OPERATING AND MAINTENANCE MANUAL FOR INSTANTANEOUS STEAM FIRED WATER HEATER

BASE MODEL “F”

Edition 2019
-- IMPORTANT --
Always reference the full model number and serial number when calling the factory.

WARNING / CAUTION

1. FLUIDS UNDER PRESSURE MAY CAUSE INJURY WHEN RELEASED.
Always shut off all incoming and outgoing valves and carefully decrease all trapped pressures to zero before opening any covers, piping or gauge connections, etc.

HOT WATER OR HOT SURFACES CAN CAUSE SEVERE BURNS. Wear safety goggles and protective gloves when carrying out maintenance procedures involving the heater and/or when removing and accessories from the heater. Shield your eyes and body to protect from spray when opening a relief valve. Due to the rigors of transportation, all connections should be checked for tightness before heater is placed in operation.

2. Safety relief valve must be installed according to local plumbing codes.
KEEP AWAY FROM LIVE ELECTRICAL CIRCUITS.
Do not perform any maintenance, make any adjustments, or replace any components inside the control panel with the high voltage power supply turned on. Under certain circumstances, dangerous potentials may exist even when the power supply is off. To avoid casualties, always turn the power supply safety switch to off, turn the charge or ground the circuit before performing any maintenance or adjustment procedure. Generalized instructions and procedures cannot anticipate all situations. For this reason, only qualified installers should perform the installations. A qualified installer is a person who has licensed training and a working knowledge of the applicable codes regulation, tools, equipment, and methods necessary for safe installation of a steam fired water heater. If questions regarding installation arise, check with your local plumbing and electrical inspectors for proper procedures and codes.

SECTION TITLE PAGE No.

I GENERAL DESCRIPTION AND CONSTRUCTION 6
II INSTALLATION 8
III START-UP AND PROCEDURE 11
IV MAINTENANCE 13
V TROUBLESHOOTING 20
VI MISCELLANEOUS CHARTS AND FORMULAS 23
# Model F Dimensional and Connection Sizing

<table>
<thead>
<tr>
<th></th>
<th>F15</th>
<th>F30</th>
<th>F45</th>
<th>F60</th>
<th>F75</th>
<th>F90</th>
<th>F105</th>
<th>F120</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height “A”</strong></td>
<td>49&quot;</td>
<td>49&quot;</td>
<td>52&quot;</td>
<td>52&quot;</td>
<td>67&quot;</td>
<td>67&quot;</td>
<td>68&quot;</td>
<td>68&quot;</td>
</tr>
<tr>
<td><strong>Width “B”</strong></td>
<td>26&quot;</td>
<td>26&quot;</td>
<td>26&quot;</td>
<td>26&quot;</td>
<td>26&quot;</td>
<td>26&quot;</td>
<td>26&quot;</td>
<td>26&quot;</td>
</tr>
<tr>
<td><strong>Length “C”</strong></td>
<td>39&quot;</td>
<td>39&quot;</td>
<td>39&quot;</td>
<td>39&quot;</td>
<td>39&quot;</td>
<td>39&quot;</td>
<td>39&quot;</td>
<td>39&quot;</td>
</tr>
<tr>
<td><strong>Cold Water Inlet</strong></td>
<td>1 1/2&quot;</td>
<td>1 1/2&quot;</td>
<td>1 1/2&quot;</td>
<td>1 1/2&quot;</td>
<td>2 1/2&quot;</td>
<td>2 1/2&quot;</td>
<td>2 1/2&quot;</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td><strong>Hot Water Outlet</strong></td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2 1/2&quot;</td>
<td>2 1/2&quot;</td>
<td>2 1/2&quot;</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td><strong>Steam Inlet</strong> (Male NPT)</td>
<td>3&quot;</td>
<td>3&quot;</td>
<td>4&quot;</td>
<td>4&quot;</td>
<td>4&quot; FLG</td>
<td>4&quot; FLG</td>
<td>4&quot; FLG</td>
<td>4&quot; FLG</td>
</tr>
<tr>
<td><strong>Main Condensate Trap Size</strong></td>
<td>1 1/4&quot;</td>
<td>1 1/4&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2 1/2&quot;</td>
<td>1 1/2&quot;</td>
<td>1 1/2&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td><strong>Drip Trap Size</strong></td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
</tr>
</tbody>
</table>

### Steam Consumption Formula

\[
\text{Steam Consumption} = \text{GPM} \times 500 \times \Delta \text{T} \times \text{Latent Heat of Steam}
\]

<table>
<thead>
<tr>
<th>Steam Pressure (psi)</th>
<th>0</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latent Heat</td>
<td>970</td>
<td>966</td>
<td>960</td>
<td>953</td>
<td>946</td>
<td>939</td>
<td>933</td>
<td>929</td>
<td>920</td>
<td>912</td>
</tr>
</tbody>
</table>

**Note:**

1. Not to be used as a submittal drawing. Steam component locations change with differing steam pressures.
2. A pressure relief valve is required when steam supply pressure is in excess of heat exchanger rating.
**Note:**
Domestic water heating applications with steam supply pressure greater than 15 psi require a steam pressure reducing valve to be installed in the incoming steam supply line prior to the heat exchanger shell. Furthermore, if the supply steam pressure exceeds the pressure rating of the heat exchanger shell, then a pressure safety relief valve must be installed in line after the reducing valve.

1. **Cold water** enters via the inlet piping and branches off to supply both the cold port on the blending valve and the heat exchanger.

2. **The cold water** passes through the coils in the heat exchanger and is heated by the surrounding steam in the shell.

3. **Hot water** exits the heat exchanger and enters the hot port on the blending valve.

4. **The plug assembly** in the blending valve opens the hot and cold ports to provide the precise amount of hot and cold water in order to achieve the desired output temperature water ±4 °F.

5. **The heated water** exits the unit at the base of the blending valve.
For domestic water heating applications, optimum performance (±4°F) is achieved when the steam pressure in the heat exchanger shell is 15 psi or less. Therefore, if the steam supply pressure is greater than 15 psi, a pressure reducing valve is used to reduce the steam pressure in the heat exchanger shell to a maximum of 15 psi.

For typical process or general applications with less stringent temperature control requirements (±8°F) up to 35 psi steam pressure in the heat exchanger shell may be utilized. If incoming steam supply pressure is greater than 35 psi, a pressure reducing valve is used to reduce steam pressure in the heat exchanger shell to a maximum of 35 psi.

### Recovery Rate Chart

<table>
<thead>
<tr>
<th>Base Model</th>
<th>°F Temp.</th>
<th>In/out</th>
<th>Steam Supply Pressure (psi)</th>
<th>Steam Supply Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F15</td>
<td>14-120</td>
<td>10-10</td>
<td>14-15</td>
<td>15-16</td>
</tr>
<tr>
<td>F15</td>
<td>16-20</td>
<td>11-12</td>
<td>15-16</td>
<td>15-16</td>
</tr>
<tr>
<td>F15</td>
<td>20-30</td>
<td>8-15</td>
<td>10-12</td>
<td>13-13</td>
</tr>
<tr>
<td>F15</td>
<td>30-40</td>
<td>7-15</td>
<td>12-15</td>
<td>12-15</td>
</tr>
<tr>
<td>F15</td>
<td>40-50</td>
<td>9-15</td>
<td>5-10</td>
<td>12-12</td>
</tr>
<tr>
<td>F15</td>
<td>50-60</td>
<td>8-15</td>
<td>10-11</td>
<td>13-13</td>
</tr>
<tr>
<td>F30</td>
<td>14-120</td>
<td>30-30</td>
<td>12-13</td>
<td>16-17</td>
</tr>
<tr>
<td>F30</td>
<td>18-20</td>
<td>9-15</td>
<td>10-12</td>
<td>13-13</td>
</tr>
<tr>
<td>F30</td>
<td>22-30</td>
<td>24-15</td>
<td>15-15</td>
<td>15-15</td>
</tr>
<tr>
<td>F30</td>
<td>30-40</td>
<td>18-20</td>
<td>12-22</td>
<td>26-26</td>
</tr>
</tbody>
</table>

### Recovery Rates Chart

<table>
<thead>
<tr>
<th>Base Model</th>
<th>°F Temp.</th>
<th>In/out</th>
<th>Supplied domestic water pressure needs to exceed steam pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>F15</td>
<td>14-120</td>
<td>10-10</td>
<td>14-15</td>
</tr>
<tr>
<td>F15</td>
<td>16-20</td>
<td>11-12</td>
<td>15-16</td>
</tr>
<tr>
<td>F15</td>
<td>20-30</td>
<td>8-15</td>
<td>10-12</td>
</tr>
<tr>
<td>F15</td>
<td>30-40</td>
<td>7-15</td>
<td>12-15</td>
</tr>
<tr>
<td>F15</td>
<td>40-50</td>
<td>9-15</td>
<td>5-10</td>
</tr>
<tr>
<td>F15</td>
<td>50-60</td>
<td>8-15</td>
<td>10-11</td>
</tr>
<tr>
<td>F30</td>
<td>14-120</td>
<td>30-30</td>
<td>12-13</td>
</tr>
<tr>
<td>F30</td>
<td>18-20</td>
<td>9-15</td>
<td>10-12</td>
</tr>
<tr>
<td>F30</td>
<td>22-30</td>
<td>24-15</td>
<td>15-15</td>
</tr>
<tr>
<td>F30</td>
<td>30-40</td>
<td>18-20</td>
<td>12-22</td>
</tr>
</tbody>
</table>
SECTION I - GENERAL DESCRIPTION AND CONSTRUCTION

GENERAL DESCRIPTION
This manual provides a complete description, as well as installation, operating, troubleshooting, maintenance and servicing procedures for an instantaneous steam powered water heater. This heater provides potable hot water for various functions. It is a permanently installed, stationary, self-contained unit with automatic operating controls.

GENERAL OPERATION
The F model operates using steam as its power source for heating potable hot water. Steam enters the heat exchanger shell where heat transfer takes place from the steam to the water. A helical coil with water flowing inside it is enclosed within the heat exchanger shell. As water flows through the coil, it is heated by the steam in the shell. After the heated water exits the coil it then enters the blending valve, which is comprised of three (3) separate ports: the cold water port, the hot water port, and the blended water port. After exiting the coil the heated water enters the hot water port of the blending valve. The blending valve then mixes the heated water with the cold water entering from the cold water port providing the precise amount of cold and hot water to produce the desired output temperature. This hot water then exits the heater through the hot water outlet.

CONSTRUCTION
STEAM HEATING COIL
The water heater is supplied with a high quality Heliflow Heat Exchanger certified to ASME Section VIII Division 1 standards and constructed from single wall copper tubing. The tubing is installed in a heavy-duty cast iron shell. Optionally, the tubing may be constructed from double wall tubing with a leak detection port (F30 and F60 models only), or alternate tubing materials may be used, such as Admiralty, 90/10 copper-nickel, or stainless steel. Additionally, as an option, the shell may also be constructed from cast steel, cast bronze, 90/10 copper-nickel, or stainless steel.

STEAM OPERATING CONTROLS
The steam operating controls are factory selected, sized, piped, and tested to ensure reliable operation.

Blending Valve
The blending valve mixes the heated water with the cold water entering from the cold water port providing the precise amount of cold and hot water to produce the desired output temperature.

Strainers
A cast iron ‘Y’ strainer with 20 mesh screen protects the steam controls and coil from dirt and debris in the steam supply.

Traps
Two traps should be utilized in the immediate steam piping system of the water heater. The first trap in the system is a thermostatic drip trap that is designed to collect condensate from the main steam line before entering the control valve. Additionally, a main condensate cast iron float and thermostatic trap should be located in the condensate line after the steam coil. This trap ensures that the steam remains in the coil and releases its energy before exiting the coil and traveling down the condensate line.
SUPPORT STAND
The unit is supported on heavy-duty integrally welded steel supports for sturdy floor mounting.

OPTIONS
The following optional features may be included in your water heater. Reference included drawing specific to your heater for further details.

Cast Steel Construction
Optional cast steel construction of all steam components (traps, strainers) may be included.

Single Solenoid Safety System
A single solenoid safety system opens the sensing line to the blending valve in order to limit the hot water output in the event of an over-temperature condition. This option requires 120-volt, 5-amp electrical service.

Double Solenoid Safety System
A double solenoid safety system opens the sensing line to the blending valve as well as closing the steam supply to the heat exchanger in the event of an over-temperature condition. This option requires 120-volt, 5-amp electrical service.

Steam Pressure Reducing Valve
In order to limit the steam pressure in the heat exchanger shell an optional steam pressure reducing valve may be factory supplied and shipped loose for in the field installation.

Klean-Koil Kit
For applications where water hardness exceeds 120 ppm and scale build-up can reduce efficiency, a factory packaged Klean-Koil Kit™ may be supplied. This kit with built-in connections will allow for quick and easy in-place cleaning of the coil to remove deposits of scale and thereby avoid long periods of down time and expensive maintenance costs.

Recirculation Package
A recirculation loop is used to provide hot water at the fixture even though the water heater may be a great distance away. This loop usually continuously recirculates the water via a small pump that returns the water to the heater for boosting if required. Since the F Model heater does not have any sensing capability, the temperature of the water is unknown and likely to escalate. The recirculation package option therefore uses a 3-way thermostatic valve. The thermostatic valve has a thermal sensing element rated at the desired loop temperature. As the temperature in the loop begins to decrease from heat loss through the piping, the thermostatic element responds by causing the water flow to be diverted to the heater. When the temperature in the loop is at the desired temperature the flow of the water by-passes the heater. For normal operation, approximately 10% of the system capacity is recirculated back to the heater. Higher flows can induce high pressure differentials in the valve and cause erratic operation.
SECTION II – INSTALLATION

1. The water heater is typically floor mounted, but can also be suspended from the ceiling. It is important that the unit is horizontal and level.

2. For optimal water heater performance the condensate trap should discharge to a condensate line which is atmospheric or sub-atmospheric in pressure, below the level of the trap. If lift of condensate is required, utilize the guidelines in the following table.

<table>
<thead>
<tr>
<th>Inlet Steam Pressure (PSIG)</th>
<th>Maximum Elevation of Condensate Discharge (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-4</td>
<td>0</td>
</tr>
<tr>
<td>5-6</td>
<td>2</td>
</tr>
<tr>
<td>7-8</td>
<td>4</td>
</tr>
<tr>
<td>9-10</td>
<td>6</td>
</tr>
<tr>
<td>10-12</td>
<td>8</td>
</tr>
<tr>
<td>12-15</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 1 - Maximum Condensate Elevations

3. If the steam supply pressure to the water heater exceeds 75 psi then a pressure relief valve must be installed in the steam supply line immediately before the heat exchanger shell. If a pressure reducing valve is used to reduce the steam supply pressure, a pressure relief valve should still be installed.

4. The heater incorporates an integral safety relief valve to relieve excess pressure caused by thermal expansion. Be sure discharge is facing a safe direction. This device does not replace or eliminate the need for a separate pressure relief valve as described in paragraph 3 above.

5. Install the combination water temperature/pressure gauge in the hot water outlet piping, as close to the heater as possible.

6. Install the steam pressure gauge in the steam supply line, as close to the heater as possible.

7. Check and verify that the water supply pressure is 40 psig minimum. This is required for optimal operation.

8. Maximum steam pressure to the heater is typically 15 psig. Set pressure reducing valve, if required, to an output pressure of 15 psig or as specified. Note: some units used in applications with less stringent temperature requirements can operate above 15 psi without a pressure reducing valve, please reference the included drawing for details.

9. Check tightness of all connections.
SECTION III – START-UP PROCEDURE

1. Check all joints for tightness. Remove protective shroud.

2. Note that for two or more units piped together, be sure to adjust all units simultaneously, as multiple units may cause unnecessary feedback.

3. If a recirculation package is included with your system, shut down flow to the recirculation package before beginning adjustment of the outlet temperature.

4. Turn on cold water supply. Set flow at midpoint of heater capacity, i.e. 15 GPM for a 30 GPM unit (minimum water pressure 40 psig, maximum pressure 150 psig).

5. Loosen compression fitting on upper diaphragm cover. Permit water to flow until free of any bubbles. Retighten fitting.

6. Turn on steam to heat exchanger.
   a. Vent air from heat exchanger by carefully loosening the vent plug in the top of the heat exchanger casing.
   b. Upon completion, retighten.
   c. Maximum steam pressure is typically 15 psig. See attached drawing for details.
   d. If unit is furnished with a pressure reducing valve, set reduced pressure to 15 psig maximum before adjusting the heater.
   e. Verify that condensate is properly drained.

7. On the blending valve loosen set screw and locking ring, enabling the control rod on the valve to move freely from right to left. The heater features a temperature stabilizer which will fine tune the proportion of hot and cold water in order to accurately produce hot water through all rated flows. The stabilization adjustment is performed by rotating the control rod from vertical to 30°. Install a pin in the hole of the control rod and rotate to the approximate position as indicated in Table 2. Operate the heater from minimum to maximum flows. Position the control rod at the correct outlet temperature and note any variations in temperature from maximum to minimum flow.
   If the outlet temperature tends to increase with increased flow, the rotation of the stabilizer should be decreased (toward 0°). Likewise, if the outlet temperature tends to decrease with increased flow, the rotation of the stabilizer should be increased (toward 30°). Correct adjustment will yield stable temperature output throughout the heaters flow capacities. Once the correct adjustments have been made, tighten the locking ring and set screw.

8. If a recirculation package is included, shut down all hot water demand on the unit, open the valves to the recirculation loop, turn the valve adjustment screw to full cold position and wait until recirculation loop settles. Then increase the temperature of the recirculation loop by adjusting the thermostatic valve adjustment screw and allow the recirculation loop to settle. Continue adjustments in this manner until the desired recirculation temperature is reached. Note that the recirculation temperature must be at least 10°F below the desired outlet temperature.

9. Heater should now be adjusted and operating. No further adjustments are required, unless there is a large fluctuation in seasonal water temperatures. If this is the case, readjustment of the control rod will be necessary. If shutdown of the unit is necessary, close water and steam valves. To restart, open all valves and repeat start-up procedure.

   NOTE
   Every 3°F change in supply cold water temperature will yield a 1°F change in the outlet hot water temperature.

10. Tighten all casing bolts (87) on heat exchanger after 2 - 3 hours and check after 24 hours. Place protective shroud over the heat exchanger.
Table 2 – Temperature Stabilization Adjustment Table
(Delete setting in degrees of rotation. See illustration below)
Steam pressure measured at heat exchanger inlet

<table>
<thead>
<tr>
<th>Inlet Water Temp.</th>
<th>Outlet Water Temp.</th>
<th>F15/F30 2 psi</th>
<th>5 psi</th>
<th>10 psi</th>
<th>15 psi</th>
<th>F45/F60 2 psi</th>
<th>5 psi</th>
<th>10 psi</th>
<th>15 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>40° F</td>
<td>120° F</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>140° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>28</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>150° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>160° F</td>
<td>∞</td>
<td>∞</td>
<td>∞</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>180° F</td>
<td>∞</td>
<td>∞</td>
<td>∞</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>60° F</td>
<td>120° F</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>140° F</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>150° F</td>
<td>28</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>23</td>
<td>21</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>160° F</td>
<td>∞</td>
<td>∞</td>
<td>∞</td>
<td>30</td>
<td>30</td>
<td>28</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>180° F</td>
<td>∞</td>
<td>∞</td>
<td>∞</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inlet Water Temp.</th>
<th>Outlet Water Temp.</th>
<th>F75/F90 2 psi</th>
<th>5 psi</th>
<th>10 psi</th>
<th>15 psi</th>
<th>F105/F120 2 psi</th>
<th>5 psi</th>
<th>10 psi</th>
<th>15 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>40° F</td>
<td>120° F</td>
<td>27</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>140° F</td>
<td>27</td>
<td>27</td>
<td>25</td>
<td>24</td>
<td>22</td>
<td>22</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>150° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>160° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>180° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>60° F</td>
<td>120° F</td>
<td>22</td>
<td>22</td>
<td>20</td>
<td>19</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>140° F</td>
<td>25</td>
<td>25</td>
<td>23</td>
<td>22</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>150° F</td>
<td>28</td>
<td>28</td>
<td>27</td>
<td>26</td>
<td>23</td>
<td>21</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>160° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>28</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>180° F</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Blending Valve

30° MAXIMUM ANGLE OF ROTATION
CONTROL ROD: MOVE FROM SIDE TO SIDE FOR BASE TEMPERATURE SETTING.
HOLE THROUGH CONTROL ROD, INSERT PIN AND TURN FOR STABILIZATION ADJUSTMENT.
SECTION IV – MAINTENANCE

1. BLENDING VALVE DISASSEMBLY
Disassembly of the blending valve need only be undertaken if a decrease in performance or instability of temperature control is linked to malfunction or wear of control valve components. Be sure all work is performed in a clean environment to prevent the introduction of foreign matter into the valve mechanism.

a. Close all steam and water supply lines.
b. Disconnect sensing tube (46) from lower valve body (42) and lower diaphragm case (5). (Note position of notch in cover relative to valve body).
c. Disconnect Victaulic® fittings at all valve connections and remove the valve support clips from frame. Lift the entire blending valve from frame.
d. Loosen and remove casing bolts (14) and lift off upper diaphragm case (6).
e. Hold valve stem (1) by placing wrench on flats. Remove jam nuts (7) taking care not to turn valve stem (1). Remove shouldered washer (8) and "O" ring (9) along with diaphragm (13), diaphragm plate (11), control valve spring (10), and shoulder washer (16).
f. Inspect diaphragm (13) for any cracks or tears.
g. Remove stop retaining clip (19) from temperature control rod (18), unscrew locking ring assembly (21), and remove cover plate (22).
h. Compress retaining "C" clip (23) and remove from temperature adjusting sleeve (27). Remove temperature control rod (18) and key cylinder (25) from stub.

CAUTION
Do not permit the plug assembly to drop from lower valve body (42). Hold valve stem (1) from above.
i. Unscrew stem screw (35), remove the yielding spring (36), and spacer washers (37,38).
j. Remove the valve plug assembly through the lower valve body (42).
k. Remove socket head cap screws (12) and lift off lower diaphragm case (5). Remove "O" ring (15) taking care not to damage groove.
l. Remove cap screws (12) and remove lower valve body (42).
m. Push black Teflon coated temperature adjusting sleeve (27) out of upper valve body (17).
n. Remove main valve stem (1).

NOTE
Inspect all parts for wear or damage. Replace all gaskets and "O" rings.

CAUTION
Do not use any abrasive to clean. Wipe with appropriate solvents and dry with clean cloth. (Acetone is a suitable solvent).

NOTE
See parts list for recommended on hand spare and overhaul parts.

2. BLENDING VALVE ASSEMBLY
a. Install temperature adjusting sleeve (27) into upper valve body (17), making sure the end of the temperature adjusting sleeve (27) with the groove pins and slot is facing the lower valve body (42).
b. Assemble upper valve body (17) to lower valve body (42) and (cold water inlet should be on same side as the control rod opening) secure cap screws (12).
c. Insert main valve stem (1) into bottom of temperature adjusting sleeve (27) and push it until the collar washer seats against upper valve body (17).
d. Insert the valve assembly into temperature adjusting sleeve (27) and push until it is fully inserted.
e. On lower end of valve stem (1) install spacer (2), space washers (37), space washer (38), yielding spring (36), and tighten stem screw (35).
f. Install "O" ring (15) in groove on upper valve body (17) and install lower diaphragm case (5) securing it with casing bolts (14) tightening in a sequential manner (note location of notch in relation to valve body).
g. Install key cylinder (25) on stub. Replace "O" ring (24) on temperature control rod (18) and insert so adjustor key is centered in slot and notch on control rod fits with groove pin in temperature adjusting sleeve (27). Install retaining "C" clip (23) and locking ring assembly (21).
h. Install in order, the control valve spring (10), guide washer (16), diaphragm plate (11), diaphragm (13), "O" ring (9), shouldered washer (8), and jam nuts (7) on main valve stem (1). Position diaphragm (13) over holes and notch on lower diaphragm case (5) prior to tightening the jam nuts (7).
i. Install upper diaphragm case (6) and be sure notches in lower cover and upper cover line up. Install bolts and tighten sequentially.
j. Install valve on frame, install sensing tube (46) Victaulic® fittings, and check all fittings for tightness.
k. Refer to start-up procedures to adjust blending valve.

3. HEAT EXCHANGER INSPECTION AND DISASSEMBLY

The Heliflow coil is readily accessible for inspection and cleaning, if necessary, without disturbing piping.

a. Remove plug (85) to drain the casing assembly (79).
b. Remove all base plate nuts (86).
c. Withdraw the casing assembly (79), being careful not to damage the gasket (81).

4. REMOVAL OF COIL (IF NECESSARY)

a. Disconnect piping and remove the manifold nuts (84) and lock rings (83).
b. Withdraw the coil assembly (78), being careful not to damage the manifold gaskets (82).

5. HEAT EXCHANGER INSPECTION - REASSEMBLY

a. In re-assembly, be sure manifold gaskets (82) and casing gaskets (81) are replaced.
b. Be sure that tabs on the manifold lock rings (83) fit into the base plate slots. These keep the coil assembly (78) from turning when tightening the manifold nuts (84) and piping to the unit.
c. Be sure the bottoms of the manifold gaskets (82) are seated in pockets located at bottom inside the casing assembly (79).
d. Install and tighten manifold nuts (84).
e. Install casing (79) and tighten base plate nuts (86) sequentially.
f. Vent the casing (79) when re-admitting fluid, using drain plug (85).
g. Check base plate nut (86) tightness after an hour or two, and again after 24 hours.

6. STRAINER FILTER (next page)

Clean strainer filter. Perform annually or more often, if required.

a. Remove blowoff bushing (E) or cap (F), as required.
b. Remove gasket (B), if required.
c. Remove, clean, and re-install screen (A).
d. Replace gasket (B).
e. Re-install blowoff bushing (E) or cap (F), as required.
Blending Valve Parts Diagram
Heat Exchanger Parts Diagram

Lower Manifold

Upper Manifold

16
### Blending Valve and Heat Exchanger Parts List

Use only genuine Hubbell Replacement Parts

* - Recommended Spare Parts
** - Overhaul Parts in Addition to Spares

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>F15/F30</th>
<th>F45/F60</th>
<th>F75/F90</th>
<th>F105/F120</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

**VALVE STEM**

1. Valve Stem
   - 60000
   - 60000
   - 60308
   - 60308
2. Spacer (2)
   - 60001
   - 60001
   - 60309
   - 60309
3. Spacer (Teflon)
   - 60002
   - 60002
   - 60002
   - 60002
4. Spirolox Ring
   - 60003*
   - 60003*
   - 60003*
   - 60003*

**DIAPHRAGM**

5. Lower Case
   - 60004
   - 60004
   - 60004
   - 60004
6. Upper Case
   - 60005
   - 60005
   - 60005
   - 60005
7. Jam Nut
   - 60052
   - 60052
   - 60052
   - 60052
8. Shouldered Washer
   - 60018
   - 60018
   - 60018
   - 60018
9. “O” Ring
   - 60019*
   - 60019*
   - 60019*
   - 60019*
10. Spring
    - 60038
    - 60038
    - 60322
    - 60322
11. Diaphragm Plate
    - 60020
    - 60020
    - 60020
    - 60020
12. S/S Cap Screw (6)
    - 60055
    - 60055
    - 60055
    - 60055
13. Diaphragm
    - 60045*
    - 60045*
    - 60045*
    - 60045*
14. Bolt (6)
    - 60057
    - 60057
    - 60054
    - 60054
14A. Nut (6)
    - 23027
    - 23027
    - 23027
    - 23027
15. “O” Ring
    - 60028
    - 60028
    - 60028
    - 60028
16. Shoulder Washer
    - 60046
    - 60046
    - 60046
    - 60046

**ADJUSTER**

17. Upper Valve Body
    - 60029
    - 60029
    - 60305
    - 60305
18. Control Rod
    - 60099**
    - 60099**
    - 60312**
    - 60312**
19. Retaining Clip
    - 60050*
    - 60050*
    - 60050*
    - 60050*
20. Set Screw
    - 60008
    - 60008
    - 60008
    - 60008
21. Locking Ring
    - 60007
    - 60007
    - 60007
    - 60007
22. Plate (Cover)
    - 60011
    - 60011
    - 60314
    - 60314
23. Retaining “C” Clip
    - 60049*
    - 60049*
    - 60049*
    - 60049*
24. “O” Ring (2)
    - 60313*
    - 60313*
    - 60313*
    - 60313*
25. Key Cylinder
    - 60006
    - 60006
    - 60006
    - 60006
26. “O” Ring (2)
    - 60027*
    - 60027*
    - 60324*
    - 60324*
27. Temperature Adjusting Sleeve
    - 60099*
    - 60099*
    - 60318**
    - 60318**
28. Guide Energizer
    - 60025**
    - 60025**
    - 60025**
    - 60025**

**PLUG ASSEMBLY**

31. Plug Stem
    - 60098*
    - 60098*
    - 60321**
    - 60321**
32. Pin Plug Stem
    - ⊗
    - ⊗
    - 60037
    - 60037
33. Plug
    - 60030
    - 60030
    - 60030
    - 60030
34. Pin Plug
    - ⊗
    - ⊗
    - 60031
    - 60031
35. Stem Screw
    - 60017
    - 60017
    - 60017
    - 60017
36. Yielding Spring
    - 60039**
    - 60039**
    - 60323**
    - 60323**
37. S/S Spacer Washer (2)
    - 60047
    - 60047
    - 60047
    - 60047
38. Brass Spacer Washer
    - 60048
    - 60048
    - 60048
    - 60048
39. Seal Plate
    - 60012**
    - 60012**
    - 60315**
    - 60315**
40. Screw (2)
    - 60032
    - 60032
    - 60032
    - 60032
41. Lock Washer (2)
    - 60033
    - 60033
    - 60033
    - 60033
1 The following part numbers (P/N) were changed as follows as of Dec. 2008:
P/N 60029 was superseded by P/N 60028
P/N 60010 was superseded by P/N 60313
P/N 60432 was superseded by P/N 60324
P/N 60021 was superseded by P/N 60099
P/N 60036 was superseded by P/N 60098
P/N 60338 was superseded by P/N 60317
P/N 28002 was superseded by P/N 28022
P/N 28003 was superseded by P/N 28023

2 The following part numbers (P/N) were changed as follows as of Jan. 2010:
P/N 60056 was superseded by P/N 60447
P/N 60320 was superseded by P/N 60476

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F15/F30</td>
</tr>
<tr>
<td>42</td>
<td>Valve Body</td>
<td>60034</td>
</tr>
<tr>
<td>45</td>
<td>Relief Valve</td>
<td>60044</td>
</tr>
<tr>
<td>46</td>
<td>Sensing Tube</td>
<td>60040</td>
</tr>
<tr>
<td>47</td>
<td>Outlet Adapter</td>
<td>60447^2</td>
</tr>
<tr>
<td>48</td>
<td>Victaulic® Coupling</td>
<td>60061</td>
</tr>
<tr>
<td>49</td>
<td>Screw (6)</td>
<td>60054</td>
</tr>
</tbody>
</table>

**LOWER VALVE BODY**

**HEAT EXCHANGER**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>Coil Assembly (Copper Tubes)</td>
<td>72916B*</td>
</tr>
<tr>
<td>79</td>
<td>Casing (Upper)</td>
<td>71907</td>
</tr>
<tr>
<td>80</td>
<td>Base Plate</td>
<td>71110</td>
</tr>
<tr>
<td>81</td>
<td>Casing Gasket</td>
<td>51215*</td>
</tr>
<tr>
<td>82</td>
<td>Manifold Gasket</td>
<td>20211*</td>
</tr>
<tr>
<td>83</td>
<td>Lockring</td>
<td>28022^1</td>
</tr>
<tr>
<td>84</td>
<td>Manifold Nut</td>
<td>23014A</td>
</tr>
<tr>
<td>85</td>
<td>Drain Plug</td>
<td>26136</td>
</tr>
<tr>
<td>86</td>
<td>Nut (13, 12 for F30)</td>
<td>23006</td>
</tr>
<tr>
<td>87</td>
<td>Stud Bolt (13, 12 for F30)</td>
<td>14019</td>
</tr>
</tbody>
</table>
Single and Double Safety Solenoid System (if installed)
7. **INSTRUCTION FOR CHEMICAL CLEANING**
   a. Shut off both water inlet and outlet on coil to be cleaned.
   b. Remove the two elbow manifolds from the heat exchanger, by disassembling the four Victaulic couplings.
   c. Attach the 3/8” nipple supplied with the adaptor kit to one of the adaptors.
   d. Insert this adaptor into the heater connection closest to the center of the exchanger. (Note: The 3/8” nipple must extend up into the exchanger). Secure the adaptor with one of the Victaulic couplings removed in Step a.
   e. Connect the other adaptor to the remaining exchanger connection with a Victaulic coupling.
   f. Connect the recirculation pump, hoses, and reservoir tank.
   g. Clean unit with de-scaling solution according to directions included with de-scaler.
   h. For proper cleaning, the solution must be pumped through the exchanger in the direction shown in the figure below. The 3/8” nipple avoids gas pockets in the top of the exchanger coil and must be on the outlet connection of the cleaning system.
   i. After cleaning is complete, the coil should be flushed with water before reconnecting the manifolds.

![Diagram of chemical cleaning process]

**SECTION V – TROUBLESHOOTING**

Observations regarding any problems should be recorded.

1. Does the problem present itself during no flow, low flow, or high flow conditions, etc?
2. High temperature or low temperature? Note the F model is designed to prevent high temperature failures, however, recirculation system failures may lead to over-temperature situations during low flow conditions.
3. Unsteady temperature?
4. Is the new or what is length of service?
5. What is local water hardness?
6. Is the problem repeatable, sporadic?

The first step in resolving a problem with an F model water heater system should be to determine the source of the problem.

- The recirculation system
- The blending valve
- The heat exchanger

1. Check the position of the water outlet temperature gauge. Has it been installed according to the recommended Piping & Instrumentation Diagram? The gauge should be downstream relative to the point where the recirculated water returns to the unit.
2. For facilities with recirculation systems, the circulating pump should be turned off to start the troubleshooting analysis.

**Water Temperature Is Too High**

1. Has inlet water temperature changed since the valve temperature setting was adjusted?
2. Is the F model temperature adjustment set correctly?
3. Has steam pressure changed since the temperature was adjusted?
4. If fitted with a recirculation system, turn the circulating pump off. If the problem is eliminated, the trouble is with the recirculation system.

For a new installation with a recirculation loop, check the setting of the thermostatic valve. The thermostatic element setting should be approximately 10°F below the normal operating temperature of the F model. For example, if 120°F is the desired loop temperature, the thermostatic element should be set for 110°F.

Also, for new installations, check that the thermostatic diverting valve has been piped in accordance with the Hubbell Recirculation Package Diagram in this manual. If the problem developed in an existing system, the thermostatic element should be replaced.

**Water Temperature Is Too Low**

1. Is the problem in the F model valve or the heat exchanger? The easiest method to answer this question is to check the temperature of the pipe which runs from the heat exchanger to the blending valve. At low flows and when the unit is idle, this pipe should be at a temperature about 200°F. At higher flow rates, check the surface temperature of the pipe which should remain above 150°F. If this pipe goes cold when water demand increases, the problem lies in the heat exchanger. Otherwise, the source of the problem is in the blending valve.

**Heat Exchanger Is Source of Problem**

1. Has air been vented from the shell side of the heat exchanger?
2. Is steam supply at constant pressure? During high demand?
3. Is the condensate drain trap functioning correctly?
4. Is the coil fouled due to hard water?

**Blending Valve Is Source of Problem**

1. Is temperature adjustment correct?
2. Disassemble valve – is the plug stuck in the open position?
3. Is the seal plate assembly and gasket in need of repair?

**Restricted Water Flow**

1. Is the valve diaphragm ruptured?
2. Is the sensing tube plugged?
3. Are there any restrictions in the water piping?
<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Corrective Action / Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit produces only cold water or no water flow at all.</td>
<td>Diaphragm ruptured.</td>
<td>Remove upper cover and inspect for tears or cracks, replace as necessary.</td>
</tr>
<tr>
<td></td>
<td>Valve plug restricted by foreign matter.</td>
<td>Remove plug and clean.</td>
</tr>
<tr>
<td></td>
<td>Sensing line restricted.</td>
<td>Remove and test for free flow.</td>
</tr>
<tr>
<td>Drop in output temperature occurring during low flow.</td>
<td>Steam pressure incorrect.</td>
<td>Check inlet pressure to heat exchanger.</td>
</tr>
<tr>
<td></td>
<td>Outlet water temperature setting incorrect.</td>
<td>Reset.</td>
</tr>
<tr>
<td></td>
<td>Stabilization setting incorrect.</td>
<td>Reset.</td>
</tr>
<tr>
<td></td>
<td>Trap restricted or experiencing excessive back pressure.</td>
<td>Check piping for free flow. Remove and inspect trap.</td>
</tr>
<tr>
<td></td>
<td>Steam strainers plugged.</td>
<td>Clean strainers.</td>
</tr>
<tr>
<td></td>
<td>Air lock in heat exchanger shell.</td>
<td>Vent exchanger.</td>
</tr>
<tr>
<td>Rise in output temperature occurring during low flow.</td>
<td>Steam pressure incorrect.</td>
<td>Check inlet pressure to heat exchanger.</td>
</tr>
<tr>
<td></td>
<td>Water supply pressure drop below 40 psig.</td>
<td>Check and correct.</td>
</tr>
<tr>
<td></td>
<td>Heater reset with fouled coils.</td>
<td>Remove coil and clean or replace.</td>
</tr>
<tr>
<td></td>
<td>Inlet water temperature too high.</td>
<td>Check water temperature.</td>
</tr>
<tr>
<td>Low steam pressure to heat exchanger.</td>
<td>Steam strainers severely plugged or restricted.</td>
<td>Clean screens.</td>
</tr>
<tr>
<td></td>
<td>Pressure reducing valve not set correctly.</td>
<td>Reset per manufacturer’s instruction.</td>
</tr>
<tr>
<td>Drop in water temperature occurring before capacity of heater is achieved.</td>
<td>Incorrect steam pressure to heater.</td>
<td>Test and adjust.</td>
</tr>
<tr>
<td></td>
<td>Water pressure below 40 psig.</td>
<td>Check and adjust (maximum pressure 150 psig).</td>
</tr>
<tr>
<td></td>
<td>Safety seal plate leaking.</td>
<td>Remove valve plug and replace plate.</td>
</tr>
<tr>
<td></td>
<td>Trap restricted or experiencing excessive back pressure.</td>
<td>Check piping for free flow. Remove and inspect trap.</td>
</tr>
<tr>
<td></td>
<td>Steam pressure incorrect or steam or condensate piping not sufficient size.</td>
<td>Check steam pressure at exchanger. Check for correct pipe diameter on steam and condensate lines. Check steam strainers for blockage.</td>
</tr>
<tr>
<td>Erratic changes in outlet temperature during no flow conditions with a recirculation package installed.</td>
<td>Improper adjustment of the recirculation thermostatic valve.</td>
<td>Check and correct.</td>
</tr>
</tbody>
</table>
### SECTION VI – MISCELLANEOUS CHARTS AND FORMULAS

#### TORQUE VALUES

<table>
<thead>
<tr>
<th>BOLT SIZE</th>
<th>18-8 S/S IN.-LBS.</th>
<th>BRASS IN.-LBS.</th>
<th>SILICON BRONZE IN.-LBS.</th>
<th>ALUMINUM 2024-T4 IN.-LBS.</th>
<th>316 S/S IN.-LBS.</th>
<th>MONEL IN.-LBS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-40</td>
<td>5.2</td>
<td>4.3</td>
<td>4.8</td>
<td>2.9</td>
<td>5.5</td>
<td>5.3</td>
</tr>
<tr>
<td>4-48</td>
<td>6.6</td>
<td>5.4</td>
<td>6.1</td>
<td>3.6</td>
<td>6.9</td>
<td>6.7</td>
</tr>
<tr>
<td>5-40</td>
<td>7.7</td>
<td>6.3</td>
<td>7.1</td>
<td>4.2</td>
<td>8.1</td>
<td>7.8</td>
</tr>
<tr>
<td>5-44</td>
<td>9.4</td>
<td>7.7</td>
<td>8.7</td>
<td>5.1</td>
<td>9.8</td>
<td>9.6</td>
</tr>
<tr>
<td>6-32</td>
<td>9.6</td>
<td>7.9</td>
<td>8.9</td>
<td>5.3</td>
<td>10.1</td>
<td>9.8</td>
</tr>
<tr>
<td>6-40</td>
<td>12.1</td>
<td>9.9</td>
<td>11.2</td>
<td>6.6</td>
<td>12.7</td>
<td>12.3</td>
</tr>
<tr>
<td>8-32</td>
<td>19.8</td>
<td>16.2</td>
<td>18.4</td>
<td>10.8</td>
<td>20.7</td>
<td>20.2</td>
</tr>
<tr>
<td>8-36</td>
<td>22.0</td>
<td>18.0</td>
<td>20.4</td>
<td>12.0</td>
<td>23.0</td>
<td>22.4</td>
</tr>
<tr>
<td>10-24</td>
<td>22.8</td>
<td>18.6</td>
<td>21.2</td>
<td>13.8</td>
<td>23.8</td>
<td>25.9</td>
</tr>
<tr>
<td>10-32</td>
<td>31.7</td>
<td>25.9</td>
<td>29.3</td>
<td>19.2</td>
<td>33.1</td>
<td>34.9</td>
</tr>
<tr>
<td>1/4-20</td>
<td>75.2</td>
<td>61.5</td>
<td>68.8</td>
<td>45.6</td>
<td>78.8</td>
<td>85.3</td>
</tr>
<tr>
<td>1/4-28</td>
<td>94.0</td>
<td>77.0</td>
<td>87.0</td>
<td>57.0</td>
<td>99.0</td>
<td>106.0</td>
</tr>
<tr>
<td>5/16-18</td>
<td>132</td>
<td>107</td>
<td>123</td>
<td>80</td>
<td>138</td>
<td>149</td>
</tr>
<tr>
<td>5/16-24</td>
<td>142</td>
<td>116</td>
<td>131</td>
<td>86</td>
<td>147</td>
<td>160</td>
</tr>
<tr>
<td>3/8-16</td>
<td>236</td>
<td>192</td>
<td>219</td>
<td>143</td>
<td>247</td>
<td>266</td>
</tr>
<tr>
<td>3/8-24</td>
<td>259</td>
<td>212</td>
<td>240</td>
<td>157</td>
<td>271</td>
<td>294</td>
</tr>
<tr>
<td>7/16-14</td>
<td>376</td>
<td>317</td>
<td>349</td>
<td>228</td>
<td>393</td>
<td>427</td>
</tr>
<tr>
<td>7/16-20</td>
<td>400</td>
<td>327</td>
<td>371</td>
<td>242</td>
<td>418</td>
<td>451</td>
</tr>
<tr>
<td>1/2-13</td>
<td>517</td>
<td>422</td>
<td>480</td>
<td>313</td>
<td>542</td>
<td>584</td>
</tr>
<tr>
<td>1/2-20</td>
<td>541</td>
<td>443</td>
<td>502</td>
<td>328</td>
<td>565</td>
<td>613</td>
</tr>
<tr>
<td>9/16-12</td>
<td>682</td>
<td>558</td>
<td>632</td>
<td>413</td>
<td>713</td>
<td>774</td>
</tr>
<tr>
<td>9/16-18</td>
<td>752</td>
<td>615</td>
<td>697</td>
<td>456</td>
<td>787</td>
<td>855</td>
</tr>
<tr>
<td>5/8-11</td>
<td>1110</td>
<td>907</td>
<td>1030</td>
<td>715</td>
<td>1160</td>
<td>1330</td>
</tr>
<tr>
<td>5/8-18</td>
<td>1244</td>
<td>1016</td>
<td>1154</td>
<td>798</td>
<td>1301</td>
<td>1482</td>
</tr>
<tr>
<td>3/4-10</td>
<td>1530</td>
<td>1249</td>
<td>1416</td>
<td>980</td>
<td>1582</td>
<td>1832</td>
</tr>
<tr>
<td>3/4-16</td>
<td>1490</td>
<td>1220</td>
<td>1382</td>
<td>958</td>
<td>1558</td>
<td>1790</td>
</tr>
<tr>
<td>7/8-9</td>
<td>2328</td>
<td>1905</td>
<td>2140</td>
<td>1495</td>
<td>2430</td>
<td>2775</td>
</tr>
<tr>
<td>7/8-14</td>
<td>2318</td>
<td>1895</td>
<td>2130</td>
<td>1490</td>
<td>2420</td>
<td>2755</td>
</tr>
<tr>
<td>1-8</td>
<td>3440</td>
<td>2815</td>
<td>3185</td>
<td>2205</td>
<td>3595</td>
<td>4130</td>
</tr>
<tr>
<td>1-14</td>
<td>3110</td>
<td>2545</td>
<td>2885</td>
<td>1995</td>
<td>3250</td>
<td>3730</td>
</tr>
</tbody>
</table>

#### METRIC CONVERSIONS

- Liters x 0.2641 = Gallons
- Gallons x 3.79 = Liters
- Gallons x 0.003785 = m³
- m³ x 264.2 = Gallons
- 1°C ΔT = 1.8°F ΔT
- °F = (°C x 1.8) + 32
- °C = (°F - 32) x 0.556
- psi x 0.06896 = Bar
- Bar x 14.5 = psi
- psi x 6.86 = kPa
- kPa x 0.1456 = psi
- Lbs x 0.4536 = Kg
- Kg x 2.2 = Lbs
- ft² x 0.0929 = m²
- m² x 10.765 = ft²