



INSTALLATION, OPERATION, & MAINTENANCE MANUAL

Thermaflo Engineering Company

STEAM-TO-STEAM GENERATORS



THERMAFLO ENGINEERING COMPANY, INC. LIMITED WARRANTY AND REMEDY

Thermaflo Engineering Company Inc. warrants to the original user of the Thermaflo Engineering equipment supplied by it and used in the service and in the manner for which they are intended, that such product shall be free from defects in material and workmanship for a period of 1 year from the date of installation, but no longer than 15 months from the date of shipment from the factory (unless a special warranty period applies as listed below). This warranty does not extend to any product that has been subject to misuse, neglect, or alteration after shipment from the Thermaflo Engineering Company factory, except as may be expressly provided in a written agreement between Thermaflo Engineering Company and the user, which is signed by both parties.

THERMAFLO DOES NOT MAKE ANY OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

The sole and exclusive remedy with respect to the above limited warranty or with respect to any other claim relating to the products or to the defects or any condition or use of the products supplied by Thermaflo, however cause, and whether such claim is based upon warranty, contract, negligence, strict liability, or any other basis or theory, is limited to Thermaflo's repair or replacement of the part or product, excluding labor or any other cost to remove or install said part of product, or at Thermaflo's option, to repayment of the purchase price. As a condition of enforcing any rights or remedies relating to Thermaflo products, notice of any warranty or other claim relating to the products must be given in writing to Thermaflo: (i) within 30 days of the last day of the applicable warranty period, or (ii) within 30 days of the date of the manifestation of the conditions or occurrence giving rise to the claim, whichever is greater. In no event shall Thermaflo Engineering Company be liable for special, direct, indirect, incidental, or consequential damages including, but not limited to, loss of use or profits or interruption of business. Thermaflo Engineering Company will not be held responsible for piping leaks after factory hydrotesting. Remedy of piping leaks and their prompt repair are the sole responsibility of the installer or user. The



Limited Warranty and Remedy terms herein apply notwithstanding and contrary terms in any purchase order or form shall be deemed rejected by Thermaflo Engineering Company Inc.

STANDARD TERMS & CONDITIONS

1. All purchase orders are subject to written acceptance at the office of Thermaflo Engineering Company, 12249 Nations Ford Road, Pineville, NC 28134.
2. Cancellation charges of 100% will apply if cancellation occurs after receipt of signed submittal drawings and release for fabrication.
3. Payment Terms: Net 30 Days from date of invoice unless other terms are stated as part of our quotation.
4. All invoices over thirty days will be subject to finance charges of 1½% per month.
5. Warranties are the responsibility of the manufacturers represented by Thermaflo Engineering Company. A copy of the manufacturer's standard warranty may be included with this proposal.
6. All sales are FOB: Factory unless otherwise specified by Thermaflo Engineering Company. Transportation will be at the buyer's sole risk and claims for loss or damages in transit are the responsibility of and must be filed by the buyer within 5 days of shipment delivery.
7. No terms, warranties, or guarantees express or implied, except as stated herein, shall apply to any quotation, sale, or contract for sale unless approved in writing by Thermaflo Engineering Company.
8. If shipment is deferred at buyer's request, payment shall nevertheless be due after notice to the buyer that the equipment is ready for shipment. Reasonable storage charges shall be paid by the buyer after seven days.



INTRODUCTION

Thermaflo Engineering Company (TEC) manufactures steam-to-steam generators using high pressure steam (150 psig max) to produce lower pressure clean steam. Thermaflo generators can also use high temperature hot water or hot oil to produce low-pressure steam. This manual will review all aspects of operation in a complete but general nature.

Each generator is custom engineered to furnish clean or pure steam to its users. All Thermaflo Steam-to-Steam Generators are furnished with manuals on each of the controlling or indicating components. These individual manuals should be reviewed for proper operation and troubleshooting if necessary.

All Thermaflo Engineering Steam-to-Steam Generators are constructed to the strict guidelines of the ASME Code and stamped in accordance with this code. Local codes should be reviewed before installation and made available to Thermaflo Engineering Company.

Thermaflo Engineering Company is not responsible for product damages or injuries due to the improper operation or maintenance of its equipment.

Thermaflo Engineering Company selects and uses products of other manufacturers to properly control their equipment and cannot be held responsible for the proper maintenance and operation of the components or the manuals furnished by these manufacturers. These manufacturers are selected on their high quality and past experienced reliability. Their manuals should be reviewed and Thermaflo Engineering strongly encourages that these companies be consulted as the need requires for information, maintenance, or operating manuals.



GENERAL OPERATIONAL DESCRIPTION

Thermaflo Engineering Steam-to-Steam Generators are constructed with two major component systems.

- *Energy Source Point System*
This is the inner tube bundle. The steam, high temperature water, or hot oil enters the generator at the tube bundle head and delivers the heat to the feedwater until it changes from a liquid state into the vapor state STEAM. Steam is a useful but hot and dangerous medium.
- *Liquid Feedwater or Makeup System*
As the liquid feedwater is changed by heat energy into a vapor state STEAM, and is delivered out to its point of use, it must be replaced by additional feedwater or makeup so that the vapor supply can continue to be delivered. The feedwater system automatically replenishes this makeup to the generator shell where the change in state can take place.

The energy source in most cases is high-pressure steam or a steam at a higher pressure in the tubes than is being produced from the shell. This source steam is controlled to the tube bundle by a steam control valve and a feedback controller. The feedback controller senses the clean steam pressure being produced in the shell, compares the pressure to its set point, and sends the steam control valve a signal as to open or close proportionally to hold the set point. This signal can be pneumatic, electronic, or pilot-connected self-operated.

As the feedwater in the shell (outside the inner tube bundle) is heated by the incoming steam (inside the tube bundle) to its saturation point, the feedwater changes state and becomes a vapor (steam).

As the steam flows from the generator outlet to its point of use, the feedwater level drops. A level controller senses this level drop and sends a control signal to the makeup control valve to open or close in order to hold a precise level of feedwater in the shell. Again, this control signal can be electric or pneumatic in nature. Always refer to your specific submittal drawing.

These two systems operate in conjunction with each other to create a supply of clean steam to its users.

Control Panel Operation Note:

*****Important- Repeated cycling of power will cause saved program error.
This will void the factory warranty setup in the controller.*****



INSTALLATION

- *Location*

Thermaflo Steam-to-Steam Generators should be located in a space where maintenance, when required, can be performed without removal of other equipment. A major consideration for installation would be the unobstructed distance in front of the head for tube bundle removal. This distance is indicated on the submittal drawing furnished with each unit. A proper housekeeping concrete pad should be constructed of approx. 4" in height so that the loner saddle or frame supports are not subjected to water, chemicals, or excessive moisture causing rust or deterioration. Steam supply, clean steam outlet, and feedwater piping connections should be close to the unit for ease of accessibility. A proper blowdown drainage point should be located in the area and it is highly recommended to use a Thermaflo type FS Blowdown Aftercooler / Separator unit to accommodate blowdown in the area. **REMEMBER: Do not discharge hot blowdown above 140 °F to drain. Check with local codes for proper drain temperature.**

- *Mounting/Install*

The Thermaflo Steam-to-Steam Generator should be properly secured to the housekeeping pad or floor. Anchor points are provided with each unit for this purpose. Be sure to check the specifications for proper fasteners and seismic codes for the site or project.

- *Source Steam Piping*

The source steam piping should be saturated and dry. A main drip trap point is supplied with each unit located at the inlet to the control valve. The steam supply line should never be smaller than the source steam inlet connection. The inlet source steam connection can be located in the submittal drawing connection schedule and has been properly sized for the load by Thermaflo. The main supply line should have drip stations at minimum every 150' so that water hammer conditions do not occur.

Water hammer will destroy the tube bundle and control valve internals. Always start up the system slowly to avoid this situation. It is always advisable to contact your local Thermaflo representative about proper steam piping design.

Dry steam means long life and optimum performance.

- *Feedwater Supply*

The feedwater supply to the generator should be clean, filtered, and softened to avoid hard water scale out. The feedwater supply should be at least one pipe size larger than the feedwater control valve size to allow for minimum pressure drop on long runs. The feedwater pressure should



always be at minimum 15 psig above the clean steam pressure being generated. For example, if the clean steam pressure being generated is 15 psig, the feedwater pressure should be 30 psig minimum. **Water should be no more than 1 grain per gallon hardness.**

All Thermaflo Steam-to-Steam Generators are furnished with a check valve on the outlet of the feedwater level control valve. If the generator is being supplied feedwater via a feed pump, a feedwater control valve may or may not be furnished. Check the 'Submittal Sheet' or contact your Thermaflo representative. Installers should be careful when using Teflon tape or excessive joint compound as not to let this material flow into the check valve or feedwater control valve.

- *Safety Relief Valves*

Each Thermaflo Steam-to-Steam Generator is fitted with pressure safety relief valves to protect the shell against overpressure. The outlet should be piped unrestricted to atmosphere. Never install a valve of any type on the outlet of the safety valve. This could cause serious injury and major damage to the generator. Local piping codes and engineers' specifications should be followed.

The discharge point should be to an area where it cannot be in contact with any person, equipment, or other obstruction. The discharge will consist of steam and hot water and is dangerous. It is the sole responsibility of the installer to locate, size, and pipe the discharge correctly.

Safety relief valves should be tested often and for proper operation per local codes for proper function.

- *Electrical Connections*

Thermaflo Steam-to-Steam Generators require a single point power connection in most cases. The source power requirements are 110 volt / 1 phase / 60 Hz except when noted on the project 'submittal sheet'. Electrical power should be furnished to the unit via proper wiring codes by a certified electrician.

- *Lower Blowdown Piping*

As indicated earlier, Thermaflo Steam-to-Steam Generators require blowdown for operation. A series of valves are located on the bottom of each shell for this purpose. The blowdown discharge line should be the same size as the valve provided and should be piped to a properly installed blowdown separator, blowdown sump, or drain. Blowdown is very hot and can cause injury to personnel if proper precaution is not taken with the discharge piping.

Other blowdown points from the generator should also be piped to drain. These points include the level controller and surface blowdown valve.

Local codes and engineers' project specifications for blowdown piping should be followed.

12249 Nations Ford Rd. Pineville, NC 28134 phone 704-940-1228 fax 704-940-1227

www.thermafloengineering.com



Hot blowdown should never be discharged to drain without a properly installed tempering system for cooling.

- *Pneumatic Air Lines*

In many cases, pneumatic pressure controls are used on Thermaflo Steam-to-Steam Generators. In order to maintain proper function and long life from the components, the air should be from a clean and dry source. Air should be filtered and the line fitted with a drip point to remove water when it forms.

Check the 'submittal sheet' for the project and installed component data sheets for proper pressures. Pneumatic supply should be shutdown on power failure.

- *Clean Steam Outlet*

The outlet clean steam discharge connection will be sized for the application. Check the project 'submittal sheet' for this size. Never downsize this line or proper flow could be compromised for capacity.

- *Condensate Return Piping*

Each Thermaflo Steam-to-Steam Generator is fitted with a properly sized F&T (Float & Thermostatic) steam trap to drain the inner energy source steam coil and a main drip trap at the control valve inlet. The size of the condensate line will be indicated on the individual 'submittal sheet' for the unit and should never be downsized or piped to a pressurized return or lifted overhead.

Proper condensate piping will enable the generator to operate properly without water hammer and thermal shock.

- *Piping Confirmation*

All Thermaflo Steam-to-Steam Generators are fitted with high quality pipe fittings and valves and have been factory hydrotested for leaks. During transportation from the factory to jobsite locations, road travel vibration can work a joint loose. Upon startup, all joints should be inspected for leaks and some retightening may be required. Any leak should be retightened before erosion takes place at the joint.

Thermaflo Engineering Company cannot be held responsible for leaks or piping drips after hydrotest and shipment from the factory. It is the sole responsibility of the installer to provide full piping confirmation after shipment and eliminate any leak points found.



STARTUP PROCEDURE

Foreword

It is advisable to the installer to have a factory representative or trained manufacturer's representative on site and present for startup assistance. All 'submittal sheet' details and component manufacturer's data should be reviewed before startup is attempted.

Startup

1. The main steam or energy source valve should be closed and the outlet steam valve from the shell should be closed.
2. The lower blowdown valves should be closed. Open the condensate valves on trap outlets.
3. Pneumatic source supply should be open if it supplies air to the level controller. If the unit is equipped with the float level controller, which is electrically operated, the pneumatic source should be closed.
4. Electrical power should be turned on to the unit. This will power up the control panel. With the shell empty of feedwater at this point, the low level alarm will sound. Push the silence button and open the manual valve on the feedwater supply line. This will allow feedwater to enter the shell through the feedwater control valve. If a feedwater pump is being used for fill, this action will start the pump, sending feedwater into the shell.
5. The feedwater will begin filling the generator shell and the low level alarm will shut off as this level comes up. A sight glass has been provided on the outside of the level controller assembly so as to give the operator a visual indication of the filling process.
6. The inlet filling feedwater will reach a point just above the inner tube bundle or about the halfway point on the sight glass before the level controller closes the makeup feedwater control valve or stops the feed pump. *Note: In some cases, the feed pump runs continuously and the feedwater control valve will stop the feedwater fill flow.* It is critical that this fill cycle function properly in order to operate the generator.
7. With the shell filled with feedwater and the level controls operating properly, the energy source to the tube bundle can be started.
8. Set the shell pressure controller to the desired set point (refer to the 'submittal sheet') and turn on the pneumatic or electrical supply to the valve. *Note: Some generators are furnished with self-acting pilot-operated steam or energy source control valves. To operate these valves, the inlet supply valve will need to be slowly opened to furnish power. Review the data sheets furnished with the unit for proper function of this valve or contact your Thermaflo representative.*
Slowly open the inlet supply valve and feed steam to the pressure control valve. This procedure should be done very slowly so that thermal expansion of the inner tube bundle can take place. The clean steam pressure in the shell will slowly begin to rise to the set point on the controller and the source control valve will begin to modulate closed to hold this setpoint.



9. At this point on the initial system startup, the generator should be held at setpoint pressure for a period of 30 minutes to assure proper cleaning of the generator shell. *If this is not the initial startup, proceed to Step 10.*
After 30 minutes at setpoint, close the main energy source valve and slowly drain the shell via the bottom manual blowdown valve. Be sure the blowdown cooling system is operational. When the low level alarm sounds, close the bottom blowdown valve and allow the fill feedwater cycle to repeat. Again, slowly open the source valve and allow the generator to come back up to setpoint pressure.
The main clean steam outlet valve can now be opened to the system. This should be done very slowly as to avoid thermal shock and water hammer. The valve should be opened in 5% increments to maintain control of the outlet clean steam flow. It is the responsibility of the startup installer to slowly warm up the clean steam system properly.
10. On initial startup, it is advisable to set a small steam purge to atmosphere for a minimum of 15 minutes to observe operation. Be sure to discharge steam to a safe place and at a low noise level.
11. At this point, the unit is ready for normal operation.
12. **Important: Head Bolts must be re-torqued after initial startup to prevent leakage between the gaskets located on either side of the tube bundle. Periodic torque checks should be done during scheduled maintenance. See pages 11 through 13 specifically for torque rating for correct torque procedure.**
13. All Thermaflo Engineering, Inc. Clean Steam Generators are furnished with blowdown controls. Applications require different types. Review the type and setup so that proper calibration and operation occurs. Consult factory with questions.

SHUTDOWN PROCEDURES

1. Close the main energy source valve, feeding the inner coil.
2. Close the outlet clean steam supply valve.
3. Shutdown the pneumatic and electrical power and lock out these sources.
4. Slowly open the lower blowdown valve and drain the shell completely. This valve should remain open on shutdown.
5. Open the lower drain valve on the level controller assembly and sight glass.

Heat Exchanger Coil and Gaskets – Inspection and Replacement

The “U-Tube” heat exchanger coil is the heart of Thermaflo Packaged Water Heaters & Clean Steam Generator. It should be removed and inspected every two (2) years. There are two (2) gaskets, one (1) between the tube face of the coil and the flange welded to the tank, and one (1) gasket with a divider to fit between the head and the tube sheet.

Caution !!! Important Notice Read Before Proceeding:

Water, boiler water, or high temperature water present situations that can be very dangerous because of the high temperatures and pressures. To avoid possible injury or death, use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.

Caution !!! The combination of electricity and water can pose a **very dangerous situation**. Turn off / disconnect all power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit offline before attempting to remove and inspect the heat exchanger coil.
2. Assure that the energy source, condensate / water return line, cold water inlet, and hot water outlet have been shut off; that the tank has been completely drained; that the pressure has been bled from both the water and energy source system; and that the water, all components, and surfaces have cooled.
3. Carefully break the joint between the heat exchanger coil head and the small line leading to the energy source pressure gauge.
4. Carefully break the connections between the heat exchanger coil head and the energy source inlet and outlet lines.

Note: It may be necessary to break the lines at a second location, and for the lines to be rotated to allow clearance for the heat exchanger coil to be removed from the tank. If it is necessary, care should be taken to insure that in-line components are not damaged.

5. Break the bolts loose that secure the heat exchanger coil head to the tank. After all bolts have been broken loose, remove them from the unit.
6. Carefully separate the heat exchanger coil head from the mounting flange and remove the coil assembly from the tank.

Caution !!! There may still be residual water condensate (or boiler / high temperature water) in the coil that can run out during removal of the coil from the tank. If

sufficient time has not been allowed for cooling, this residual condensate / water could present **a danger of injury**.

7. Examine the heat exchanger coil for scale buildup and signs of leakage. If no leakage is detected, carefully clean the excess scale from the coils and prepare the heat exchanger coil for installation. If leakage is detected between the coils and water in the tank, either repair the leaking coil(s) or replace the heat exchanger coil.
8. Remove the old gaskets and completely clean the mating surfaces. Install the two (2) new gaskets: one (1) between the tube face of the coil and the flange welded to the tank, and one (1) gasket with a divider to fit between the heat and the tube sheet.
9. Carefully insert the heat exchanger coil into the tank. The coil should be installed so that the divider in the head lines up with the coil, and that the divider is parallel to the horizon.
10. After assuring that the heat exchanger unit is correctly aligned, clamp the flanges together and proceed with the torque procedures detailed below.

Note: Bolts used to secure the heat exchanger unit in Thermaflo Packaged Water Heaters and Clean Steam Generators are rated as either Grade A or Grade 5. Grade A bolts have no marking on the head. Grade 5 bolts are designated by three (3) slash marks on the head (///).

- a. Lubricate the bolt threads and the nut faces with a suitable lubricant.
- b. Insert the bolts through the flanges, and then start and finger tighten the nuts.
- c. Number all bolts so that torque requirements can be followed.

Note: Appendix A contains drawings depicting the typical flange configurations (number of bolts, location, tightening sequence, etc.) for Thermaflo Packaged Units. Reference the applicable drawing for the unit being serviced.

- d. Apply torque in twenty percent (20% [1/5]) steps of required final torque, loading all bolts at each step before proceeding to the next step. The following tables list ANSI approved target torques for both Grade A and Grade 5 bolts. The correct target torque can be determined by the nominal pipe size, number and grade of bolts used to secure the flange, and the size of the bolt used.

- ▼ Be sure of the bolt grade used in the unit. Do not tighten a Grade 5 bolt to the torque specification of a Grade A bolt, or vice versa. When replace bolts, be sure to use the same type of bolt and corresponding nuts. Grade 5 bolts can be used in all cases. Grade A bolts can only be used to replace Grade A bolts.

**Garlock Bolt Torque Values
Grade A Bolts**

.062" Ring Gaskets

ANSI – 150# Flanges

Nominal Pipe Size (IN)	Number of Bolts	Size of Bolts (IN)	Grade A Target Torque (FT - LBS)
2"	4	5/8"	96
2 1/2"	4	5/8"	96
3"	4	5/8"	96
3 1/2"	8	5/8"	96
4"	8	5/8"	96
5"	8	3/4"	160
6"	8	3/4"	160
8"	8	3/4"	160
10"	12	7/8"	184
12"	12	7/8"	184
14"	12	1"	250
16"	16	1"	250

Garlock Bolt Torque Values Grade 5 Bolts

.062" Ring Gaskets

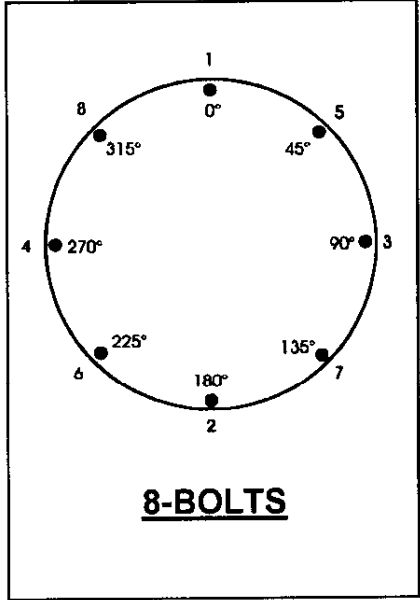
ANSI – 300# Flanges

Nominal Pipe Size (IN)	Number of Bolts	Size of Bolts (IN)	Grade 5 Target Torque (FT - LBS)
2"	8	5/8"	86
2 1/2"	8	3/4"	113
3"	8	3/4"	160
3 1/2"	8	3/4"	160
4"	8	3/4"	160
5"	8	3/4"	160
6"	12	3/4"	160
8"	12	7/8"	256
10"	16	1"	392
12"	16	1 1/8"	568
14"	20	1 1/8"	521
16"	20	1 1/4"	730

- e. Tighten bolts in the applicable sequential order (0-180°, 90°-270°, 45°-225°, 135°-315°, etc.) at each step until final target torque is reached (see applicable diagram contained in Appendix A).
 - f. Use rotational tightening until all bolts are stable at final torque level. Two (2) complete times around is usually required.
11. Reconnection the energy source inlet and outlet lines to the heat exchanger coil. If these lines were broken at an additional location to allow for removal of the coil, be sure to also tighten those connections. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
 12. Reconnect the small line leading to the energy source pressure gauge.
 - ▼ If the unit is equipped with a circulating pump, the pump relay **must be interlocked with the temperature control valve** so that the energy source will shut off if the pump is not operational. Failure to do so could create a **very dangerous situation** if the pump were to fail.
 13. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Appendix A

Bolt Torque Procedure

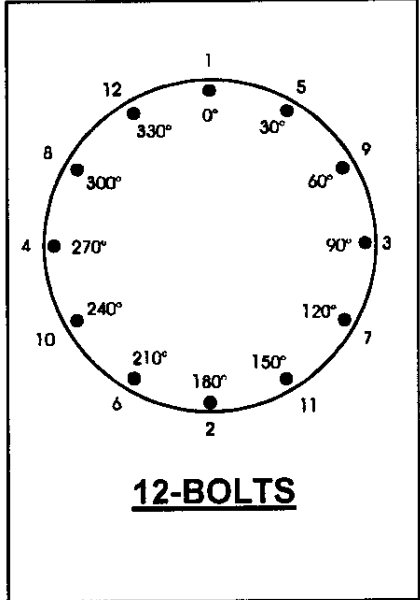


SEQUENTIAL ORDER

1 - 2
3 - 4
5 - 6
7 - 8

ROTATIONAL ORDER

1
5
3
7
2
6
4
8



SEQUENTIAL ORDER

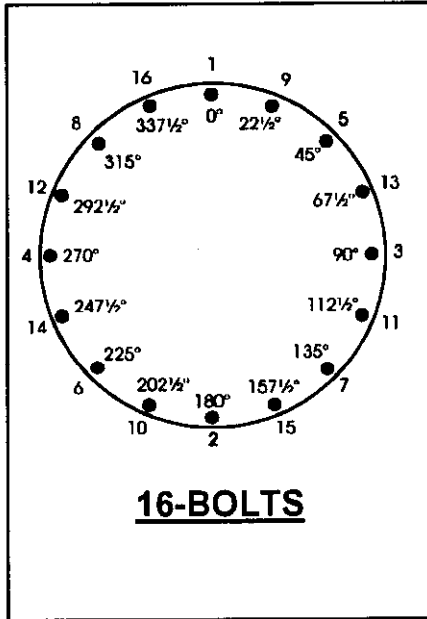
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12

ROTATIONAL ORDER

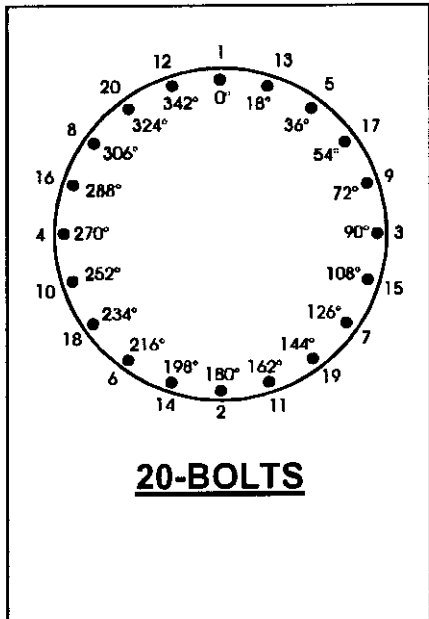
1
5
9
3
7
11
2
6
10
4
8
12

Appendix A (cont'd)

Bolt Torque Procedure



<u>SEQUENTIAL ORDER</u>	<u>ROTATIONAL ORDER</u>
1 - 2	1
3 - 4	9
5 - 6	5
7 - 8	13
9 - 10	3
11 - 12	11
13 - 14	7
15 - 16	15
	2
	10
	6
	14
	4
	12
	8
	16



<u>SEQUENTIAL ORDER</u>	<u>ROTATIONAL ORDER</u>
1 - 2	1
3 - 4	13
5 - 6	5
7 - 8	17
9 - 10	9
11 - 12	3
13 - 14	15
15 - 16	7
17 - 18	19
19 - 20	11
	2
	14
	6
	18
	10
	4
	16
	8
	20
	12

OPERATION

Start up - Open cold side first; then start hot side fluid slowly to gradually bring unit to operating condition. Bring unit from ambient temperature up to operating temperature gradually. Do not introduce hot or cold fluids suddenly. This could damage the unit and void the warranty.

Shut down - Always close off flow of hot fluid first.

Important - Never admit hot fluid suddenly when unit is empty or cold. Do not shock with cold water when unit is hot.

Gasket Creep is inherent to most gasket joints, and retorquing is required. The greater the operating temperature and pressure the greater the problem can become. It is imperative that the head bolts be torqued after installation, after initial startup, and inspected seasonally to be sure the bolts are torqued correctly.

The bolts should be torqued incrementally to 30%, 60%, and then to 100% of the appropriate value in Figure 1. They should be torqued in the sequential order of the appropriate pattern in Figure 2.

Figure 1: Bolt Size and Torque Requirements

Heat Exchanger Size	Bolt Size	Number Of Bolts	Torque Ft/Lb. 150# Flgs.
4"	.62	8	30
6"	.75	8	50
8"	.75	8	50
10"	.87	12	80
12"	.87	12	80
14"	1.00	12	123
16"	1.00	16	123
18"	1.12	16	195
20"	1.12	20	195
22"	1.25	20	273
24"	1.25	20	273
26"	1.25	24	273

Heat Exchanger Size	Bolt Size	Number Of Bolts	Torque Ft/Lb. 300# Flgs.
4"	.75	8	100
6"	.75	12	100
8"	.87	12	160
10"	1.00	16	245
12"	1.12	16	390
14"	1.12	20	390
16"	1.25	20	545
18"	1.25	24	545
20"	1.25	24	545

Figure 2: Sequential Order for Torquing Flange Bolts

