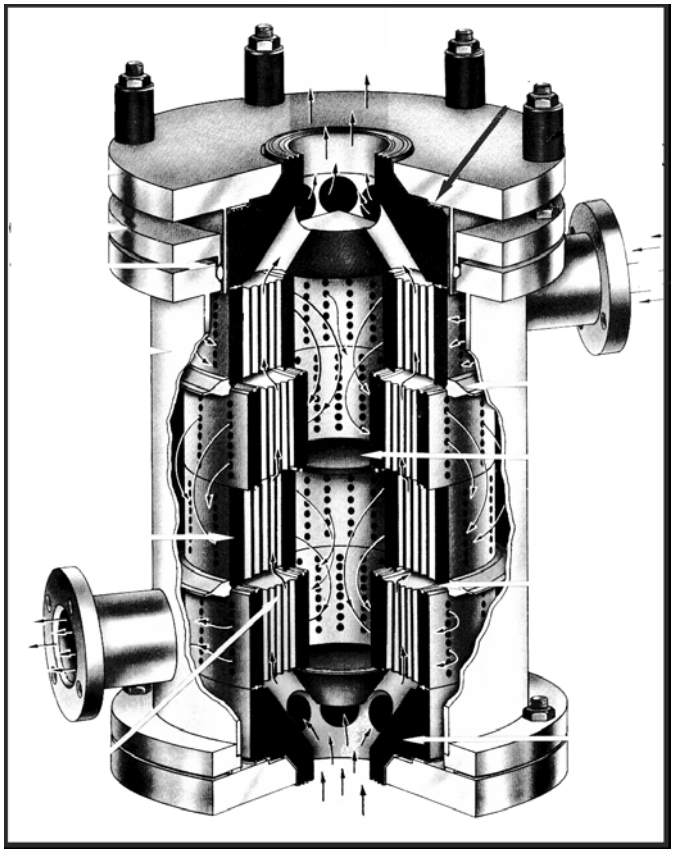
www.serviceprocess.net
Service Process Equipment, Inc.
PO Box 850908
Mobile AL 36685-0908
251.342.1313•Fax 251.342.1377
Email msellers@serviceprocess.net

POLYBLOC® I HEAT EXCHANGERS

INSTALLATION
COMMISSIONING
MAINTENANCE



REF: PBIMAN.ED

POLYBLOC® I IMPERVIOUS HEAT EXCHANGERS

WE STRONGLY RECOMMEND THAT YOU READ THIS MANUAL CAREFULLY AND FOLLOW THE INSTRUCTIONS TO ENSURE SAFE AND RELIABLE OPERATION OF THE UNIT.

Model #: _____

Type of impregnation: _____

Carbone drawing No.: _____

Customer/Ultimate owner _____

& address : _____

_____

P.O. number: _____

Project No.: _____

Equipment tag number(s): _____

Vessel Serial numbers: _____

Diameter (shell) : _____

Height or length: _____

Weight empty: _____

Weight full of water: _____

IMPORTANT INFORMATION FOR PROPER OPERATION OF CARBONE IMPERVIOUS GRAPHITE HEAT EXCHANGERS HEATED WITH STEAM OR THERMAL OIL.

1. PROPER SEQUENCE ON START UP:

A. Start acid circulation first.
B. Gradually open steam (or thermal oil) valve, increasing flow rate to design conditions over a period of approximately 5 minutes. Prevent steam (or thermal oil) or water hammer.

2. PROPER SEQUENCE ON SHUTDOWN:

A. Shut down steam (or thermal oil) flow first. Prevent steam (or thermal oil) or water hammer.
B. Allow acid to circulate several minutes in order to stabilize the temperature in the exchanger, then shut off flow.

3. PREVENT BOIL UP OF ACID IN THE HEAT EXCHANGER.

This can cause excessive fouling in the blocks and may result in damage to internal parts of the exchanger. Provide safety interlocks – If acid flow stops for any reason the steam (or thermal oil) must shutdown automatically. Upon shut-down, the steam (or thermal oil) valve should be reset to the closed position to prevent auto wind up or a "wide open position" upon restart.

4. STEAM (OR THERMAL OIL) LEAKING ON STARTUP & 1st THERMAL CYCLES: (for further details refer to section 4 b of manual).

The seal ring (at the flange gland) may be braided TFE which has a tendency to "cold flow" during the initial operation of the equipment. The flange gland nuts tend to become loose during the 1st few thermal cycles and steam (or thermal oil) may leak out between the "top" flanges of the exchanger. ("top" means upper flange sets for vertical installations; it is the "spring" end of the exchanger for horizontal installations.)

To stop leaks at this location, tighten the nuts on "top" of the flange gland (which is the flange between the top compression plate and the top shell flange.) Tighten nuts in ¼ turn increments using a diagonal sequence pattern to a max. of 20 ft-lbs (27 N·m).

Do not overtighten the nuts such that the flange gland contacts the top shell flange.

5. OTHER GENERAL NOTES:

- **Never exceed the design conditions labelled on the exchanger nameplate.**
- **Inspect steam traps periodically to prevent backup of condensate in the exchanger; this will reduce the performance of the exchanger.**
- **Refer to the Carbone exchanger assembly drawing for proper bolt torque information when tightening or adjusting nozzle and shell flanges. Damage to graphite parts may result if overtorqued! Always use Carbone TFE expansion joints at or near graphite nozzle connections to lessen nozzle loadings.**

READ AND UNDERSTAND THE INSTRUCTION MANUAL PROVIDED WITH THE EXCHANGER.

FOR FURTHER ASSISTANCE, CONTACT YOUR LOCAL CARBONE REPRESENTATIVE OR: 1-800-839-7535 (or direct 1-540-389-7535) (IN THE USA ONLY) OR PHONE 1-450-455-5728 (IN CANADA)

POLYBLOC IMPERVIOUS GRAPHITE HEAT EXCHANGERS

SINGLE SHELL CONSTRUCTION

C A U T I O N

BEFORE INSTALLATION & WHEN NEW TFE SEALS ARE INSTALLED – CHECK TORQUE ON THE BELLEVILLE (CONICAL) SPRING WASHERS PERIODICALLY – WHEN UNIT IS **COLD**

6" POLYBLOC – 25 FT.-LBS.

13" POLYBLOC – 30-35 FT.-LBS.

24" POLYBLOC – 35-40 FT.-LBS.

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B		Oct. 16/98	BT	WM

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INTRODUCTION

Polybloc® heat exchangers are uniquely designed corrosion resistant units consisting of stacked cylindrical Graphilor® blocks held in compression. Blocks have holes (or channels) drilled perpendicular to one another serving as “process” and “service” circuits seperated by the highly conductive but corrosion resistant Graphilor® wall. This robust and modular type of construction has become the industry standard for many corrosive process applications worldwide and will continue to do so for many years to come. For specifics on corrosion resistance, consult Carbone of America’s corrosion guide or one of our representatives.

The installation, operation and maintenance instructions which follow are believed to be reliable general guidelines for usage of the equipment described herein. In order to ensure a reliable and durable operation of your heat exchanger, we recommend that you follow these instructions carefully. CARBONE OF AMERICA **expressly disclaims any warranty, expressed or implied, of fitness for any specific purpose in connection with the information contained herein.**

Unless otherwise specifically provided in the contract of sales, CARBONE OF AMERICA does not provide project engineering or process design and, accordingly, the information presented herein is general in nature and should not be considered applicable to any specific process or application. While equipment is designed and manufactured in accordance with applicable codes and good manufacturing practices, it is the responsibility of the user to locate and install the equipment and provide those safety and warning devices which are appropriate for the specific application intended by the user.

1. TERMINOLOGY

Refer to Figure 1 & try to familiarize oneself with the Polybloc® terminology

a) Spring / Belleville assembly (see section 5 f for details)

b) Spring end compression plate

c) Header block & “process” nozzle (usually Graphilor®)

d) Flange gland

e) Seal ring (gland packing)

f) Steel shell

g) Graphilor® block

h) Service baffles

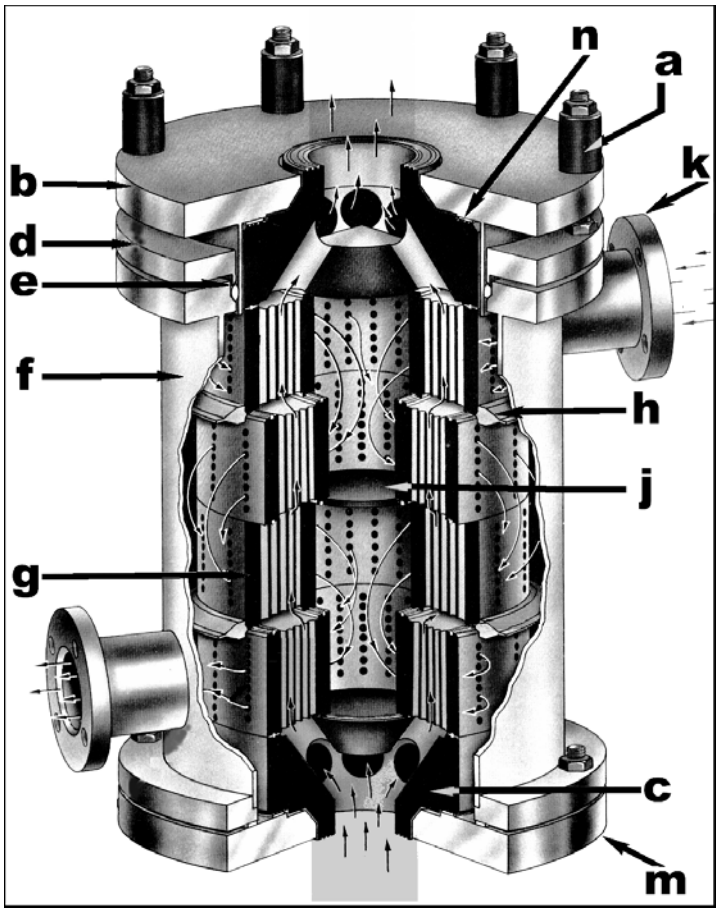
j) Baffle disc

k) Service nozzle

m) Fixed compression plate

n) Head gasket

FIGURE 1 – PB I



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2. RECEIVING INSPECTION

All equipment produced by CARBONE OF AMERICA is carefully inspected and hydrostatically tested at the specified test pressure as indicated on the Carbone assembly drawing. The method of packing the exchangers on skids has proven satisfactory over many years, and is approved by the carriers when accepting the units for shipment. However, damage in transit is always possible, and the exchanger should be inspected immediately upon receipt, before removing from the packing skid. Do not give the carrier a clear receipt or put the unit in storage before performing the following :

a) Examine the skid and crating carefully for evidence of damage in transit.
Note: Carbone of America usually installs a "shock watch" device on the packaged shipment which if broken (indicates red in the glass vial) is immediate evidence of mishandling during transit.

b) Visually inspect all nozzles, flanges, support brackets, etc. for damage.

c) Check the torque of the springs (Belleville washers) at the shell flange, and the torque loading of all other bolts. Retorquing may be necessary due to gasket set during transportation. Refer to your assembly drawing for the proper torque values.

d) Perform an initial hydro test by following these steps: (refer to figure 2).

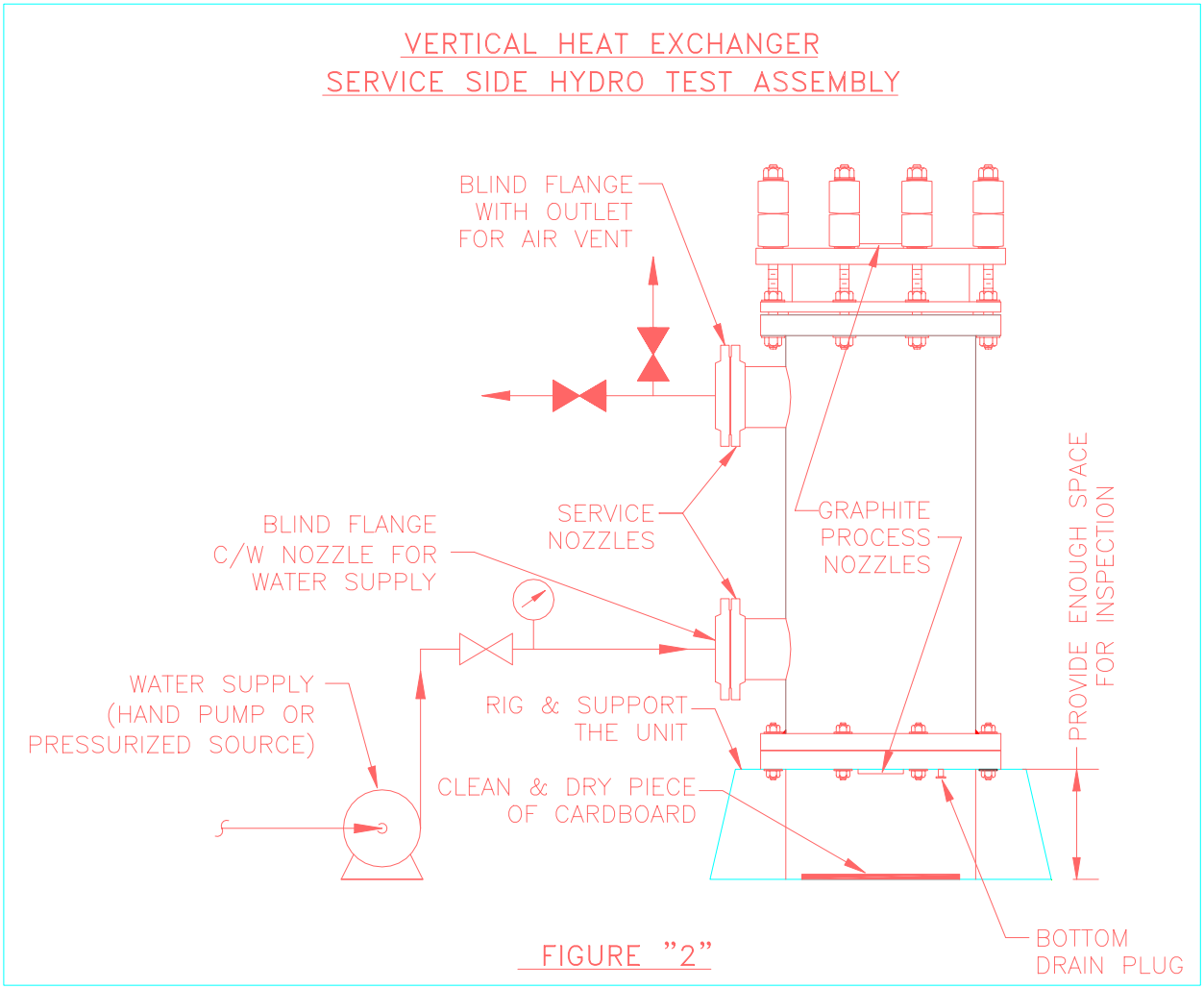


FIGURE "2"

i) Rig and support the unit in a vertical position and remove wood protection from graphite process nozzles.

ii) Connect pressure piping & valving to the service nozzles.

iii) Put a dry clean piece of cardboard under the graphite process nozzle which will serve as a leak detector.

iv) Fill the shell with water through the service connections. Vent air through an outlet vent valve.

v) Pressurize the service side gradually up to the test pressure noted on the assembly drawing. Check for leaks while under pressure. Pressure should be held for a minimum of one hour. Expect 2 to 10 psi (14 to 70 kPa) pressure drop over time dependant on test apparatus. If a leak develops, this will show up as drops of water coming out of the bottom graphite nozzle.
TEST PRESSURE MUST NEVER EXCEED THE DESIGN OR TEST PRESSURE AS MARKED ON THE NAMEPLATE OR ON THE ASSEMBLY DRAWING.
If leaks occur after the preceding procedure, a claim should be filed immediately with the shipper, and Carbone of America should be notified of the problem.
If the exchanger is not to be installed immediately, be sure to drain the test water completely in order to prevent freeze damage during cold weather.

vi) Use the bottom drain plug to completely drain the exchanger once the test is over.

3. INSTALLATION

a. Handling

The heat exchanger must be handled carefully. It should be lifted either by the support brackets or by lifting lugs (if so provided) attached to the shell. NEVER LIFT THE EXCHANGER BY THE SPRING ASSEMBLIES OR BY THE NOZZLES.

b. Clearance for dismantling

For installations where maintenance is to be provided directly at the installation point, minimum headroom equal to the height of the unit should be allowed for single shell units, and for units with a double sectional shell the clearance should be equal to the height of the longest shell section. Otherwise the entire unit must be removed to allow for maintenance in the shop or elsewhere.

c. Foundation

Any concrete foundation or floor must be adequately designed to support the Polybloc® heat exchanger and its contents. The weight of your heat exchanger either empty or full of water is indicated at the beginning of this manual and on the assembly drawing.

d. Vertical installation

Vertical installation is usually recommended. Complete overhaul maintenance can only be performed in this position. This position also allows for complete draining. The Polybloc® may be supported on any rigid steel frame or stand suitable for the loads, either by its integral supports or by the “bottom” or fixed compression plate. Do not fix the spring end compression plate, since this will prevent expansion and cause potential damage.

e. Horizontal installation

The Polybloc® may be operated horizontally only if originally designed for this arrangement. Special provisions must be made at the design stage to maximize draining and venting of the unit.

The Polybloc® may rest on suitable saddles without bolting the shell directly to the saddles. This allows for free expansion of the shell. For fixed horizontally mounted exchangers, one support has drilled mounting holes and the other support has slotted holes (refer to figure 3). Tighten and “fix” the bracket with the “holes” and use double nuts at the slotted bracket so there is clearance between the bolts and the slotted holes to allow the bracket to slide as the shell thermally expands and contracts.

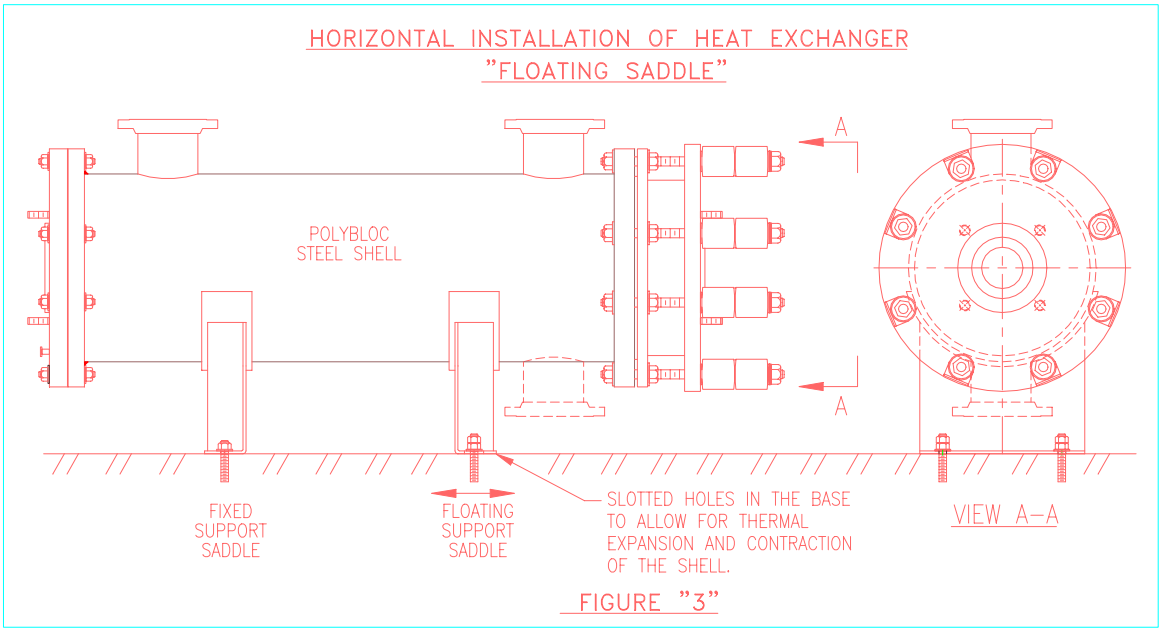


FIGURE "3"

f. Levelling

Polybloc® heat exchangers should be set level and square so that all piping connections may be made without excess force. The use of expansion joints (see sections h and i for details) is recommended.

g. Dirt removal

The entire piping system connected to the heat exchanger should be isolated and then cleaned and flushed prior to the start of operation to prevent plugging of holes or damage to the heat exchanger. The use of strainers or settling tanks in the pipe line up-stream of the exchanger is strongly recommended.

h. Process Piping / Axial (Nozzles 1 & 2 on figure 4)

Piping to Graphilor® header process nozzle connections should be planned carefully to prevent undue stresses from being transmitted to the exchanger. TFE expansion joints, installed as close to the exchanger as possible, are recommended to isolate the unit from vibration, misalignment and thermal expansion of the piping or other loads which can impose stress on the heat exchanger. Carbone of America can supply Armylor® corrosion resistant TFE expansion joints for this purpose. Contact Carbone of America for assistance in sizing and selection. The heat exchanger is not a pipe support. Make sure to respect the torque values indicated on the assembly drawing when connecting the process piping to the heat exchanger. Torques exceeding the indicated values can crush or crack the graphite and create unwanted process leaks.

Note: Use gaskets which are easy to seal and require low torque values for process nozzle connections. Woven PTFE tape gaskets or suitable elastomeric gaskets are recommended.

i. Shellside Piping / Radial (Nozzles 3 & 4 on figure 4)

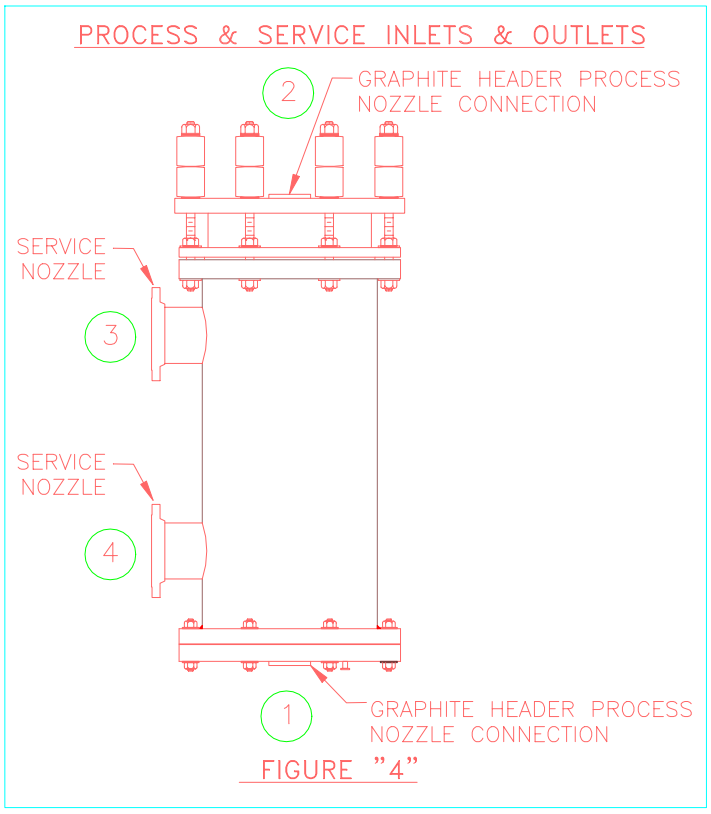


FIGURE "4"

Piping connections can be made to the steel shell using standard pipefitting techniques. (Refer to piping handbook by Crocker and King). Expansion joints, installed as close to the exchanger as possible, are recommended to isolate the unit from vibration, misalignment and thermal expansion of the piping or other loads which can impose stress on the heat exchanger. Steam lines should be properly trapped and provisions made to drain all water legs which might develop in the supply line on shutdown. Use slow opening valves to prevent water or steam hammer. Water or steam hammer can cause the gaskets to blow out and create a leak between the process and the service fluids. Automatic control valves, when closed or almost closed, can allow steam to enter the exchanger without providing enough pressure to discharge the condensate. Therefore, condensate lines should be arranged so there is no back pressure after the trap, and a vacuum breaker should be provided at the highest point in the piping system. This will permit condensate to drain by gravity.

j. Pressure Relief Devices/Thermowells

If the heat exchanger is to be operated under pressure, the installation of pressure relief devices on both process and service sides of the exchanger are recommended or may be required by law. Check with local jurisdictions for laws or codes that apply. Refer to ASME Code Section VIII, Division I for recommendations on these devices. Impervious graphite (Graphilor®) rupture disks are available from CARBONE OF AMERICA to alleviate pressure safely from corrosive process lines.

For added convenience, Graphilor® thermowells can be installed on the inlet and outlet process piping to permit temperature indication and transmission. Carbone of America can supply these thermowells if required.
Installation of a valved bypass lined across the heat exchanger nozzles will permit disassembly of the exchanger itself without shutting down the line if multiple heat exchangers are plumbed in series or parallel.

4. COMMISSIONING AND OPERATION

a. Warnings

i) **Danger:** Do **not** operate the unit at pressure or temperature conditions exceeding those specified on the nameplate or the assembly drawing. Exceeding the values could result in an explosion and bodily harm. (Note: The lowest value listed must be respected. Note that the process side rating can be different from the service side rating).

ii) **Danger:** Do **not** use compressed air to clean the unit if fluids normally handled are flammable. Dissipating these fluids could result in fire and bodily harm.

iii) PREVENT BOIL UP OF PROCESS FLUIDS IN THE HEAT EXCHANGER. This can cause excessive fouling in the blocks and may result in damage to internal parts of the exchanger. Provide safety interlocks with the control system. If the process fluid flow stops for any reason, the steam or thermal oil must shutdown automatically.

iv) Inspect steam traps periodically to prevent backup of condensate in the exchanger. Condensate flooding will reduce the performance of the heat exchanger.

v) Refer to the Carbone exchanger assembly drawing for proper bolt torque information when tightening or adjusting nozzle and shell flanges. Damage to graphite nozzles may result if overtorqued! Always use Carbone TFE expansion joints at or near graphite nozzles connections to lessen nozzle loadings. Expansion joints if used should always employ safety shields to avoid splashing in case of rupture. Safety shields are available from Carbone of America.

vi) Torquing of any section of the exchanger must be done when the unit is shut down and “cold”.

b. Commissioning

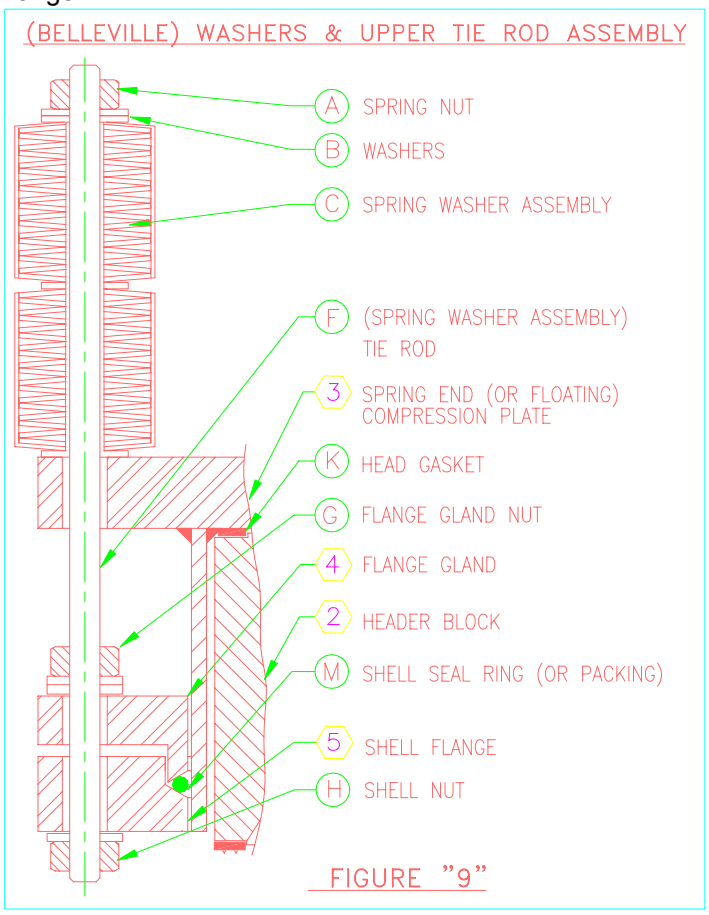
i) If you are commissioning a new unit or one that has been re-assembled for service, make sure that all nuts and springs (Belleville washers) are at the design torque value. Torque values are indicated on the assembly drawing. Gaskets may compress (or cold flow) over time. This will cause a loss of compression of the springs (Bellevilles). The compression of the springs (Bellevilles) should thus be checked periodically and always after the 1st few thermal cycles.

ii) To start the unit, run the cold fluid first. Open valves slowly to flood the unit and to vent all air before allowing full flow. Once steady flow conditions are reached, introduce the hot fluid in the same manner.

iii) For steam service; the steam trap bypass valve should be open when starting up a steam-heated unit. This valve can be closed when a steady flow of steam has been attained. STEAM OR HOT THERMAL OIL MUST NEVER BE ALLOWED TO CIRCULATE ALONE IN THE EXCHANGER. If the flow of the cold fluid is stopped for any reason, the steam or hot thermal oil must be stopped automatically. (We recommend a flow switch interlock).

A steam or thermal oil leak can develop during the 1st few thermal cycles. The seal ring at the flange gland (item M, figure 9, below) may be TFE which has a tendency to "cold flow" during the initial operation of the equipment. The flange gland nuts (item G) tend to become loose during the 1st few thermal cycles and steam or thermal oil may leak out between the "top" flanges. ("top" means upper flange sets for vertical installations; it is the spring (belleville) end of the exchanger for horizontal installations.)

To stop leaks at this location, tighten the flange gland nuts on "top" of the flange gland (item G). Tighten nuts in 5 ft-lb (7 N·m) increments using a diagonal sequence pattern to a max. of 20 ft-lbs (27 N·m). Do not overtighten the nuts such that the flange gland contacts the top shell flange.



iv) Operation of all valves must always be slow and gradual to avoid water or steam hammer. Automatic valves require special attention. Upon shut down, the steam or thermal oil valve should be reset to the closed position to prevent a wide open position upon restart and possible "hammer".

c. Shutting down the Polybloc®

The hot fluid should be gradually shut off first in all cases. If it is necessary to stop the circulation of the cooler medium, the hot medium should also be stopped immediately or the Polybloc® bypassed accordingly. Once the hot fluid has stopped, let the cold fluid circulate for several minutes in order to stabilize the temperature and then close the valve gradually. For prolonged shutdowns, fluids should be drained from the unit to prevent corrosion, crystallization or precipitation. In addition, in cold environments where freezing may occur, all fluids must be drained. As indicated above, condensation in a steam system should also be drained to prevent water hammer, both when starting up and when shutting down the unit.

5. MAINTENANCE

a. Fouling

The Polybloc® heat exchanger should be periodically cleaned by mechanical or, preferably, chemical means to keep fouling (sludge or scale formation) to a minimum. This fouling greatly reduces the efficiency of the Polybloc®, even though an estimated fouling factor is included in the original design. In addition to the reduction in efficiency, there is generally a marked increase in the pressure drop across the process & service nozzles. The graphite (process side) can be cleaned with a wide assortment of acids and bases except highly oxidizing ones. Contact Carbone of America if there are any questions on the cleaning agent. The shell, which is generally carbon steel, should be cleaned taking into account the corrosion resistant properties of steel. The different chemical and mechanical means of cleaning the exchanger are explained in the following sections.

b. Carbone Factory Service

Carbone of America provides complete heat exchanger servicing, including complete unit overhauling at its Vaudreuil-Dorion, Quebec and Salem, Virginia facility and other facilities worldwide.

Carbone of America can also provide the services of a field service technician or engineer to supervise in an advisory capacity, customers' routine heat exchanger cleaning and maintenance.

c. Chemical Cleaning

Note: Make sure that chemicals listed below are compatible with your process piping system.

i) Sulfuric Acid Cleaning (Process side)
- Feed and flood 10% to 15% sulfuric acid (H_2SO_4) solution (by weight) through process side.
- Bring solution to boil by introducing steam on the shell side. Do not exceed the pressure and temperature rating of the exchanger. (We usually recommend 15 psig (100 kPag) steam or lower).
- Stop cycle after two to four hours and drain sulfuric acid solution.
- Rinse heat exchanger for 30 minutes with clean water.
- Check torque values of connections and return unit to normal operation.

ii) Caustic Cleaning (Process side)
- Same as above except use a max. 15% caustic solution (NaOH); we recommend a 10 % caustic solution.
- Since caustic can attack impregnated graphite materials above 15% and 212ºF (100ºC), the cleaning cycle should not exceed 2 hours duration and the temperature should not exceed 212ºF (100ºC).
- Rinse heat exchanger with clean water, as above and check torque values of connections.
- Return unit to normal operation.

iii) Other solutions such as organic solvents can be used to clean Polybloc® exchangers, but it is strongly suggested that the customer be thoroughly familiar with the properties of the particular solvent, and with the chemical manufacturer's recommended precautions. Carbone of America can only make recommendations regarding the compatibility of the solvent with the graphite impregnation and not surrounding piping.

iv) Chemical cleaning of the service side

Water scale and lime can accumulate on the service side of the exchanger. Many cleaners are available commercially to remove these deposits without any detrimental affect on the steel portions of the exchanger.
Refer to the chemical supplier's instructions for these cleaners for proper cleaning procedures. Beware that Graphilor® graphite is attacked by strong oxidizing agents. These must be avoided.

d. Mechanical Cleaning

It is necessary to dismantle the Polybloc® unit in order to effectively clean both process and service side passages mechanically. Dismantling and re-assembly will be explained in the following sections of this manual. Several techniques can be used to clean the exchanger blocks. Precautions must be taken to avoid damage to the graphite components.

i) Rodding
This method consists of inserting by hand a steel rod of a diameter slightly smaller than the diameter of the holes to clean. This should remove deposits.

ii) Drilling
This method consists of drilling each hole with a slightly smaller diameter drill than the diameter of the holes. THIS METHOD IS VERY RISKY AND REQUIRES A VERY PRECISE DRILL. This should not be performed with a hand drill. If the drill is not aligned correctly, one can drill through the channel into the opposing perpendicular one, thus causing a cross leak.

iii) Brushing (or Brush Drilling)
This is the recommended method. The channels are cleaned using a plastic (never metallic) cylindrical brush (tube cleaner) which can be attached to a pneumatic drill and used either wet or dry.

iv) Pressure cleaning (or water blasting)
The channels are cleaned using long nozzles and a warm water pressure cleaning machine (below 1500 psi, 10300 kPa).

Regardless of which method is used, it is suggested that, after cleaning, each block be leak tested, prior to re-assembly of the unit. Blocks can either be tested individually or as a group.

Individual block testing

Each block can be tested separately by compressing it between the bottom and top compression plate and headers, with gaskets, and pressurizing the process side with water (refer to section 5 f, iii for details of assembly, page 15). Water appearing in the service holes would indicate a leaking or damaged block.

Group block testing

The blocks can also be tested as a group without completely assembling the unit. The partial assembly required for the test of the unit saves some time for the final assembly if the test is positive. Refer to section 5 f, iii for complete assembly instructions. Stack the blocks and headers on the bottom compression plate the same way as for a re-assembly and put the spring compression plate on top of the stack. Do not install the steel shell or flange gland. Use long threaded rods joining the top compression plate to the bottom compression plate and use the spring assembly to put the stack of blocks in compression.

Test the blocks by pressurising the process side with water as for the single block test. The service side holes will show water if a leak occurs. If one of the blocks is leaking, remove the top compression plate and replace the leaking block. If there are no leaking blocks, remove the top compression plate and proceed with the final assembly of the unit as explained in section 5 f, iii, page 15.

A hydrostatic test is still required on the completely assembled unit.

e. Disassembly of the Polybloc® (refer to figure 5, page 13).

Units must be in the vertical position with springs at the top to allow for disassembly.

For installations where maintenance is to be provided directly at the installation point, as a minimum, headroom equal to the height of the unit should be allowed for single shell units, and for units with a double shell the clearance should be equal to the height of the longest shell section. Otherwise the entire unit must be removed to allow for maintenance in the shop or elsewhere.

If piping permits it, chemically clean & rinse the unit prior to removal. For easy disassembly, the exchanger should be dismantled from the installation location using appropriate lifting tackle. Lift only from designated lifting lugs or supports and never from the spring assembly tie rods.

Rinse both circuits with water. Set the heat exchanger on suitable wood blocks (minimum 4" x 4") to allow for hand access under the bottom plate. (If possible, access of 12" to 18" underneath the exchanger should be provided to allow for pressure testing the process side).

i) The Polybloc® heat exchanger should be set plumb under a hoist or crane for removal of the steel shell.

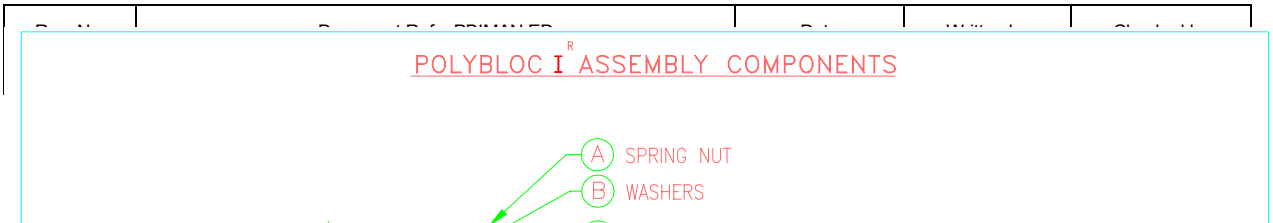
ii) Diagonally & progressively loosen the top spring (Belleville) nuts (A) until Belleville asemblies can be removed. Remove the spring / Belleville assembly (parts A, B and C).

iii) Remove the top compression plate (part 3), by lifting it vertically. If necessary, use a puller and a piece of ½" plywood against the graphite header to avoid lifting the header with the plate.

iv) Remove the flange gland (part 4) and remove the shell seal ring (part M).

v) Remove the nuts and rods on the bottom compression plate (parts J & U).

vi) A weight (50-100 lbs / 25-50 kg), the OD of which should be no greater than the OD of the graphite blocks, should be put on the stacked blocks. The shell (part 5) should then be very carefully hoisted directly upward, rotating it a little back and forth to make sure baffles (parts Q & S) do not bind. A little diluted liquid soap may be used to aid in removing the shell. If the steel shell is in several sections but there is enough over-head space, one can remove it in one piece.



CAUTION : The stack of graphite blocks is relatively unstable. For double shell section assemblies, remove the steel shell one section at a time and remove the graphite blocks of each section before proceeding with the next section.

NOTE : If the purpose of the disassembly was due to cross leaking, carefully examine the blocks (for corrosion) and the gasket interfaces for signs of a gasket blow out. If nothing is visible, the stacked assembly (less the shell) can be pressure tested from the process nozzle side to determine where leaking occurs. This is described in Section 5 d.

Handling of the Graphite Blocks :

vii) The graphite blocks and other components may be removed as required. Caution must be exercised when separating the graphite blocks if they stick. A tool should never be inserted between two blocks to force them apart, as this will damage the block(s) and gasket surfaces.

It will be necessary to have available means of handling the graphite blocks and headers for maintenance. Metal collars (refer to figure 6) with an internal lining of rubber (or other soft corrosion resistant padding) can be used to avoid damaging the graphite. The collars should include holes for the attachment of lifting tackle. Compress the collars on the block enough to avoid any slipping during handling. Be careful not to damage the graphite service baffles.

To eliminate any possibility of slipping, we recommend that four (4) rods, slightly less in diameter than the diameter of the radial channels, be inserted through four (4) radial channels in the block immediately above the collar.

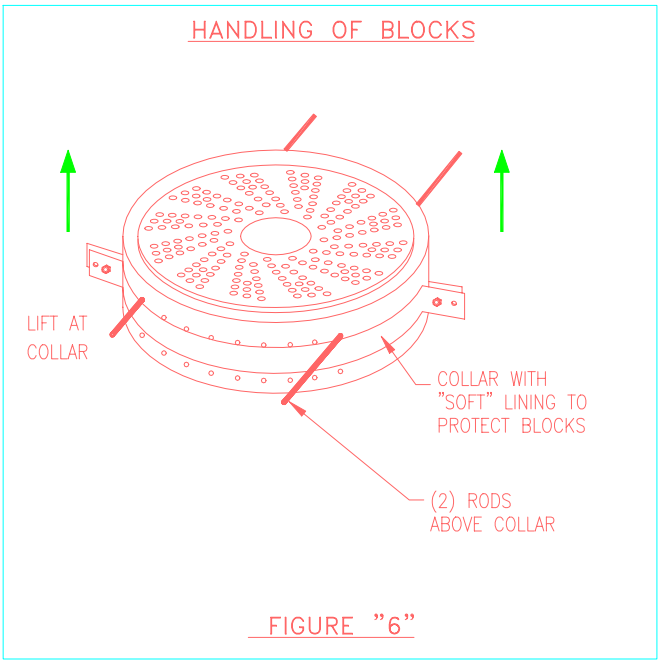


FIGURE "6"

viii) Blocks can now be individually or group cleaned mechanically in cleaning solution or water as per sections 5 c and 5 d or can be individually pressure tested.

f. Reassembly of Polybloc® (refer to figure 5, page 13).

Before reassembling the heat exchanger, grooves and surfaces on the blocks and headers for gaskets and baffles should be cleaned thoroughly to prevent any leakage between the two fluids. Use acetone to remove completely all dirt and deposits. Be careful not to scratch or gauge the graphite since it might create a leak path. All gaskets and seals should be carefully examined and replaced. **New gaskets are always recommended.**

Steel parts of the exchanger should also be carefully cleaned. Wire brushing, sandblasting or chemical cleaning are possibilities. DO NOT USE A WIRE BRUSH OR SANDBLAST GRAPHITE COMPONENTS.

ALWAYS refer to the assembly drawing for proper selection & placement of all gaskets and parts (Note : At least one full set of gaskets should be kept in stock at all times for servicing).

i) Place the bottom compression plate (part 6) on wood (min. 4" x 4") or a stand so that there is enough space to install the nuts and studs (parts J & U) to the steel shell later. Make sure the unit will be in a stable vertical position. (Try to provide 12" to 18" underneath the assembly for hand or visible access).

ii) Install the head gasket (part K) and the shell gasket (part N) before any graphite parts. We recommend that both gaskets be covered with a thin layer of silicone sealant (or other sealant compatible with the service media and conditions) to prevent gasket slippage during further installation steps.

iii) Assembly should then proceed in the reverse order of the disassembly as indicated previously (section 5 e). Make sure that the gasket grooves are wiped clean and that the blocks turn easily, indicating proper seating during successive block stacking. The space between the blocks should be equidistant all around. Make sure that the baffles and the baffle discs are located as per the design assembly drawing.

iv) Once all the blocks, headers and gaskets are restacked, the inside of the steel shell (part 5) should be lubricated with diluted liquid soap & hoisted directly over the stacked blocks. Make sure that the bolt holes of the bottom of the shell are aligned with the bolt holes of the plate (part 6). Once plumb and carefully aligned, the shell should be lowered slowly into position.

v) Attach the steel shell (part 5) to the bottom compression plate (part 6). The torque value is indicated on the assembly drawing. Torquing must be made diagonally and progressively following standard torquing techniques up to the maximum torque value.

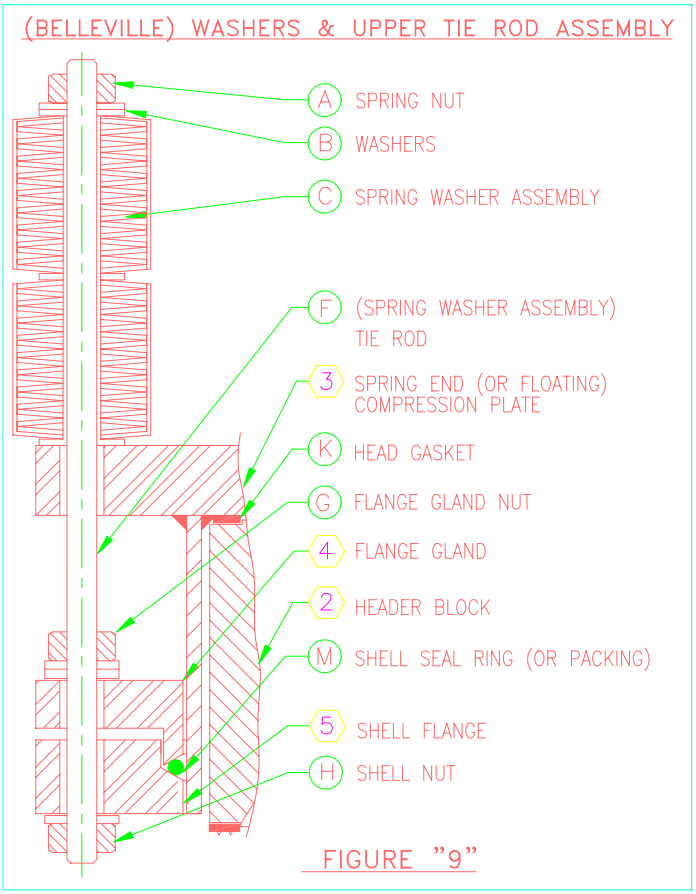
vi) The spring end portion of the exchanger should be assembled as per the following instructions (Refer to figure 5 on page 13 or figure 9 on page 16) :

Using a few nuts and bolts, temporarily attach the flange gland (part 4) to the spring end compression plate (part 3). If the seal ring is an elastomeric O-ring (part M), slide it on the skirt of the spring end compression plate and then put the whole assembly on top of the steel shell (part 5).

If the seal ring is TFE packing, place 3 wood or other shims (approximately 1-1/2" (40mm)) thick to act as spacers between the steel shell flange (part 5) and the flange gland (part 4). This allows for placement of the TFE packing. Put the spring end compression plate (part 3) with the flange gland (part 4) attached to it on top of the steel shell flange (part 5) and then, put the TFE packing in place (part M) carefully diagonally butt ending the TFE packing at its meeting point.

Remove the nuts and bolts from the flange gland so that it can take its place.

Install the spring assemblies on the Polybloc® as per below. Don't forget nuts (part G) between the flange gland and the spring end compression plate.



The spring assembly is designed to maintain the proper compression on the Graphilor® blocks.

WARNING:

Over tightening will cause excessive compressive stress on the Graphilor® blocks and can damage the blocks and the springs.

Tighten the nuts of the spring assemblies in the following order :

1. Tighten the nuts (part H) under the flange of the steel shell. Make sure that a few threads are protruding through the nuts. Keep the flange gland nuts (part G) loose.

2. Tighten the spring nuts (part A) as described above to the proper torque, diagonally & progressively.

3. Tighten the flange gland nuts (part G) with torque increments not exceeding 5 ft-lbs (7 N·m). Torquing should be carried out diagonally & progressively. If a leak should occur during hydro test, increase the torque on the seal ring (flange gland nuts) up to the maximum indicated on the assembly drawing. The flange gland must never contact the top flange of the steel shell. If this happens, the seal ring has been overcompressed and most likely has to be replaced or another one added within.

g. Testing of the Polybloc® unit

i) Units should always be tested in a vertical position. Connect a heat source (hot water or low pressure steam) to the service (shell side) nozzles.

ii) Low pressure steam (generally below 15 psig, 100 kPa) or hot water between 200ºF and 210ºF (95ºC to 99ºC) should be introduced gradually to the shell nozzles and allowed to flow through the unit for at least two hours. Vent the unit as required. This should be continued until the entire unit is hot over 200ºF (95ºC). This procedure softens the seals and gaskets, allowing them to seat between the graphite blocks. Abrupt temperature changes must be avoided.

At midpoint in the heating cycle, the spring (Belleville) compression should be checked and adjusted (tightened) if required to the correct “torque” as per Figure 9.

iii) The unit should be allowed to stand, preferably overnight, until it cools to approximately 100ºF (40ºC). Once the unit has cooled, retighten the spring assembly to the correct “tightening level”.

iv) One can now perform a service side hydro test as per the following instructions (refer to figure 2, page 2).

- Rig and support the unit in a vertical position (if not already done).
- Connect pressure piping & valving to the service nozzles in accordance with the applicable codes and standards for the test pressure to be used.
- Put a dry clean piece of cardboard under the graphite process nozzle which will serve as a leak detector.
- Fill the shell with water through the service connections.
- Pressurize the service side gradually up to the test pressure noted on the assembly drawing. Check for leaks while under pressure. Pressure should be held for a minimum of one hour. Expect 2 to 10 psi (14 to 70 kPa) pressure drop over time dependant on test apparatus. If a leak develops, this will show up as drops of water coming out of the bottom graphite nozzle.

  TEST PRESSURE MUST NEVER EXCEED THE DESIGN OR TEST PRESSURE AS MARKED ON THE NAMEPLATE OR ON THE ASSEMBLY DRAWING for the service side.

v) If any leaks develop, the heating and cooling cycle should be repeated, perhaps with a higher temperature source (up to 250ºF (120ºC)) and proper spring adjustments must be made as per above. Any leaks that cannot be stopped in this manner indicate improper seating of the block or header gaskets or seal rings, or a leaking block. If this is the case, the unit must be disassembled to check for the source of the leak and then reassembled.

If no leaks develop, the unit is ready for installation in the process.

If the exchanger is not to be installed immediately, be sure to drain the test water completely in order to prevent freeze damage during cold weather.

- Use the bottom drain plug to completely drain the exchanger once the test is over and reinstall and tighten it (with TFE tape) after fully drained.

6. SPARE PARTS

When ordering spare parts, please refer to the heat exchanger drawing supplied with the unit and order parts using the full part number (with suffix) from this drawing. This will ensure that the parts ordered will be the correct items and material of construction for your heat exchanger. As a minimum, one complete set of gaskets should be stocked at all times for each exchanger in service.

For replacement parts, field servicemen or exchanger repair call your local Carbone representative, or the factories direct at :

CARBONE OF AMERICA (LCL) LTD.
225 HARWOOD BLVD
VAUDREUIL-DORION, QUEBEC
J7V 1Y3
TELEPHONE: (450) 455-5728
FACSIMILE: (450) 455-5052

CARBONE OF AMERICA CORP.
540, BRANCH DRIVE
SALEM, VA 24153
U.S.A.
TELEPHONE: (540) 389-7535
FACSIMILE: (540) 389-7538

TABLE 1 - Polybloc® I Reference Part Numbers and recommended spares (Vaudreuil-Dorion)

NOTE : * These part numbers are "generic". The part numbers of your unit could have a suffix which identifies a special feature and should always be taken from the assembly drawing specific to your unit.

			Carbone of America Reference Part Number *		
Figure 5 & 9 Ref. #		Description	PB 6	PB 13	PB 24
	1	Intermediate Graphilor® block	6-1	13-1	24-1
	2	Header block	6-2	13-2	24-2
	3	Spring end (or floating) compression plate	6-5Q	13-34 Top	24-7
	4	Flange gland	6-4	13-33	24-5
	5	Steel Vessel (or shell)	6-3	13-31	24-3
	6	Fixed compression plate	6-5R	13-34 Bottom	24-6
	A	Spring nut	6-14	13-19	24-24
	B	Washers (spring assembly)	6-15	13-76	24-19
	C	Spring Assembly	6-40	13-64H	24-17
	F	(Spring assembly) Tie rod	6-11	13-37	24-18
	G	Flange gland nut	6-14	13-19	24-24
	H	Shell nut	6-14	13-19	24-24
	J	Fixed compression plate bolt (or tie rod)	6-12	13-62	24-22
*	K	Header gasket	6-9	13-13	24-12
*	M	Shell seal ring (or packing)	6-7	13-10	24-11
*	N	Shell gasket	6-37	13-36	24-10
*	P	Baffle disc	*****	13-3	24-14
*	Q	Service baffle ring	6-8	13-35	24-13
*	R	Outer seal ring	6-6	13-8	24-8
*	S	Inner seal ring	*****	13-9	24-9
	U	Fixed compression plate nut	6-14	13-19	24-24

7. CLEANING CARBONE EQUIPMENT BEFORE RETURNING IT TO CARBONE FOR REPAIRS.

Employee safety and the strict adherence to OSHA, EPA and other safety and pure air and water regulations are primary concerns to CARBONE OF AMERICA. To repair equipment in a safe and expedient manner, it is mandatory that the equipment be returned in a thoroughly cleaned condition.

It should be noted that there are no facilities at CARBONE OF AMERICA to discharge effluent from dirty equipment.

A Returned Equipment Questionnaire and Material Safety Data Sheets must be completed by the customer and sent prior to returning equipment to Carbone of America. Failure to comply may cause delays in processing the equipment or possible rejection of the equipment, with return of it to the customer at his expense. In general, the following should be carried out sequentially:

a. Remove all external insulation.

b. Clean equipment exterior and interior. The inside and outside of the equipment and related accessories must be free of any residue or other contaminants which may be toxic, flammable, explosive and irritating at any temperature from ambient up to and including welding temperatures.

c. Flush shell and tubeside of the exchanger to remove all heating or cooling medium and product residue. A thorough flushing of the unit with water or a non-harmful solvent is required.

d. All materials/items removed from the vessel should not be returned to CARBONE OF AMERICA. They should be disposed of in a manner consistent with the customer's safety or salvage policies.

e. Contact CARBONE OF AMERICA for an applicable Returned Equipment Questionnaire. A Material Safety Data Sheet will be required as well. Complete the forms and return them to CARBONE OF AMERICA.

f. After our review of the completed Questionnaire and Material Safety Data Sheets, Carbone will send you a "Return Authorization Tag" that you should attach to your unit before returning it to us.

8. ASSEMBLY DRAWINGS (attached) & NOTES