HT-406
HIGH TEMP STEEL PIPING SYSTEM

HT-406
THERMACOR’S HT-406 is a factory-fabricated, pre-insulated piping system for below ground distribution of steam, condensate return, and high temperature heating water. The system is designed with a steel carrier pipe (type and grade specified, as required), closed cell polyisocyanurate/polyurethane foam insulation, and a High Density Polyethylene (HDPE) jacket combined with molded or mitered HDPE fitting covers, incorporating electro-fusion welding, to create a seamless pressure testable jacket throughout the entire system.

Carrier Pipe
- d > 2” - A53 ERW Grade B, Std. Wt. Black Steel
- d < 2” - A106 SML, Std. Wt. Black Steel
- Seamless & Schedule 80 pipe are available for all sizes.
- Std. Wt. is the same as Schedule 40 through 10”.
- XS is the same as Schedule 80 through 8”.

Polyisocyanurate Insulation
- Density > 2.4 lbs/ft³
- “K” Factor 0.17 @ 75°F, < 0.30 @ 366°F
- Compressive Strength > 30 psi @ 75°F
- Closed Cell Content ≥ 85%
- Minimum Thickness ≥ 2.5”

Jacket
- High Density Polyethylene (HDPE)

ERM Leak Detection
All HT-406 systems are provided with an Electric Resistance Monitoring (ERM) leak detection system. This simple leak detection system should be used on all high temperature systems to ensure the longevity of the piping system. See Thermacor’s ERM brochure for more information.
GENERAL
All underground and above ground piping materials transporting steam, condensate return, or high temperature heating water shall be HT-406 as manufactured by THERMACOR PROCESS INC. All straight pipe, fittings, anchors, and other components shall be factory-fabricated and pre-insulated. No field insulation of fittings shall be allowed. All piping connections shall incorporate Pressure Testable closures to create a seamless pressure testable jacket throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax or Canusa GTS-65 wrap prohibiting the ingress of water. No PVC, FRP, HDUP, or tape allowed.

SERVICE PIPE
The carrier or service pipe shall be A-53, Grade B, ERW, Standard Weight for pipe sizes 2” and larger and A106/ A53, Grade B, seamless, standard weight for pipe sizes 1.5” and smaller. Condensate piping materials shall be extra strong. Pipe shall be butt-welded for sizes 2” and larger and socket-welded for 1.5” and smaller. Straight sections shall be supplied in 20 or 40 foot random lengths with cutbacks to allow for welding at the field joints.

INSULATION
Insulation of the service pipe shall be rigid polyisocyanurate foam with a minimum 2.4 lbs/ft³ density, 85% minimum closed cell content, and a “K” factor of .17 at 75°F and .30 at 366°F per ASTM C518. The foam shall be CFC-free and not exceed a temperature of 366°F. The foam shall completely fill the annular space between the service pipe and jacket, and shall be bonded to both. Insulation shall be provided to the minimum insulation thickness specified, but not less than 2.5”.

JACKET
The outer protective jacket shall be High Density Polyethylene (HDPE). The HDPE jacket shall be seamless and pressure-tested for watertight integrity. PVC, FRP, HDUP, or tape materials are not allowed.

FITTINGS
All straight sections, fittings, anchors, and other components shall be factory-fabricated and pre-insulated, and manufactured in accordance with ASME B31.1. Fitting covers shall be molded HDPE, extrusion welded, or butt-fusion welded. No gluing, taping, or hot air welding of the jacket allowed. Tangent footage shall be added to all pipe ends up to 24” pipe, so that all field joints are at straight sections of pipe. No field insulation of fittings allowed.

ERM LEAK DETECTION
The piping system shall be made Leak Detection Ready by means of installing a bare copper wire between the carrier pipe and the HDPE jacket. The piping system manufacturer shall install the wire in a manner that has the wire embedded in the foam insulation and incorporated into each piece of pre-insulated pipe and fittings. Connections of ERM wire shall be made by the Contractor prior to insulating joints.

FIELD JOINTS
Service pipe shall be hydrostatically tested as per the Engineer’s specification with a factory recommendation of 1.5 times the specified pressure of the system. Straight joint sections shall be closed with a pressure testable joint closure, either an electro-fused split sleeve HDPE joint closure, Canusa SuperCase, or Raychem RayJoint. The joints will be field tested at 5 psi for five minutes while simultaneously soap testing the joint closure’s seams for possible leaks. All joint closures and insulation shall occur at straight sections of pipe. ERM wire will be connected and tested at all field joints. No field insulation of fittings allowed. All insulation and jacketing materials shall be furnished by THERMACOR.

INSTALLATION
Installation of the piping system shall be in accordance with the manufacturer’s instructions. Factory trained field technicians shall be provided for critical periods of installation, unloading, field joint instruction, and testing.

* For alternate specifications, please contact THERMACOR.
Pre-insulated HDPE-Jacketed Steel Piping Systems suitable for Steam, Condensate Return, and High Temperature Heating Water.

Part 1 - General

1.1 Pre-insulated Piping - Furnish a complete HDPE jacketed system of factory pre-insulated steel piping for the specified service. The jacket throughout the entire system shall incorporate electric fusion, butt fusion, or extrusion welding at all HDPE fittings, joint closures, or other points of connection. This shall create a jacket that is seamless throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax, Canusa GTS-65, or WLNN wrap, prohibiting the ingression of water. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the Pre-insulated Piping System manufacturer.

1.2 A complete layout of the system, showing anchors, expansion provisions, and building entrance details, shall be provided by the pre-insulated pipe manufacturer. Means for expansion must be made in pipe offsets or loops.

1.3 The system shall be HT-406 as manufactured by Thermacor Process Inc. of Fort Worth, Texas, or prior approved equal.

Part 2 - Products

2.1 Carrier pipe shall be steel ASTM A-53, Grade B, ERW (Type E) or seamless (Type S), standard weight for sizes 2” and larger, and shall be ASTM A-106, Grade B, standard weight for sizes 1-1/2” and smaller (Std. Wt. is the same as Sch. 40 through 10”). Condensate return piping shall be extra strong (XS is the same as Sch. 80 through 8”). When practical, piping shall be provided in 40-foot double-random lengths. All carbon steel pipe shall have ends cut square and beveled for butt-welding. Straight sections of factory insulated pipe shall have 6” of exposed pipe at each end for field joint fabrication.

2.2 Insulation shall be polyisocyanurate foam insulation bonded to both the jacketing and carrier pipe and either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of 2-1/2” for systems operating at or below 366°F. Insulation shall be rigid, 85% closed cell foam insulation with not less than 2.4 pounds per cubic foot density, having a compressive strength of not less than 30 psi @ 75°F and a coefficient of thermal conductivity (K-Factor) not higher than 0.17 @ 75°F and 0.30 @ 366°F. Maximum operating temperature of the system shall not exceed 366°F.

2.3 Water Stops: Thermacor’s HT 406 product with operation temperatures above 212°F shall come standard with a patented water stop system. At each spool piece and length of pipe, a steel disk shall be welded to the carrier pipe and extend into the high temperature foam, embedded between the foam insulation and HDPE jacket. The longitudinal length of the water stop will be determined by Thermacor based on project design conditions to sufficiently dissipate the heat from the carrier pipe protecting the integrity of the high temperature insulation. The water stop shall have been tested and proved to contain for a period of at minimum 5 months the spread of groundwater that is capable of flashing to steam when in contact with the hot carrier pipe. This spread of moisture shall be contained in the immediate area of a field joint and not allowed to spread further.

2.4 Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 125 mils for jacket sizes less than or equal to 12”, 150 mils for jacket sizes greater than 12” to 20”, and 175 mils for jacket sizes larger than 20”. The jacket throughout the entire system shall incorporate electric fusion, butt fusion, or extrusion welding at all HDPE fittings, joint closures, or other points of connection. This shall create a jacket that is seamless throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax, Canusa GTS-65, or WLNN wrap, prohibiting the ingestion of water. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment (patent pending), or other approved methods. This will ensure a secure bond between the jacket and foam insulation.

(Continued)
2.5 Straight run joints are insulated using high temperature foam to the thickness specified and jacketed with a pressure testable joint closure, either an electro-fusion welded split sleeve HDPE joint closure, Canusa Supercase, or Raychem Rayjoint. No joints will be made unless the person(s) making the joint have been trained by a factory representative. The joint will be pressure tested at 5 psi for 5 minutes while simultaneously soap tested at the joint closure's seams for possible leaks. After passing the pressure test, the field joint is insulated and closure patches are welded (as per specified joint closure instructions) over the foaming holes. All joint closures and insulation shall occur at straight sections of pipe. A log will be made showing who made the joint, the amount of time for the fusion, and that the joint was inspected. **This is a permanent record and will be furnished as a close-out document.**

2.6 Terminations inside of manholes shall have a corrosion coated steel sleeve protecting the foam. This steel sleeve shall be fillet welded onto the carrier pipe and come up and extend back on the jacket a distance of 16”. A high temperature shrink sleeve 4” wide shall be used to seal the steel sleeve to the HDPE jacket. The pipe shall penetrate the manhole a distance of 9”, the first 6” is exposed pipe, followed by the 16” steel sleeve, then the 2” overlap of the heat shrink sleeve, and finally 1” of bare jacket just before the inside of the manhole wall.

2.7 Fittings are factory pre-fabricated and pre-insulated with polyisocyanurate to the thickness specified and jacketed with a one piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket. **NO TAPING OR HOT AIR WELDING SHALL BE ALLOWED.** All fitting jackets/cover shall be connected to the straight lengths of pipe by electro-fusion, butt fusion, or extrusion welding. Carrier pipe fittings shall be butt-welded, except for sizes smaller than 2”, which shall be socket-welded. Fittings include expansion loops, elbows, tees, reducers, and anchors. Elbows, loops, offsets, or any other direction changes shall conform to the standards set by ASME B31.1, Code for Power Piping.

2.8 Expansion/contraction compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. Flexible expansion pads shall be utilized for external expansion compensation on all fittings having expansion in excess of 1/2”. Expansion pads shall be a minimum one inch thick and shall extend to cover both the inside and outside radius of the fittings. Anchors shall be 1/2” thick steel plates welded to the carrier pipe and shall incorporate a steel water shed ring, sized to allow the jacket to slide underneath, that shall be sealed to the HDPE jacket with a Raychem Dirax, Canusa GTS-65, or WLNN wrap. Anchors are located per manufacturer’s recommendations.

2.9 The ERM Leak Detection System is a mandatory requirement for all HT-406 systems operating above 250°F. The ERM system consists of a copper wire embedded in the foam of each piece of pre-insulated pipe and fittings. The piping system manufacturer shall install the wire in a manner that prevents touching the steel carrier pipe. The contractor shall connect the wire together at each field joint with a recommended crimping tool. After crimping the wire at a joint, the contractor shall check the joined pieces for continuity of the wire and electrical isolation from the carrier pipe by use of a standard analog ohmmeter. This check shall be repeated after each crimp, until the entire system is connected. After the piping system is installed, the owner at any time may check the system for a leak by using a standard analog ohmmeter. If a leak is detected (a leak is signaled by a drastic drop in the electrical resistance of the circuit), the panel will alarm, and the owner should contact the system manufacturer for a TDR instrument to determine the location of the leak. One or more alarm panels are furnished with each ERM system, designed to monitor up to 2000’, which will provide continuous leak detection monitoring.

No warranty will be issued until the PTC & ERM Log Sheets are completed and returned to the manufacturer.

(Continued)
Part 3 - Execution

3.1 Pre-engineered systems shall be provided with all straight pipe and fittings factory pre-insulated and pre-fabricated to job dimensions.

3.2 Underground systems shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill placed over the top of the pipe will meet H-20 highway loading.

3.3 Trench bottom shall have a minimum of 6” of sand or rounded, smooth, maximum 1/4” O.D. pea gravel material as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer’s installation instructions.

3.4 A hydrostatic pressure test of the carrier pipe shall be performed per the engineer’s specification with a factory recommendation of one and one-half times the normal system operating pressure for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

3.5 Field Service is required and will be provided by a certified manufacturer’s representative or company field service technician. The technician will be available at the job a minimum of one day (or more if required by job size) to check unloading, storing, and handling of pipe, pipe installation, pressure testing, field joint insulation, and backfilling techniques.

3.6 A Final ERM Panel Test is required with the owner’s representative present, along with the contractor and the Thermacor field service representative.
### Carrier Pipe:
- \( d \geq 2" \): A53 ERW Grade B, Std. Wt. Black Steel
- \( d < 2" \): A106 SML, Std. Wt. Black Steel
- Seamless and Schedule 80 pipe available for all sizes
- Std. Wt. is the same as Schedule 40 for all sizes thru 10"
- XS is the same as Schedule 80 for all sizes thru 8"

### Jacketing Material:
High Density Polyethylene (HDPE)

### Insulation:
Polyisocyanurate Foam

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<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Jacket Size</th>
<th>Standard Length</th>
<th>Insulation Thickness</th>
<th>External Diameter</th>
<th>Weight Per Foot (lbs.)</th>
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* Other pipe sizes and pipe and jacket combinations are available.

** Insulation thickness is calculated using minimum wall thickness. Actual wall thickness may be greater than stated, thereby minimally decreasing actual foam thickness.
HEAT LOSS FOR 3" OF POLYISOCYANURATE FOAM*

- Burial depth: 36”
- Soil conductivity: 12 (Btu/h.ft².°F/ft)
- Soil temperature: 50°F

*Values are calculated using 3E Plus in accordance with ASTM C680 and are subject to the terms and limitations stated in the software. Actual heat loss may vary.
INSTALLATION INSTRUCTIONS

UNLOADING & HANDLING
Lift joints from trucks. DO NOT DROP SHARP OR HEAVY OBJECTS ON INSULATED UNITS. DO NOT use chains or other devices which might puncture insulation jacket.

STORAGE
Pipe is stockpiled off the ground. Do not exceed a stacking height of 6’. Prevent dirt and debris from entering pipe. Fittings, joining materials, etc. must be stored indoors to protect them from freezing, overheating, moisture, or loss.

LAYING OF PIPE UNITS – TRENCHING
All sharp rocks, roots, and other abrasive material must be removed from the trench. The trench bed should be 6” of sand or backfill as specified by the engineer, providing a smooth and uniform stabilizing surface (sandbags may be used as a means to keep the pipe off the ground until backfilling is started). The trench width should provide a minimum of 6” from trench wall to jacket O.D. and a minimum of 6” between pipe units. Trench depths will be indicated on the contract drawing and in line with good construction practices. Trench depth should allow for a minimum cover of 24” on top of the insulated unit.

FIELD JOINING METHODS
HT-406 piping and fittings shall be joined in the field using approved methods of welding for appropriate pipe. Installation drawings will be provided to indicate location of each individual piece of pre-insulated pipe. Pre-insulated pipe will be marked with Job Number and Piece Number correlating to those on the installation drawings. Installation of pipe must follow the installation drawings. Field changes to fabricated units must be authorized in writing by the factory.

HYDROSTATIC TESTING
Anchor blocks shall be poured and cured, prior to testing. Bleed all air from lines to eliminate possible incorrect readings. The hydrostatic pressure test shall be performed per the engineer’s specification with a factory recommendation of one and one-half times the normal operating pressure for not less than two hours. Inspect all fittings, valves, and couplings at this time. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

FIELD JOINT INSULATION
See Drawings furnished with job material.

BACKFILL FINAL
Before backfilling is started, the trench should be cleaned of any trench wall cave-ins and general trash, especially metal. Backfilling should be done with sand or other engineer-approved material 6” below the casing to 1’ above. Engineer-approved backfill may be used to fill the rest of the trench. This material should be free of rocks, roots, large clods, or anything that could cause damage to the jacket. Jacket should have a minimum of 2’ cover.

WHEELED OR TRACKED VEHICLES SHALL NOT BE USED FOR TAMPPING!
SHIPPING & HANDLING INSTRUCTIONS

HANDLE COATED PIPE WITH EXTRA CARE! THIS PIPE CAN DAMAGE WHEN HANDLED, MOVED, OR STORED IMPROPERLY!

UPON RECEIPT OF MATERIALS
Make an overall inspection of the load, checking all bands and braces to see if they are intact. Also, check the load for shifting. If the load has shifted, or if the braces and bands are broken, examine each pipe for damage. HAVE THE TRUCK DRIVER MAKE AN ITEMIZED NOTATION OF ANY DAMAGE ON THE DELIVERY RECEIPT AND HAVE IT SIGNED BY THE DRIVER.

CHECK PACKING LIST
Compare materials received with those listed on the packing list. Count all pipe and boxes. NOTE ANY SHORTAGES ON DRIVER’S DELIVERY RECEIPT.

CHECK BOXES
Open all boxes and inspect for damages, shortages, and correct size. REPORT ANY DISCREPANCIES WITHIN 30 DAYS AFTER RECEIPT.

CLAIMS FOR DAMAGES
Claims for damages in transit or lost goods must be made within 30 days. The filing of any claim is the Purchaser’s Responsibility. Thermacor will file any claim on Purchaser’s behalf upon receipt of the following:
1. Written authority to file such a claim.
2. Written notice of loss or damage (signed and noted Bill of Lading) by truck driver or carrier freight agent.

UNLOADING PIPE
Pipe may be unloaded by hand or with fork lifts*, cherry pickers, or cranes. DO NOT HOOK pipe ends. Minimum 4” wide straps or slings should be used.

*Fork Lift – When using Fork Lift, wide tines or a large surface covering the fork tines must be used to prevent coating damage. Fork Lift must be able to handle the weight of the insulated pipe length.

PIPE STOCKPILING
Pipe should be stored on level ground, elevated to be as dry as possible, and in such a way that the pipe ends do not lie in water or on the ground. To prevent deformation of the jacket and insulation due to the weight of the pipe, place a series of supports (3 for 20’ or 5 for 40’) of ample size generally constructed from 2” x 4”s under the pipe as shown below. Supports should increase in width as weight load increases so that the top supports of a fully loaded stockpile should be approximately 10” wide, gradually increasing to the bottom level, approximately 18” wide. Pipe can be pyramided (within reasonable and safe limits) approximately 6’ high after a properly braced or chocked base is formed. Pipe stored outside for long periods of time can be covered with blue mesh tarpaulin (plywood can also be used). Do not prevent airflow as jacket can be deformed from heat buildup.

BE VERY CAREFUL NOT TO DROP THE PIPE!

NOTE: Thermacor does not approve of the practice of installing pipe and fittings, and backfilling the pipe before testing. Thermacor will not allow or pay claims for charges which arise in locating and digging up leaks regardless of cause.
SITE PLAN DIMENSIONS END HERE

* NOTE:
STEEL END CAP WILL INCREASE
OUTSIDE DIAMETER OF HDPE
JACKET BY 1/2"

OUTSIDE FACE OF WALL
WALL SLEEVE AND SEAL
(BY INSTALLING CONTR.)

CARRIER PIPE
INSULATION
JACKET
HEAT SHRINK

1/2" X 3" NIPPLE
NIPPLE THREADED
1/4"-20 BOLT
w/LOCK NUT
 FOR GROUND

16" LG STEEL END CAP

GENERAL NOTES:
(1) FOR SYSTEMS WHICH ARE ANCHORED, A LINK-SEAL
ASSEMBLY CAN BE UTILIZED FOR WATERPROOFING
THE WALL PENETRATION.

(2) IF EXPANSION THRU THE WALL IS ANTICIPATED,
WE RECOMMEND THE FOLLOWING SEALING MECHANISM:

A. WRAP THE EXTERIOR OF THE JACKET WITH AN
OILED OAKUM MATERIAL FROM THE INSIDE OF
THE WALL TO ABOUT HALFWAY THRU THE WALL.

B. WRAP THE EXTERIOR OF THE JACKET WITH
ARMAFLEX MATERIAL TO THE OUTER WALL.

C. COAT THE ARMAFLEX WITH A BITUMASTIC
SEALANT.

WALL PENETRATION DETAIL
SCALE: NONE
INSTALLATION INSTRUCTIONS:

EXPANSION BOLSTERS PROCEDURE

1. EXPANSION BOLSTER MATERIAL IS SUPPLIED IN PADS:
   6'-0" LONG x 3" THICK x HEIGHT SPECIFIED ON CHART.
   4'-0" LONG x 1" THICK x HEIGHT SPECIFIED ON CHART.

2. PLACE BOLSTER PADS AGAINST JACKET AND CURVE AROUND
   ELBOW AS SHOWN. HOLD IN PLACE BY ATTACHING PADS TO
   JACKET WITH DUCT TAPE OR EQUIVALENT ON TOP AND
   BEDDING SAND ON THE BOTTOM. BE CERTAIN THAT THE
   BOLSTER PADS FITS SNUG TO JACKET.

3. BOLSTER PAD CONFIGURATION IS DEPENDENT ON LAYOUT &
   WILL BE SHOWN ON THE INSTALLATION DRAWING.

* NOTE:
   DUCT TAPE TO BE 1'-0" ON CENTERS.
HT-406 EXPANSION LOOP DETAIL

1" THK x 6'-0" LG

BOLSTER PAD (TYP/WHERE REQUIRED)

3" THK x 6'-0" LG

(1- PAD VIEW)

(2- PAD VIEW)
STEEL PIPE ANCHOR SPECIFICATIONS

1. STEEL ANCHOR PLATE AND WELDED RINGS FURNISHED BY THERMACOR. ANCHOR PLATE SHALL MEET ASTM A36 AND ON ALL SIZES SHALL BE 1/2" THICK. ANCHOR PLATE SHALL EXTEND 2-1/2" BEYOND THE CASING DIAMETER ON ALL SIDES. ANCHOR PLATE SHALL BE CORROSION COATED WITH A HIGH TEMPERATURE MASTIC MATERIAL AFTER WATERSHED RINGS HAVE BEEN SEALED TO CASING BY HEAT SHRINK TAPE.

2. ANCHOR ASSEMBLY SHALL BE POURED IN A CONCRETE BLOCK BY THE CONTRACTOR IN THE FIELD. GENERALLY, THE ANCHOR BLOCK EXTENDS 12" IN ALL DIRECTIONS FROM THE ANCHOR AND RESTS ON UNDISTURBED EARTH. THE JOB SITE CONDITIONS SHALL BE THE FINAL DETERMINING FACTOR FOR ANCHOR BLOCK SIZING.

PIPING ANCHOR DETAIL
SCALE: NONE
TRENCH DETAIL

HDPE JACKET (TYP)

GRADE

TRENCH WALL

UNDISTURBED EARTH

6" MIN.

B

C

D

E

6" MIN.

24" MIN. OF SELECT BACKFILL

CARRIER PIPE (TYP)

SAND OR SELECT BACKFILL 6" OVER TOP OF JACKET

6" SAND OR SELECT BACKFILL BED IN BOTTOM OF TRENCH

A

MINIMUM

MINIMUM

HDPE JACKET (TYP)

GRADE

TRENCH WALL

UNDISTURBED EARTH

6" MIN.

B

C

D

E

6" MIN.

24" MIN. OF SELECT BACKFILL

CARRIER PIPE (TYP)

SAND OR SELECT BACKFILL 6" OVER TOP OF JACKET

6" SAND OR SELECT BACKFILL BED IN BOTTOM OF TRENCH

A

MINIMUM

MINIMUM

4-PIPE TRENCH SECTION

SCALE: NONE