.3 Leveling

-The heat exchanger must be set so that pipe connections can be made without forcing. However, small forces might be unavoidable, small forces are then acceptable.

2.4 Cleanliness

- Protective plugs should not be removed from connections until just prior to installation.

- The entire system should be cleaned before starting operation. All exchanger openings should be inspected for foreign material before operation.

2.5 Fittings and piping

-By-pass valves.

User may install valves and by-passes in the piping system to permit inspection and repairs.

-Test connections.

The user may opt to install a thermometer well and/or pressure gauge connections close to the exchanger.

-Vents.

The user may install vent valves close to the exchanger.

-Pulsation and vibration.

Care should be taken to eliminate or minimize transmission of fluid pulsations and mechanical vibrations into the heat exchanger.

-Safety relief devices.

It is the user's responsibility to install the required safety devices.

Operation

3.1 General

The heat exchanger must not be operated at conditions, which exceed those specified on the data plate.

Caution: If the heat exchanger surface temperature is expected to be hot or there are local regulations related to surface temperature, it is the users' responsibility to either insulate the unit or take precautions by labeling the unit with a warning about the hot surface temperature to avoid risk of personnel injuries

Special Instructions: Before placing the heat exchanger in operation, reference should be made to the as built documentation for any special instruction.

Regulations: Local safety and health regulations must be considered.

Improper start-up or shutdown sequences may cause leaking of tube-to-tube and/or floating joints. It is the customer's responsibility to carefully pay attention and ensure a proper start-up and operation when running media with a higher risk for damages on the heat exchanger.

3.2 Startup

-During start-up all vent valves should be opened and left open until all passages have been purged of air and are completely filled with fluid. Fluid must be introduced in a manner to minimize differential expansion between the tubes.

Caution: Adjustments of flow rates should be made slowly to avoid the risk of pressure surge or water hammer. Water hammer is a short-lasting pressure peak that can appear during start-up or shut-down of a system, causing liquids to travel along a pipe as a wave at the speed of sound. This can cause considerable damage to the equipment.

-Shutdown operation: The heat exchanger must be shut down in a manner that minimizes different expansions between tubes. When shutting down the system, the heat exchanger should be drained completely.

-Temperature shocks: The heat exchanger should not be subjected to abrupt temperature fluctuations. Hot fluid must not be suddenly introduced when the unit is cold nor cold fluid suddenly introduced when the unit is hot.

-Joints: The heat exchanger is pressure tested before leaving the manufacturers shop in accordance with various standards. However, normal relaxing of the gasketed joints may occur in the interval between testing in the manufacturer's shop and installation at the job site. Therefore, all external joints may require retightening after installation and, if necessary, after the heat exchanger has reached operating temperature.

Maintenance

4.1 Inspection

At regular intervals and as frequently as experience indicates, an examination should be made of the interior and exterior condition of the unit. Neglect in keeping all tubes clean may result in decreased performance of the heat exchanger.

4.2 Fouling

Heat exchangers are subject to fouling or scaling which should be cleaned periodically. A light sludge or scale coating on the tube greatly reduces its thermal efficiency not only on the product side but the media side as well. An increase in pressure drop and/or reduction in performance usually indicate that cleaning is necessary.

4.3 CIP Clean in place

-Tubular heat exchangers are designed to be chemically cleaned in place. CIP is a function of the process and adequate time, temperature, flow and concentrations are needed for satisfactory cleaning.

Caution: Chemicals used for cleaning must be compatible with materials of construction.

4.4 Inspection and manual cleaning

Before disassembly the user must assure that the unit has been locked out, de-pressurized, ambient temperature and drained.

To inspect the inside of the product tubes, remove the U bends and or jumpers.

-Multi Tubes: Remove the reducer to access product tubes.

-Double Tubes: Product tubes may be accessed upon removal of the U bends.

-Triple tubes: Once the U bends are removed the headers will need to be removed to access the product tubes.

-Regeneration: Double tubes and Triple tubes configured for product to product regeneration will have all tubes in contact with product and complete disassembly is required.

4.5 Leaks internal and external

-External leaks: All floating series tubular heat exchangers are designed so that an elastomer failure will leak to the ground. Identify the leaking elastomer and follow disassembly/assembly procedures to replace the elastomer.

-Internal leaks: Internal leakage can cause intermixing of fluids and will not be visible. Tubular heat exchangers used in sanitary applications should be tested regularly with the Thermaline Cross Contamination Tester (CCT 4.0) Visit www.Thermaline.com/cct to find out more.

Assembly/Disassembly

(Floating series only, all welded Units are serviceable only as an assembly)

- Before disassembly the user must assure that the unit has been locked out, de-pressurized, reached ambient temperature and drained.
- Remove all U bends, and connecting pipes to the heat exchanger. Reinstall all pipes after re-sealing the heat exchanger and follow start up procedures.

5.1 Multi Tubes (Seal Replacement):

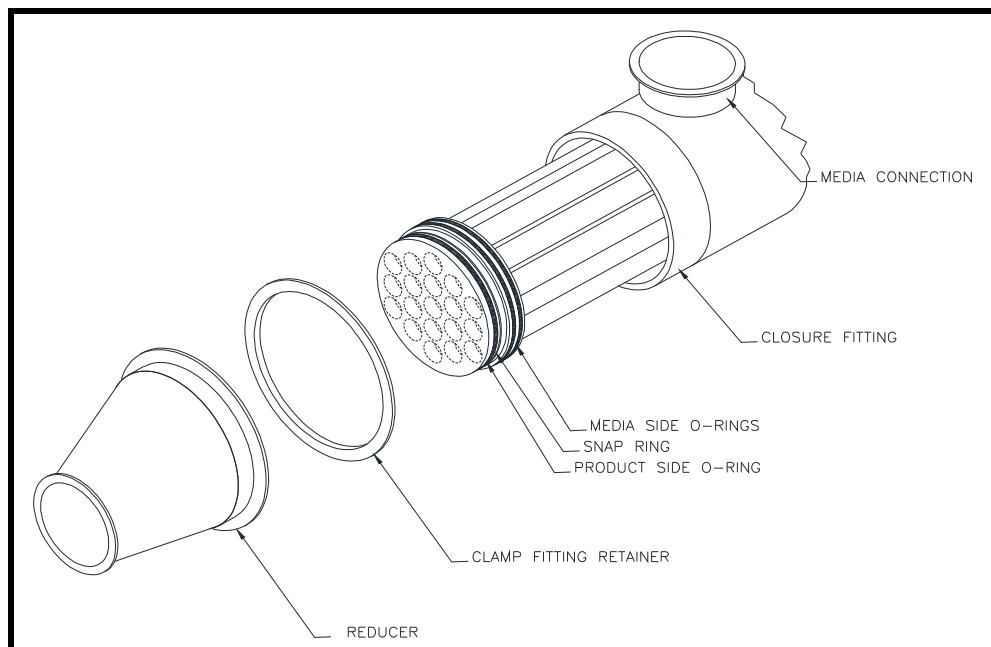


Figure 1- Exploded View of a Multi Tube Heat Exchanger

Disassembly

- Remove reducer clamp and reducer. Clean and inspect reducer.
- Remove outer O Ring and snap ring. Clean and inspect tube sheet surfaces
- Remove retainer

Figure 2- Multi Tube Disassembly step 1

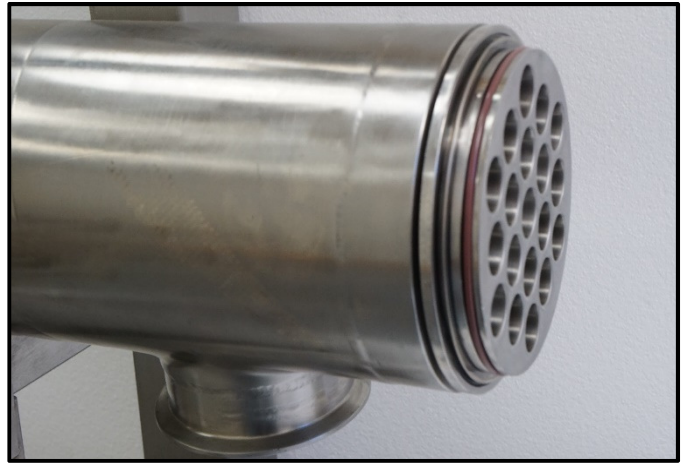


Figure 2

- Clean and inspect surface ID of the shell

Figure 3- Multi Tube Disassembly step 2

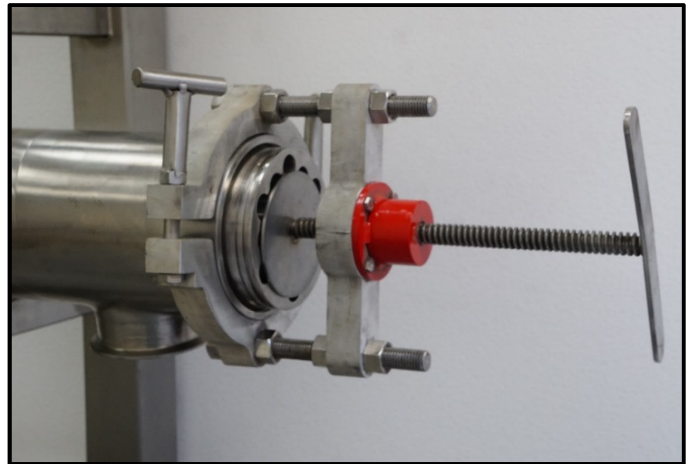


Figure 3

- Attach tube bundle pusher and push tube bundle until tube sheet is separated from shell on opposite end. (The tube bundle can be completely removed which is not necessary if only the seals are to be replaced)

Figure 4- Multi Tube Disassembly step 3

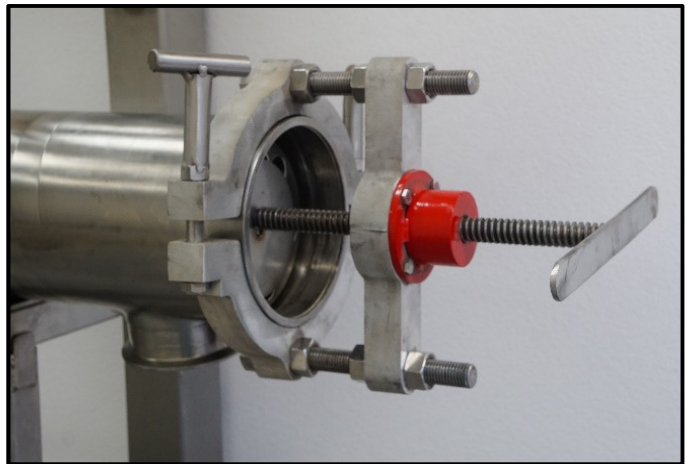


Figure 4

- Remove the two O rings from tube sheet opposite end of pusher
- Reattach the pusher to this side and repeat the previous steps

Figure 5-Multi Tube Disassembly step 4

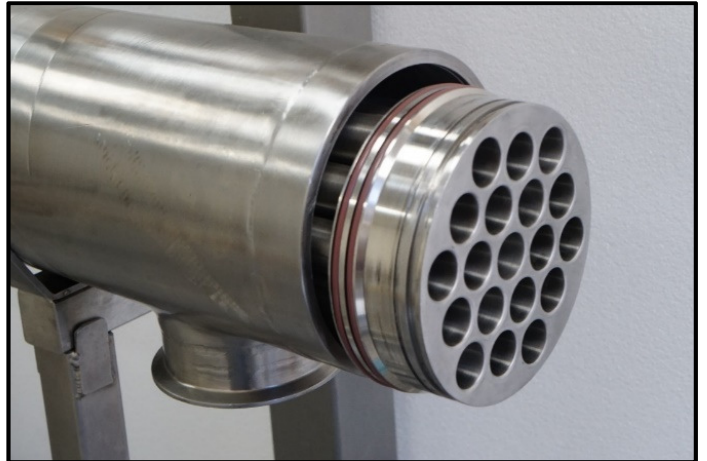


Figure 5

Reassembly

- Install new O rings and lube both the O rings and shell ID.
- Push the bundle into the shell and out the opposite end until the tube sheet is accessible.
- Caution:** Do not to tear or stress the O rings as they pass into the shell.
- Install new O rings onto the exposed tube sheet, lube and push the bundle into the shell until it is centered.

Figure 6-Multi Tube Assembly step 1



Figure 6

- Install retainer, snap ring and new O ring onto tube sheet. Lube O ring and ID of the reducer.
- Push reducer over the tube sheet careful not to damage the O ring and install clamp.

Figure 7-Multi Tube Assembly step 2

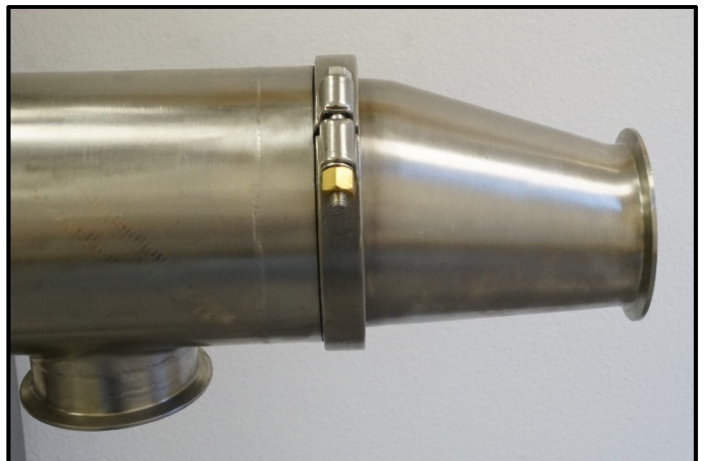
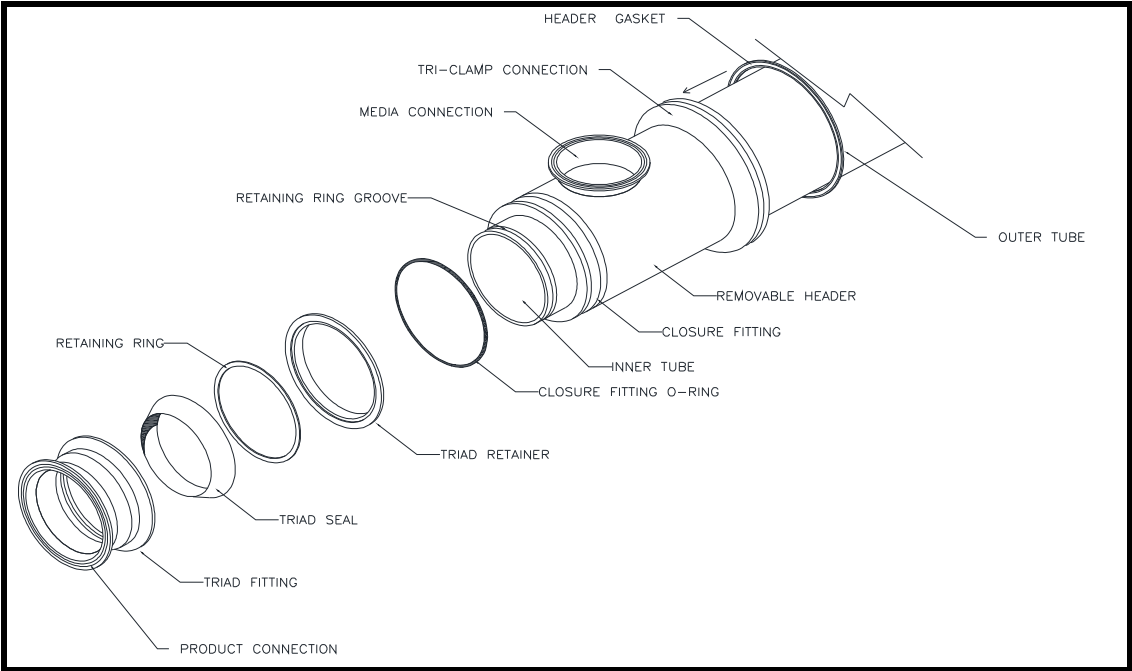


Figure 7

5.2 Double tube



Disassembly

-Remove triad seal, snap ring and retainer from inner tube both sides.

Figure 8- Double Tube Disassembly Step 1



Figure 8

-Remove header clamp and header closure O ring.

-Slide Inner tube out exposing closure O ring opposite end, remove O ring and clean and inspect all surfaces.

-Install new closure fitting O rings into the shell and header.

Figure 9- Double Tube Disassembly Step 2

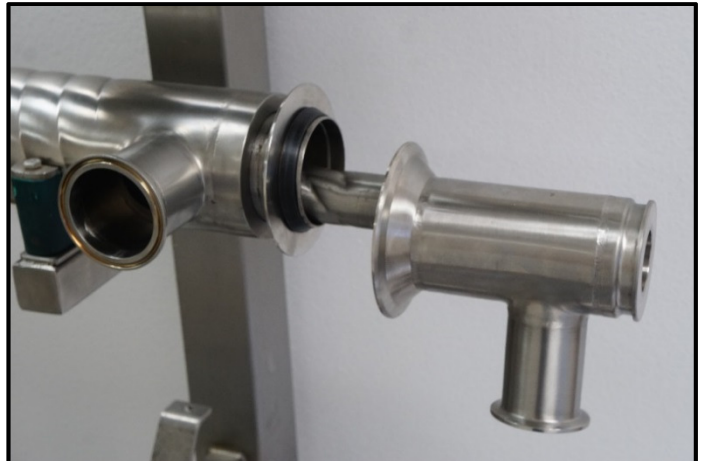


Figure 9

Reassembly

-Carefully push inner tube through closure fitting so as not to damage the O ring.

-Install new header gasket and header. Clamp header to shell.

-Install retainer, snap ring and seal both sides.

Figure 10- Double Tube Assembly Step 1

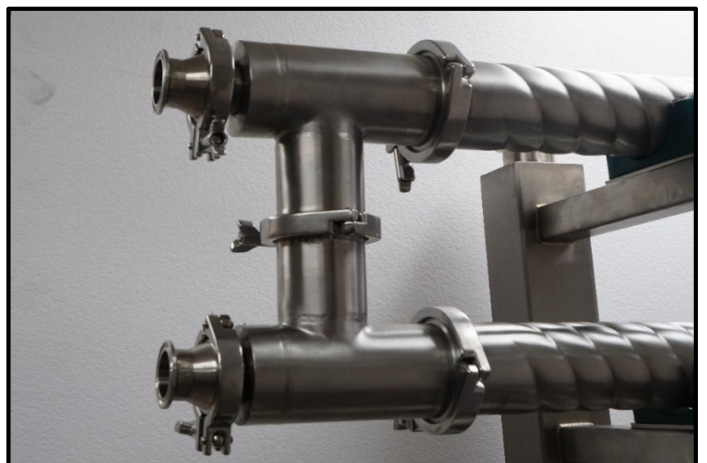
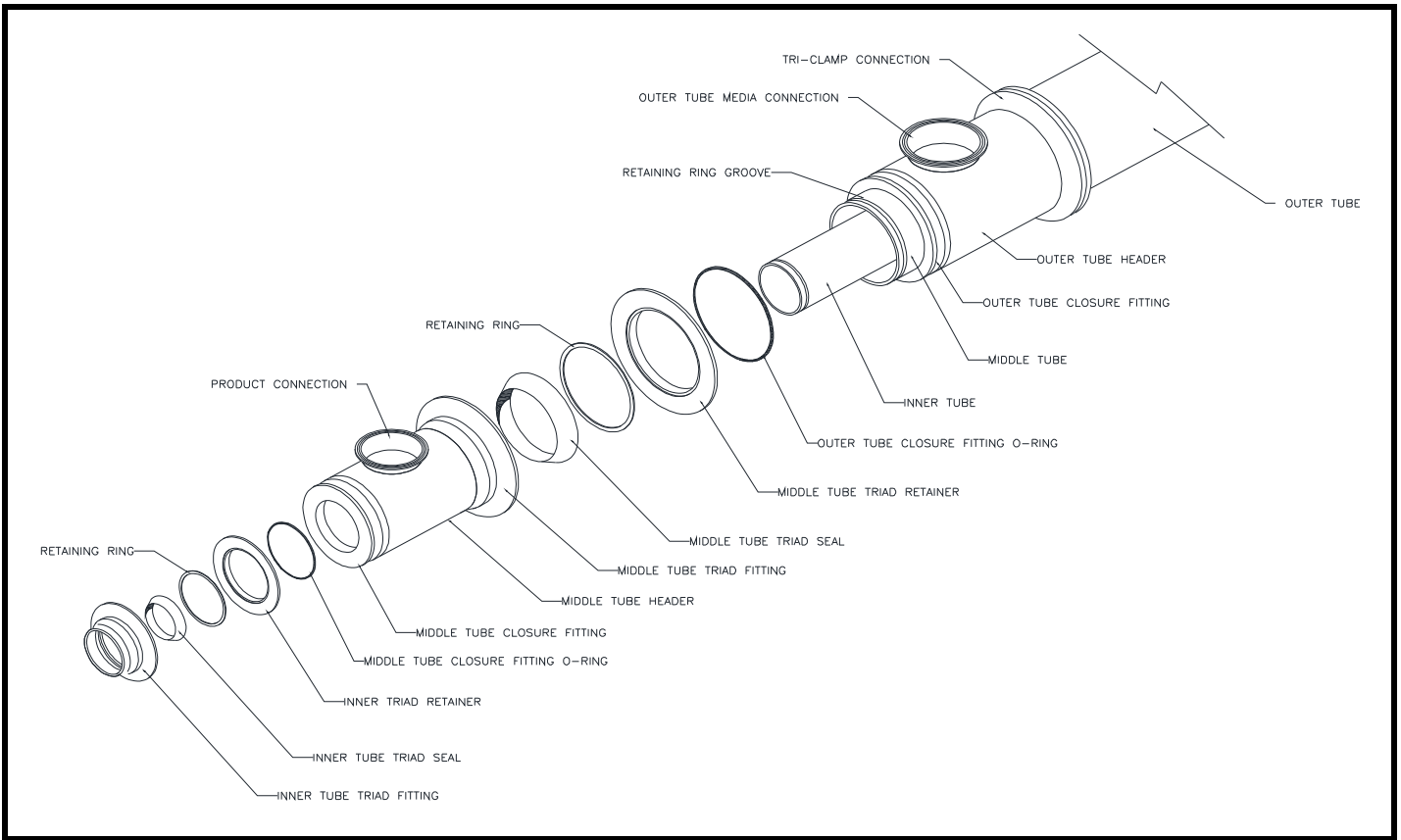


Figure 10

5.3 Triple tube



Disassembly

-Remove triad seal, snap ring and retainer from inner tube.

-Remove middle tube header clamps, headers and closure O ring both sides.

Figure 11- Triple Tube Disassembly step 1



Figure 11

-Remove outer tube header clamp, header and closure O ring.

Figure 12- Triple Tube Disassembly step 2

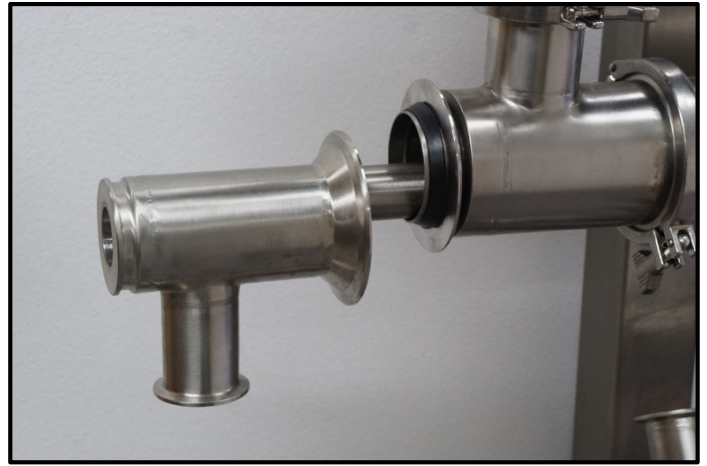


Figure 12

Push inner tube from outer tube exposing closure fitting O ring
-Inspect and clean all mating surfaces.
Replace all seals and apply lube to all mating surfaces.

Figure 13- Triple Tube Disassembly step 3

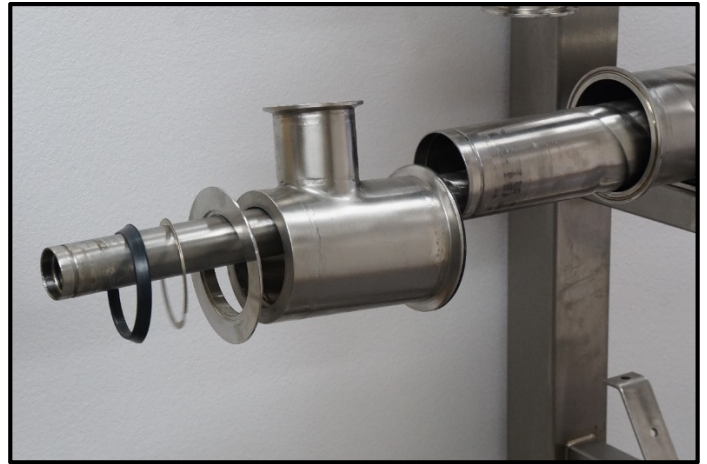


Figure 13

Assembly

-Push middle tube into outer tube closure fitting. Install new gasket to the header and clamp outer tube.

-Install new gaskets to mid tube headers and push header and clamp

Figure 14- Triple Tube Disassembly step 4

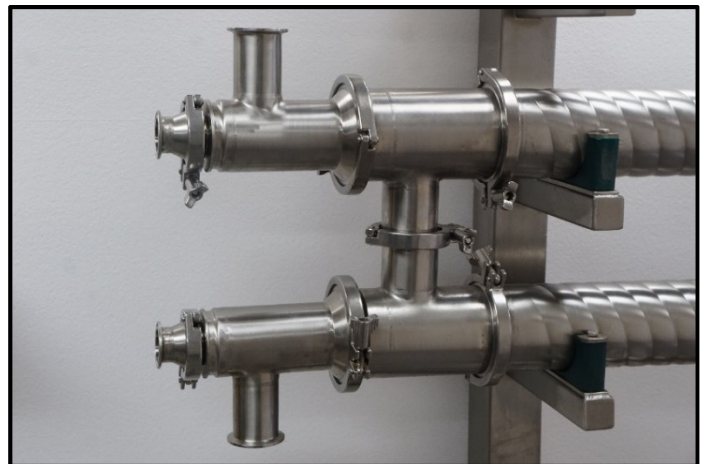


Figure 14

Multi Tube Part Numbers

Multi tube part number guide for standard floating units (refer to assembly documentation for actual sizes)

Model	Shell Diam	Shell to Shell Clamp	Shell to Shell Gasket	Inner Tube Diam	Inner Tube Qty	Retainer	Shell O Ring (Media Side)	Qty	Snap Ring	Jumper O Ring (Product Side)	U Bends Elbows	U Bend Gasket	U Bend Clamp	Dry Weight	Flooded Weight	Hold Up Inner Per 10'	Hold Up Shell Per 10'	MAWP (PSI) Shell Side @ 250 Deg F	MAWP (PSI) Tube Side @ 250 Deg F	
	inches	Qty (1)	Qty (1)	inches	Qty	Qty (2)	*		Qty (2)	Qty (2)	Qty (2)	Qty (1)	Qty (1)	LBS	LBS	Gallons	Gallons			
M378-3	3" Tube	40272	40444	1/2"	7	20960		228	2	21921	227	40286	40446	40274	42.06	70.106	0.3910	2.9697	250	200
M3412-3	3" Tube	40272	40444	3/4"	4	20960		228	2	21921	227	40286	40446	40274	39.92	67.966	0.6273	2.7333	250	200
M3712-3	3" Tube	40272	40444	3/4"	7	20960		228	2	21921	227	40286	40446	40274	54.38	82.426	1.0978	2.2628	250	200
M4198-3	4" Tube	40273	40446	1/2"	19	N/A		239	1	N/A	N/A	40286	40446	40274	93.32	143.371	1.0612	4.9362	150	200
M4712-3	4" Tube	40273	40446	3/4"	7	N/A		239	1	N/A	N/A	40286	40446	40274	68.92	118.971	1.0978	4.8996	150	200
M4416-3	4" Tube	40273	40446	1"	4	N/A		239	1	N/A	N/A	40286	40446	40274	59.7	109.751	1.2353	4.7622	150	200
M51912-4	5" Tube	40275	40447	3/4"	19	20970						40286	40446	40274	134.9	214.465	2.9799	6.5541	125	100
M51916-4	5" Tube	40275	40447	1"	19	20970						40286	40446	40274	159.79	239.355	5.8675	3.6665	125	100
M61912-3	6" Sch 5 Pipe	40275	40447	3/4"	19	20980		256	2	21928	254	40286	40446	40274	184.48	322.078	2.9799	13.5080	125	200 (HD Clamp)
M61912-4	6" Sch 5 Pipe	40275	40447	3/4"	19	20980		256	2	21928	254	40287	40447	40275	184.48	322.078	2.9799	13.5080	125	200 (HD Clamp)
M61916-3	6" Sch 5 Pipe	40275	40447	1"	19	20980		256	2	21928	254	40286	40446	40274	209.37	346.968	5.8675	10.6204	125	200 (HD Clamp)
M61916-4	6" Sch 5 Pipe	40275	40447	1"	19	20980		256	2	21928	254	40287	40447	40275	209.37	346.968	5.8675	10.6204	125	200 (HD Clamp)

Double Tube Part Numbers

Double Tube part numbers and general specifications (standard design) Confirm sizes with your assembly documentation

Model	Outer Diam	Header	Header To Shell Clamp	Header to Shell Gasket	Shell to Shell Clamp	Shell to Shell Gasket	Triad Seal	Retainer	Snap Ring	Retainer Clamp	Dry Weight Per 10'	Flooded Weight Per 10'	Hold Up Inner Per 10'	Hold Up Shell Per 10'	MAWP Shell Side @ 250 Deg F	MAWP Tube Side @ 250 Deg F
	inches	Qty (1)	Qty (2)	Qty (2)	Qty (1)	Qty (1)	Qty (2)	Qty (2)	Qty (2)	Qty (2)	LBS	LBS	Gallons	Gallons		
DT-151	1.5	22051	40271	40443	40271	40442	42000	20925	21901	40271	16.63	22.23	0.309	0.358	250	250
DT-21	2	22052	40272	40444	40271	40443	42000	20925	21901	40271	20.13	31.23	0.309	1.019	250	250
DT-251	2.5	22053	40273	40445	40272	40444	42000	20925	21901	40271	23.65	41.96	0.309	1.884	250	250
DT-2515	2.5	22053	40273	40445	40272	40444	42005	20928	21903	40272	27.22	45.04	0.766	1.374	250	250
DT-315	3	22054	40274	40446	40273	40445	42005	20928	21903	40272	30.74	57.46	0.766	2.443	200	250
DT-32	3	22054	40274	40446	40273	40445	42010	20932	21905	40273	34.24	60.55	1.426	1.729	200	250
DT-42	4	22055	40275	40447	40274	40446	42010	20932	21905	40273	48.80	97.07	1.426	4.365	150	250
DT-425	4	22055	40275	40447	40274	40446	42015	20935	21907	40274	52.32	100.15	2.291	3.447	150	200
DT-43	4	22055	40275	40447	40274	40446	42020	20938	21909	40275	55.84	103.24	3.359	2.325	150	150
DT-525	5	22056	40276	40448	40275	40447	42015	20935	21907	40274	60.44	137.73	2.291	6.984	125	200
DT-53	5	22056	40276	40448	40275	40447	42020	20938	21909	40275	63.96	140.81	3.359	5.862	125	150
DT-63	6	22057	40518	40449	40275	40447	42020	20938	21909	40275	85.14	196.19	3.359	9.968	125	150
DT-64	6	22057	40518	40449	40275	40447	42025	20940	21911	40518	99.70	208.92	5.995	7.112	125	125

Triple Tube Part Numbers

Triple Tube part numbers and general specifications (standard design) Confirm sizes with your assembly documentation

Model	Inner Tube OD	Triad Seal	Retainer	Snap Ring	Retainer Clamp Inner Tube	Mid Tube OD	Triad Seal Mid Tube	Retainer	Snap Ring	Retainer Clamp Mid Tube	Mid tube To mid tube clamp	Mid tube to mid tube Gasket	Closure Fitting O Ring Mid Tube	Outer Tube OD	Header to Shell Clamp	Header to Shell Gasket	Closure Fitting O Ring	Header To Header Clamp	Header To Header Gasket	Hold Up Shell per 10'	Hold Up Middle Only per 10'	MAWP Product Side @ 250 Deg F	MAWP Media Side @ 250 Deg F
	inches	Qty (2)	Qty (2)	Qty (2)	Qty (2)	inches	Qty (2)	Qty (2)	Qty (2)	Qty (2)	Qty (1)	Qty (1)	Qty (2)	inches	Qty (2)	Qty (1)	Qty (2)	Qty (1)	Qty (1)	Gallons	Gallons		
TT-25151	1	42000	20925	21901	40271	1.5	42005	20928	21903	40272	40271	40442	214	2.5	40273	40445	222	40272	40444	1.683	0.358	250	250
TT-2521	1	42000	20925	21901	40271	2	42010	20932	21905	40273	40271	40443	214	2.5	40273	40445	226	40272	40444	0.969	1.019	250	250
TT-25215	1.5	42005	20928	21901	40272	2	42010	20932	21905	40273	40271	40443	222	2.5	40273	40445	226	40272	40444	1.425	0.509	250	250
TT-321	1	42000	20925	21901	40271	2	42010	20932	21905	40273	40271	40443	214	3	40274	40446	226	40273	40445	2.037	1.019	250	200
TT-3215	1.5	42005	20928	21903	40272	2	42010	20932	21905	40273	40271	40443	222	3	40274	40446	226	40273	40445	2.494	0.509	250	200
TT-3251	1	42000	20925	21901	40271	2.5	42015	20935	21907	40274	40272	40444	222	3	40274	40446	230	40273	40445	1.119	1.884	250	200
TT-32515	1.5	42005	20928	21903	40272	2.5	42015	20935	21907	40274	40272	40444	222	3	40274	40446	230	40273	40445	1.576	1.374	250	200
TT-3252	2	42010	20932	21905	40273	2.5	42015	20935	21907	40274	40272	40444	226	3	40274	40446	230	40273	40445	2.237	0.660	250	200
TT-4251	1	42000	20925	21901	40271	2.5	42015	20935	21907	40274	40272	40444	214	4	40275	40447	230	40274	40446	3.756	1.884	250	200
TT-42515	1.5	42005	20928	21903	40272	2.5	42015	20935	21907	40274	40272	40444	222	4	40275	40447	230	40274	40446	4.213	1.374	250	2150
TT-431	1	42000	20925	21901	40271	3	42020	20938	21909	40275	40273	40445	214	4	40275	40447	337	40274	40446	2.634	2.953	200	150
TT-4315	1.5	42005	20928	21903	40272	3	42020	20938	21909	40275	40273	40445	222	4	40275	40447	337	40274	40446	3.091	2.443	200	150
TT-432	2	42010	20932	21905	40273	3	42020	20938	21909	40275	40273	40445	226	4	40275	40447	337	40274	40446	3.752	1.729	200	150
TT-4325	2.5	42015	20935	21907	40274	3	42020	20938	21909	40275	40273	40445	230	4	40275	40447	337	40274	40446	4.617	0.811	200	150
TT-532	2	42010	20932	21905	40273	3	42020	20938	21909	40275	40273	40445	226	5	40276	40448	230	40275	40447	7.289	1.729	200	125
TT-5415	1.5	42005	20928	21903	40272	4	42025	20940	21911	40518	40274	40446	222	5	40276	40448	345	40275	40447	3.772	5.079	150	125
TT-542	2	42010	20932	21905	40273	4	42025	20940	21911	40518	40274	40446	226	5	40276	40448	345	40275	40447	4.433	4.365	150	125
TT-5425	2.5	42015	20935	21907	40274	4	42025	20940	21911	40518	40274	40446	230	5	40276	40448	345	40275	40447	5.298	3.447	150	125
TT-642	2	42010	20932	21905	40273	4	42025	20940	21911	40518	40274	40446	226	6	40518	40449	345	40275	40447	8.539	4.365	150	125

Notes:

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