



NOTICE TO ALL FIRMS

Date: April 26, 2024
To: All Prospective Bidders
From: Sam Li
Interim Director of Procurement Services
Re: Addendum Number 1
IFB # C1632 – Alumni Residence Hall Exhaust Riser Repairs Line A, B, & C

Questions

- Q1. Please provide specifications for insulation.
- A1. See the attached specification - Section 23 07 00.

THIS ADDENDUM IS PART OF THE CONTRACT DOCUMENT AND SHALL BE INCLUDED WITH YOUR REQUEST FOR PROPOSAL SUBMITTAL. YOUR SIGNATURE BELOW WARRANTS THAT YOU UNDERSTAND THIS ADDENDUM AND THAT YOU HAVE MADE THE APPROPRIATE ADJUSTMENTS IN YOUR PROPOSAL AND CALCULATIONS.

Signature

Print Name and Title of Authorized Representative

Print Name of Company/Partnership/Individual

Date

SECTION 23 07 00 - INSULATION FOR HVAC WORK**PART 1 - GENERAL****1.01 GENERAL REQUIREMENTS**

- A. This Section is coordinate with and complementary to the General Conditions and Supplementary General Conditions of the Work, wherever applicable to Mechanical Work.
- B. Section 01 31 46 - Special Requirements for Mechanical and Electrical Work shall apply.

1.02 DESCRIPTION OF WORK

- A. The work includes furnishing and installing all labor, materials, equipment, accessories and services necessary to provide Piping, Ductwork and Equipment Insulation installation, which is complete in every respect and of the composition and quality as shown on the Drawings and hereinafter specified.

1.03 PIPE INSULATION

- A. The following pipes shall not be insulated. Insulate all other piping:
 - 1. Unions.
 - 2. Drain pipes embedded in concrete.
 - 3. Refrigerant liquid and outdoor portions of refrigerant hot gas piping except where otherwise noted.

1.04 DUCTWORK INSULATION

- A. Insulate all ductwork except the following portions of ductwork:
 - 1. Ducts provided with sound absorptive lining (except where humidifier is installed and except where located outdoors) may have external insulation thickness decreased provided overall insulation R-value internal plus external complies with R-value specified herein.
 - 2. All exhaust ductwork, except where otherwise noted.
 - 3. Return air ductwork passing through air-conditioned space and/or hung ceiling of air-conditioned space, except in single story buildings and ducts in ceiling of uppermost floor or in attic space, where all return air ducts must be insulated.
 - 4. Return air ductwork for heating and ventilating systems, where return air ducts pass through heated areas.
 - 5. Supply ducts above hung ceilings where space above hung ceilings is used for return air plenum, except below roof.
 - 6. Exposed supply and return air ducts in air-conditioned spaces if same supply air duct serves that area only.
 - 7. Exposed supply air duct in ventilated spaces, if same duct serves that area only.

1.05 QUALITY ASSURANCE

- A. "Installer": A firm with at least ten 10 years successful installation experience on projects with piping and ductwork insulation similar to that required for this project.
- B. All insulation shall have composite (including insulation jacket or facing and adhesive) fire and smoke hazard ratings as tested by procedure ASTM E-84, NFPA 255 and UL 723 not exceeding:
 - 1. Flame Spread 25
 - 2. Smoke Developed 50
 - 3. Fuel Contributed 50
- C. Accessories such as adhesives, mastics, cements, tapes and cloths for fittings shall have component ratings as listed above. All products shall bear UL labels indicating the above are not exceeded.
- D. Provide certifications or other data as necessary to show compliance with these Specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
- E. Provide products produced by the manufacturers which are listed in Section 23 05 12, "Approved Manufacturers List"
- F. Insulation Materials: Insulating materials manufacturing facilities must be certified and registered with an approved registrar for conformance with ISO9000 quality standard.

1.06 SUBMITTALS

- A. Refer to Section 01 31 46 - "Special Requirements for Mechanical and Electrical Work" and submit shop drawings and samples.

1.07 GUARANTEE

- A. Refer to Section 01 31 46 - "Special Requirements for Mechanical and Electrical Work".

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.
- B. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp, or label, affixed showing fire hazard ratings of the products.
- C. Store insulation in original wrappings and protect from weather and construction traffic.

PART 2 - PRODUCTS

2.01 COLD AND DUAL TEMPERATURE PIPING INSULATION

A. The following piping shall be covered with fiberglass insulation with vapor barrier:

<u>Service</u>	<u>Thickness</u>
Hot-Chilled (Dual Temperature)	
Water Supply & Return	
Up to 1¼ "	1½"
1½" and above	2"
Refrigerant Suction	
All pipe diameters	1½"
Cold Water Make-Up and Air Conditioning	
Condensate Drain Piping from Cooling Coil Drain Pans	
All sizes	1"

B. Insulation on any piping, fitting, flange and valve located in areas exposed to freezing (in unheated areas, at cooling towers and where noted on the Drawings as to provide "Frost Insulation") shall be increased by one inch with the same finish as specified for the particular service when not subject to freezing. Insulation shall always be a minimum of 2½" inches in thickness.

C. Insulation shall be glass fiber complying with ASTM C547, Type I with a maximum K factor of 0.23 BTU in/hr ft² F at 75 degrees F. mean temperature with factory-applied all service vapor barrier jacket with self-seal lap meeting the requirement of ASTM C-1136 Type I.

D. Insulation shall be heavy density fiberglass sectional pipe insulation as made by Owens-Corning Fiberglass Corp. or Johns-Manville Micro-Lok fiberglass insulation.

E. Ends of pipe insulation shall be sealed off at all flanges, fittings, valves and at intervals of 21 feet on continuous runs of pipe, with Foster fire-resistant vapor barrier coating Foster 30-65 or Childers CP-34 or equal.

F. All fittings, valves and flanges for pipe sizes smaller than 4" shall be insulated with molded fiberglass fittings of same thickness as the adjoining pipe insulation, secured with No. 20 gauge galvanized annealed steel wire and covered with Zeston 2000 25/50 PVC as made by Johns Manville, applied per manufacturer's recommendation, except as specified in 2.01 H.

G. All fittings, valves and flanges for pipe sizes 4" and larger shall be insulated with fabricated mitered segments of pipe insulation of same thickness as the adjoining pipe insulation, secured with No. 20 gauge galvanized annealed steel wire and covered with Zeston 2000 25/50 PVC fitting covers as made by Johns Manville installed per manufacturer's recommendation, except as specified in 2.01 H.

H. Finish for Exposed Pipe Insulation:

1. The term “exposed” is hereby defined as any place outdoors, as well as any place indoors in Mechanical Rooms, Storage Rooms, Janitor’s Closets, etc., where located within 7 feet of floor or access platforms.
 2. All exposed pipe, valve and fittings insulation shall have 0.016 inch thick corrugated aluminum jacket banded with ½" s.s. bands spaced 12” o.c. Piping, fittings and valves exposed in building, within seven feet of the floor or access platform, shall have 0.016" thick aluminum jacket banded with ½" aluminum bands spaced 12" o.c. or two bands per section. Joints and jacket shall provide complete weatherproof protection either by mechanical contact or by use of Foster 95-44 or Childers CP-76 metal jacketing sealant (gallon cans only; no tubes).
 3. All calcium silicate pipe insulation, all insulated condenser water piping exposed to weather and all other insulated pipe exposed to weather shall have 0.016 inch thick aluminum jacket banded with ½” s.s. bands spaced 12" o.c. This shall include pipe, fittings and valves.
- I. All below ambient, coated molded fittings and mitered segments shall be vapor sealed with a layer of open weave glass fabric embedded between two 1/16" thick coats of Foster 30-65 or Childers CP-34 vapor barrier coating and lap seal at least 1" for molded type and 2" for mitered type on itself and adjoining insulation.
 - J. Direct contact between pipe and hanger shall be avoided. Hanger shall pass outside of a metal saddle which shall support a section of high density insulation equal thickness to adjacent insulation (such as calcium silicate) and of sufficient length to support pipe without crushing insulation. (See table below.) Hangers shall not pierce insulation and all vapor barriers shall be unbroken and continuous.

Pipe Size	Saddle & Insert Length
1½”- 2"	10" Long
3"-6"	12" Long
8"-10"	16" Long
12" & over	22" Long

- K. At pipe supports, insulation shield protection saddles and matching hanger shall be used.
- L. All strainers for chilled water and insulated condenser water piping shall be insulated and boxed in with galvanized sheet metal cover. The insulated metal covers shall be segmented and shall be made removable.
- M. As an alternative to fiberglass insulation, on cold pipes, elastomeric closed-cell insulation may be used.
 1. Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular or sheet form: AP Armaflex, AP Armaflex W, AP Armaflex SS, or AP Armaflex SA. These products meet the requirements as defined in ASTM C 534, “Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form.”
 2. Insulation materials shall have a closed-cell structure to prevent moisture from wicking which makes it an efficient insulation.

3. Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOC's, fiber free, dust free and resists mold and mildew.
4. The insulation material shall contain MICOBAN Antimicrobial additive to aid in the prevention of mold and mildew.
5. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.
6. Materials shall have a maximum thermal conductivity of 0.25 Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
7. Materials shall have a maximum water vapor transmission of 0.05 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
8. The material shall be manufactured under an independent third-party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.
9. Valves, Flanges and Fittings:
 - a. Armacell Fabricated Fittings can be used on all fittings. 2 and 3 Pieces 90s, 45s, Ts, P traps and couplings along with grooved fittings are available.
 - b. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seam and mitered joints shall be adhered with Armaflex 520, 520 BLV or 520 Black Adhesive. Screwed fittings shall be sleeved and adhered with a minimum 1" overlap onto the adjacent insulation. Armaflex HT 625 Adhesive shall be used with UT Solaflex.
 - c. Valves, flanges, strainers, and Grooved couplings shall be insulated using Armaflex donuts that shall then be covered with sheet or oversized tubular insulation.
10. Adhesives and Finishes
 - a. Adhesive shall be the insulation manufacturer's recommended contact adhesive: Armaflex 520, Armaflex 520 BLV, Armaflex 520 Black, Low VOC Spray Adhesive or Armaflex HT 625 Adhesive.
 - b. Insulation finish shall be the insulation manufacturer's recommended finish: Armaflex WB Finish.
 - c. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings as specified above.

2.02 PVC INSULATED FITTING COVERS

- A. The Contractor shall use Zeston 2000 25/50 rated PVC covers as made by Johns Manville or approved equal, for concealed piping.
- B. Hot Systems: Fittings shall be insulated by applying the proper factory precut Hi-Lo Temp insulation insert to the pipe fitting. The ends of the Ho-Lo Temp insulation insert shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe

covering tufted and tucked in, fully insulating the pipe fitting. PVC fitting cover is then applied and shall be secured by tack fastening, banding or taping the ends to the adjacent pipe covering.

- C. On fittings where the operating temperature exceeds 250 deg. F, 2 or more layers of the Hi-Lo Temp insulation inserts shall be applied prior to the installation of the PVC fitting cover. The first layer shall be applied with a few wrappings of fiber glass yarn to eliminate voids or hot spots.
- D. Cold Systems: Fittings shall be insulated by applying the proper factory precut Hi-Lo Temp insulation insert to the pipe fitting. The ends of the Hi-Lo Temp insulation insert shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked in, fully insulating the pipe fitting. All fittings and elbows shall be coated with vapor barrier coating and reinforcing mesh before PVC covers are applied.
- E. A vapor barrier mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover is then applied and shall be secured with pressure sensitive pearl-gray Z-Tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side.
- F. 2 or more layers of the Hi-Lo Temp insulation inserts shall be applied with the first layer being secured with a few wrappings of fiberglass yarn.
- G. Refrigerant systems and cold systems located outdoors: Fittings shall be insulated to a full thickness the same as the adjacent pipe insulation, with insulation which has been mitered. An intermediate vapor barrier shall be applied, completely sealing the insulation and on the fitting cover overlap seam. 0.016" aluminum cladding shall be applied and shall be secured with pressure sensitive pearl-gray Z-Tape along the throat seam and the circumferential edges overlapping itself 2" on the downward side with aluminum bands on 12" intervals.
- H. Qualifications for Using Insulation: When the pipe insulation thickness is greater than 1½" or the pipe temperature is greater than 250°F or less than 45°F, additional insulation inserts should be used. Use one Hi-Lo Temp insert for each additional 1" of pipe insulation.
- I. Fitting cover: The temperature of the PVC fitting cover must be kept below 150°F by the use of proper thickness of insulation and by keeping the PVC cover away from contact with, or exposure to, sources of direct or radiant heat.
- J. Where insulated piping is exposed (indoors up to 7 feet above the floor or platform) or any place outdoors, the PVC covers shall be omitted since the use of 0.016" thick aluminum cladding is required on all piping, fittings and valves.

2.03 INSULATION OF PIPING IN FAN COIL UNITS

- A. The Contractor shall have the option to use ¾" thick AP Armaflex pipe insulation in lieu of fiberglass hereinbefore specified for chilled and hot water piping insulation in fan coil units. Refer to paragraph 2.01 L.

2.04 PIPING EXPOSED TO FREEZING

- A. Insulation on any piping, fitting, flange and valve located in areas exposed to freezing (in unheated areas, at cooling towers and where noted on the Drawings as to provide "Frost Insulation") shall, in addition to above covering, be increased by one inch with the same finish as specified for the particular service when not subject to freezing. Insulation shall always be a minimum of 2½" inches in thickness.
- B. Weatherproofing of Piping:
1. Weatherproof all insulated outdoor piping.
 2. Where weatherproofing is required, in addition to insulation and finishes specified for frostproofing, cover with Tedlar Film Jackets as made by ALPHA Assoc, Inc. (Woodbridge N.J.).
 3. Fittings insulation shall be heavily coat with Childers CP-10/11 or Foster 46-50 weather barrier mastic for hot piping; Childers CP-34 or Foster 30-65 vapor barrier coating for cold piping. Embed into the wet coat a layer of open weave glass cloth and finish with a second coat of same mastic over entire surface.
 4. In addition to insulation and finishes specified for frostproof, cover all piping, including fittings and valves, with corrugated aluminum sheet cladding, 0.016 inch thick with lock seams at longitudinal seams, and preformed straps at transverse joints at 12" intervals. Joints and jacket shall provide complete weatherproof protection either by mechanical contact or by use of Foster 95-44 or Childers CP-76 metal jacketing sealant (gallon cans only; no tubes).

2.05 FIRE STOPPING

- A. Packing of openings, where ducts and pipes penetrate fire barriers, shall be done with Rockwool insulation as made by United States Gypsum, Co.
- B. Insulation shall comply with Fed. Spec. HH-1-558, Form A, Class 4, K=0.24, melting point 2000 degrees F.
- C. An acceptable alternative to rockwool insulation shall be 3M Product Caulk CP25 or approved equal.

2.06 DUCTWORK INSULATION

- A. Insulation for Concealed Duct
1. Except where otherwise noted, all concealed rectangular and round ductwork shall be covered with flexible duct insulation with or without vapor barrier complying with ASTM C553, Types I and II and of the thickness and densities indicated below.

<u>Service</u>	<u>R Value</u>	<u>With</u>
Cold and Hot Air Supply Ducts	6	Vapor Barrier
Return Air Ducts (only where required)	6	Vapor Barrier
Hot Supply Ducts	6	---
Flexible connections to Mixing Boxes, Induction Units, Lighting Troffers	6	Vapor Barrier
Outside Air Duct	6	Vapor Barrier
Sound traps	6	Vapor Barrier
Within 5'-0" downstream and upstream of Humidifier in ducts	6	Vapor Barrier

- B. Flexible duct insulation with vapor barrier shall be 1 lb. per cu. ft. density glass fiber with a maximum K factor of 0.29 at 75 deg. F. mean temperature, with reinforced foil-faced, flame resistant kraft vapor barrier (facing to comply with ASTM C1136, Type II).
- C. Insulation with vapor barrier shall be duct wrap insulation FRK-25, type 100 as made by Owens-Corning or Johns Manville Microlite Type 100 with FSK vapor barrier facing or standard 1 lb./cf duct insulation as made by CGG with FSK facing.
- D. Flexible duct insulation without vapor barrier shall be 1 lb. per cu. ft. density glass fiber with a maximum K factor of 0.29 at 75 deg. F. mean temperature and shall be Owens Corning Fiberglass Type 75P, Johns Manville Microlite Type 100 or approved equal.
- E. Adhere insulation to duct with Foster fire resistant adhesive 85-60 or Childers CP-127 or approved equal, applied in 4 inch wide transverse strips at 8 inch intervals. Insulation shall be butted with facing overlapping all joints at least 2 inches and sealed with Foster fire resistant adhesive 85-60 or Childers CP-127 or equal. For insulation with vapor barrier use Foster fire resistant vapor barrier adhesive or approved equal and joints without tabs shall be firmly sealed with aluminum foil tape adhered with same adhesive. Secure insulation with 18 gauge corrosion resistant wire spaced not more than 18 inches on center. Coat all duct taped seams, punctures and breaks with Foster 30-65 or Childers CP-34 vapor barrier coating.
- F. Additionally, secure insulation to bottom of rectangular ducts over 24" wide with welded pins or stick clips on 18" centers. Cut off excess pins and seal as above.
- G. Insulation for Exposed Rectangular Duct
 - 1. Except where otherwise noted, all exposed rectangular ductwork and plenums shall be covered with rigid duct insulation complying with ASTM C612 Types IA and IB and of the thickness and densities indicated below.

<u>Service</u>	<u>R Value</u>	<u>With</u>
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Cold and Hot Air Supply Ducts in Mechanical Equipment Rooms	6	Vapor Barrier
Return Air Ducts in Mechanical Equipment Room	6	Vapor Barrier
Cold and Hot Air Supply Ducts Except where otherwise noted	6	Vapor Barrier
Cold and Hot Air Return Air Ducts Except where otherwise noted	6	_____
Outside Air Intake Ducts & plenums	6	Vapor Barrier
Sound Traps		6 Vapor Barrier
Combustion Air Ducts & plenums	6	Vapor Barrier
Within 5'-0" downstream and upstream of Humidifier in Ducts	6	Vapor Barrier
Outside and Return Mixed Air Duct	6	Vapor Barrier
Hot Supply Duct	6	
Exhaust Air Plenum or Duct Behind Louver up to Automatic damper	6	Vapor Barrier
Exhaust Ducts connected to penthouse louvers or goosenecks up to damper		6 Vapor Barrier
Unused portion of Louvers	6	in 20 gauge sheetmetal sandwich.
Supply and Return ducts located outdoors	8	

2. Rigid duct insulation with vapor barrier shall be 6 lbs. per cu. ft. density glass fiber with maximum K factor of 0.22 at 75 deg. F mean temperature with fire retardant

- vapor barrier facing all service jacket complying with ASTM C1136 Type I (white finish).
3. Rigid duct insulation with vapor barrier shall be Fiberglass Type 705 by Owens-Corning or Johns Manville, No. 817 spin-glass w/ASJ or approved equal.
 4. Rigid duct insulation without vapor barrier shall be 6 lbs. per. cu. ft. density glass fiber with maximum K factor of 0.22 at 75 deg. F mean temperature with fire retardant facing foil reinforced draft. (all service jacket).
 5. Rigid duct insulation without vapor barrier shall be Fiberglass type 705 by Owens-Corning, Johns Manville, No. 817 spin glass w/ASJ or approved equal.
 6. Insulation shall be fastened to duct with 12 gauge welded pins and washers, or equivalent as approved. Fasteners shall be spaced 12 to 18 inches on center, a minimum of two rows per side of duct. Secure insulation in place with washers firmly embedded in insulation or push a self-locking cap over pin after coating with fitting mastic type C by Owens-Corning or approved equal.
 7. Seal all joints, breaks and impressions with Foster fire resistant vapor barrier coating Foster 30-65 or Childers CP-34, or equal, and apply 5" wide joint sealing tape to all joints. All surfaces must be clean and dry before applying tape.
- H. As an alternative to fiberglass insulation on ducts, elastomeric closed-cell insulation may be used.
1. Insulation material shall be a flexible, closed-cell or conformable elastomeric insulation in sheet form: AP Armaflex, and AP Armaflex SA. These products meet the requirements as defined in ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."
 2. Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOC's, fiber free, dust free and resists mold and mildew.
 3. The insulation material shall contain MICOBAN Antimicrobial additive to aid in the prevention of mold and mildew.
 4. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.
 5. Materials shall have a maximum thermal conductivity of 0.25 Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
 6. Materials shall have a maximum water vapor transmission of 0.05 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision. (other than conformable elastomeric)
 7. The material shall be manufactured under an independent third-party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.
 8. Adhesives and Finishes

- a. Adhesive shall be the insulation manufacturer's recommended contact adhesive: Armaflex 520, Armaflex 520 BLV, Armaflex 520 Black, Low VOC Spray Adhesive or Armaflex HT 625 Adhesive.
- b. Insulation finish shall be the insulation manufacturer's recommended finish: Armaflex WB Finish.
- c. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings as specified above.

I. Insulation for Exposed Round Duct

- 1. Insulation for exposed round ductwork shall be of material as specified for concealed ductwork and shall be covered with glass cloth or all service jacket smoothly adhered with Foster 85-60/85-20 or Childers CP-82 (5 gallons cans only) adhesive. Seal joints with 5" wide tape.

<u>Service</u>	<u>R Value</u>
Cold and Hot Air Supply Ducts in Mechanical Equipment Rooms	6 with vapor barrier
Air Conditioning Return Air Ducts in Mechanical Equipment Rooms	6 with vapor barrier
Cold and Hot Air Supply Ducts Except where otherwise noted	6 with vapor barrier
Hot Supply Duct	6
** Flexible Duct Connection to Mixing Boxes, Induction Units, Lighting Troffers	6 with vapor barrier
Return Air Fan for Air Conditioning Units.	6 with vapor barrier

- 2. The Contractor shall have the option to use the following material: Insulation for round ducts shall be of thickness noted above and shall be fiberglass pipe and tank insulation having a factory applied ASJ vapor barrier jacket secured with staples and ASJ pressure sensitive tape. Pipe and tank insulation is a 3.00 p.c.f. board cut into strips, fibers oriented perpendicularly to the facing it is adhered to and it must have a UL label.
- 3. Transition ductwork at sound traps shall be insulated with fibrous glass board with reinforced aluminum vapor barrier, Owens-Corning #705, Johns Manville 817 spin glass, or approved equal. Fasten insulation in place with welded pins and washers or equivalent mechanical fastening method, as approved. Seal all joints with vapor

barrier coating to provide continuous vapor barrier. All edges, corners and joints, reinforced with 4" wide tape. Tape, of type, and applied in strict conformance with manufacturer's recommendations. Over the insulation apply a flood coat of Foster 30-65 or Childers CP-34 or equal vapor barrier coating. Provide fiberglass fitting tape or glass cloth smoothly adhered with Foster 85-60/85-20 or Childers CP-82 (5 gallon cans only) adhesive.

4. Transition piece at stack and ductwork for high temperature hot water generators shall be insulated with 2" thickness calcium silicate block insulation, applied over a 1" "V" ribbed lath to provide a 1" air space under insulation. Firmly attach "V" ribbed lath to surfaces to be insulated by tack welding clip angles to breeching, ductwork and transition piece at a spacing of not greater than 12" centers vertically and horizontally. Lath shall be tack welded or wired to clip angles. Insulation shall be covered with 1" galvanized hexagonal wire mesh, #18 gage minimum and two 3 inch thick coats of Portland asbestos cement plaster. First coat to be rough or scratch coat. The second coat shall be trowelled to a smooth and even finish. Access doors and expansion joints shall be not covered. Access door shall be double wall construction with 2" insulation.

J. Weatherproofing Finishes for Outdoor Duct Insulation

1. Outdoor duct shall be finished with 0.016 Aluminum Jacketing with factory applied moisture barrier as manufactured by the Pabco-Childers Metals, smooth finish with PSMR, or approved.
2. Heavy duty 0.016 inch thick aluminum with poly-moisture barrier shall be used. All metal jacketing laps shall be sealed with 1/8" bead of Foster 95-44 or Childers CP-76 metal jacketing sealant.
3. Jacketing shall be applied with minimum 2-inch overlaps facing down from the weather and the jacketing shall be secured with aluminum bands 1/2 inch by 0.020 inches and aluminum wing seals applied on 12 inch centers, with bands applied directly over butt overlaps or with Pli-Grip Rivets. Where jacketing is cut out or abuts an uninsulated surfaces, the joint shall be sealed with Foster 95-44, Childers CP-76 or Insul-Coustic Sure-Joint 405 (gallon cans only; no tubes).
4. Fittings, valves and other irregular surfaces shall be protected with two coats of Foster 30-65, Childers CP-34, Marathon Vi-AC Mastic, I-C 551, with Foster Mast-a-Fab, Childers Chil Glas #10 or Vi-AC open weave glass cloth membrane between the coats. The total thickness of the coats shall be .32 mils when dry.
5. Outdoor rectangular ductwork aluminum cladding shall be formed with a high point located along the top longitudinal centerline in order to ensure rainwater runoff and so that no water accumulation will occur.

2.07 EQUIPMENT INSULATION

- A. Chilled and dual temperature water pump casings shall be constructed by utilizing a frame of 2" wide 0.05" thick galvanized sheet metal corner angles assembled with pop rivets or welded. This frame shall encompass the lower half of the pump and shall have a split removable cover frame for the top sections of the pump. Entire top of bottom frame shall be closed with 18 gauge galvanized sheet metal either by spot welding or structural screws. Provide 2" thick 1 lb. density fiberglass blanket lining for top and bottom half of

the frame. Frame sidings shall be cut for pipes, flanges, pump shaft and instrumentation/gauges. The innermost layer shall be aluminum in order to protect the insulation from damage.

- B. The chilled water header of refrigeration machines shall be insulated in the field with not less than 2" thick, 1 lb. density fiberglass blanket insulation and boxed in four sections with removable and replaceable, 20 gauge aluminum metal cover. The four sections shall be bolted together with ¼" bolts on 6" centers through an outstanding flange.
- C. Chilled water expansion tank, chilled water air separator and chemical treatment tanks other than condenser water tank shall be covered with 2" thick fiberglass U.L. labeled pipe and tank insulation with vapor barrier. Finish shall be 0.016" aluminum cladding as described above for equipment and piping insulation cladding.
- D. Insulation for single inlet return air fans shall be of material as specified for concealed ductwork and shall be covered with glass cloth or all service jacket smoothly adhered with Foster 85-60/85-20 or Childers CP-82/CP-127 adhesive. Seal joints with 5" wide tape. The Contractor shall have the option to use the following material: Insulation for the fans shall be of thickness noted above and shall be fiberglass pipe and tank insulation having a factory applied fire retardant vapor barrier jacket and shall be provided with pre-sized glass cloth smoothly adhered with Foster 85-60/85.20 or Childers CP-82/CP-127 adhesive. Pipe and tank insulation is a 3.00 p.c.f. board cut into strips, and fiber perpendicularly oriented and adhered to jacket. Finish shall be Insulating Cement or approved equal applied 3" thick in one coat, trowelled to a smooth finish. Same option of pipe and tank insulation with ASJ shall apply.
- E. Sound traps shall be insulated same as the connecting ductwork.
- F. Kitchen Type I hood exhaust ductwork: Insulate with Thermo-12 Gold calcium silicate block 2" thick, wired on, finished with 3" hard coat of fire retardant cement applied over 1 inch hexagonal mesh wire. See ductwork section of this specification for alternative installation options.
- G. Ductwork directly connected to Ovens shall be insulated same as "Breeching". Ductwork outside of the building shall have weatherproof cover. Fan located inside or outside of the building shall have insulation similar to return air fans. If fan located outside of the building, provide weatherproofing.
- H. Duct insulation installed within 18" of a Type I hood shall be non-combustible or shall be listed for the application.

PART 3 - EXECUTION**3.01 INSPECTION**

- A. Contractor shall examine location where this insulation is to be installed and determine space conditions and notify Architect in writing of conditions detrimental to proper and timely completion of the work.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install insulation in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that insulation complies with requirements and serves intended purposes.
- B. Coordinate with other work as necessary to interface installation of insulation with other components of systems.
- C. All insulating materials shall be applied only by experienced workmen, in accordance with the best covering practice. All piping, duct or equipment shall be blown out, cleaned, tested and painted prior to the application of any covering. Adhesives, sealers and mastics shall not be applied, when the ambient temperature is below 40°F, or surfaces that are wet.
- D. Insulation for factory-fabricated air handling units, furnished as part of units.
- E. At all openings in insulation and acoustical duct lining, insulate edges neatly and protect with sheet metal nosing. Use sealant as well.
- F. All items described in general indicate the type of covering required, however, all piping, ductwork or equipment that transmits heat or will form condensation shall be insulated.
- G. Finish for Concealed Pipe Insulation:
 - 1. Factory ASJ (All service jacket) secured in place with Bostich staples 4" o.c. or ASJ with self-sealing lap as made by Johns Manville, Owens-Corning or approved equal. All fittings shall be covered with Zeston PVC covers.
- H. All piping and ductwork insulation shall be continuous through non-fire rated ceiling openings and sleeves passing through non-fire rated walls or floors. Sleeves shall be packed with mineral wool or thermofiber. Discontinue insulation as it passes through fire-rated wall or floor and use mineral wool or thermofiber packing instead. Specific mastics, adhesives and coating shall be applied in strict accordance with Manufacturer's instruction, including recommended coverages.
- I. Where packaged type units are called for in the Specifications, or as scheduled on the Drawings, the insulation shall be as herein specified for the specific system.

- J. All valved and capped outlets left for future work shall be insulated as herein specified for the specific systems with a removable section of insulation over caps.
- K. Where insulation on existing piping, equipment, etc., has been cut, removed or damaged, this Contractor shall reinsulate as herein specified.
- L. All insulation of access doors shall be set in sheet metal double-pan construction.
- M. All ductwork shall be insulated in the field, following complete installation of the ductwork. Installation of insulation on the ductwork in the shop (prior to delivery and installation of the ductwork) is prohibited.
- N. For installation of elastomeric closed-cell insulation:
 - 1. Piping:
 - a. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armaflex 520, 520 BLV or 520 Black Adhesive. When using AP Armaflex SS, only the butt joints shall be adhered using Armaflex 520, 520 BLV or 520 Black Adhesive. Armaflex HT 625 Adhesive shall be used with UT Solaflex.
 - b. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
 - c. Tape the ends of the copper tubing before slipping the Armaflex insulation over the new pipes to prevent dust from entering the pipe.
 - d. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp non-serrated knives must be used.
 - e. On cold piping, insulation shall be adhered directly to the piping at the high end of the run and every 18 feet, using a two-inch strip of Armaflex 520, 520 BLV or 520 Black Adhesive on the ID of the insulation and on the pipe. All exposed end cuts of the insulation shall be coated with Armaflex 520, 520 BLV, or 520 Black Adhesive. All penetrations through the insulation and termination points must be adhered to the substrate to prevent condensation migration.
 - f. Sheet insulation shall be used on all pipes larger than 8" IPS. Insulation shall not be stretched around the pipe. On pipes larger than 12" IPS, adhere insulation directly to the pipe on the lower 1/3 of the pipe. On pipes greater than 24" IPS, complete adhesion is recommended.
 - g. Seams shall be staggered when applying multiple layers of insulation.
 - 2. Hangers:
 - a. Support piping system using high density inserts with sufficient compressive strength. The pipe support insulation shall be elastomeric foam with the same or greater thickness than the pipe insulation. All joints shall be sealed with Armaflex 520, 520 BLV or 520 Black adhesive.
 - b. Standard and split hangers -- Piping supported by ring hangers shall have hangers insulated with the same insulation thickness as the adjacent pipe. All seams and butt joints shall be sealed with Armaflex 520, 520 BLV or 520

- Black Adhesive. Armaflex HT 625 Adhesive shall be used with UT Solaflex. Ring hangers may be sleeved using oversized tubular insulation. On cold piping, insulation shall extend up the hanger rod a distance equal to four times the insulation thickness. Insulation tape may be used to a thickness equal to the adjacent insulation thickness.
- c. Clevis hangers or other pipe support systems -- Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers, or locations where the insulation may be compressed due to the weight of the pipe. All piping shall have wooden dowels or blocks of a thickness equal to the insulation inserted and adhered to the insulation between the pipe and the saddle. It is highly recommended for continuous insulation protection to use hanger sizes equal to the outer diameter of the pipe plus insulation thickness.
 - d. Armafix IPH or Armafix NPH can be used to prevent compression of insulation at standard split, clevis hangers or other pipe support systems. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads be adhered to the clamps. In addition, to prevent loosening of the clamps, use of an anti-vibratory fastener, such as a nylon-locking nut, is also recommended.
3. Square and Rectangular Ductwork:
- a. The top of the ductwork must be sloped to prevent “ponding” of water. The recommendation is at least a 2° angle to the outer side.
 - b. Armaflex Sheet Insulation shall be adhered directly to clean, oil-free surfaces with a full coverage of Armaflex 520, 520 Black or Low VOC Spray Adhesive. Armaflex HT 625 Adhesive shall be used with UT Solaflex. AP Armaflex SA shall be adhered directly to clean, oil-free surfaces.
 - c. The duct insulation shall be constructed from the bottom up, with the top insulation sized to extend over the side insulation. This will form a watershed.
 - d. Butt-edge seams shall be adhered using Armaflex 520, 520 Black, or HT 625 Adhesive by the compression fit method to allow for expansion/contraction. Leave a 1/2”-wide uncoated border at the butt-edge seams on the duct surface and the insulation surface. Overlap the insulation 1/4” at the butt-edges and compress the edges into place. Apply Armaflex 520, 520 Black or HT 625 Adhesive to the butt-edges of the insulation.
 - e. Standing metal duct seams shall be insulated with the same insulation thickness as installed on the duct surface. Seams may be covered using strips of Armaflex Sheet Insulation or half sections of tubular pipe insulation with miter-cut ends. Standing seams shall be adhered using Armaflex 520, 520 Black or HT 625 Adhesive.
 - f. Insulation seams shall be staggered when applying multiple layers of insulation.
4. Round Ductwork:
- a. AP Armaflex Sheet and Roll Insulation, UT Solaflex Roll Insulation, or NH Armaflex Sheet and Roll Insulation shall be used on all round ductwork. Insulation shall be wrapped not stretched around the duct. On ductwork larger than 12” in diameter, the insulation shall be adhered to the duct surface on the lower one third. On ductwork greater than 24” in diameter, the insulation

- shall be completely adhered to the duct surface. Longitudinal seams shall be located on the lower half of any round ductwork.
- b. Butt-edge seams shall be adhered using Armaflex 520, 520 Black or HT 625 Adhesive by the compression fit method to allow for expansion/contraction. Leave a 1/2" wide uncoated border at the butt-edge seams on the duct surface and the insulation surface. Overlap the insulation 1/4" at the butt-edges and compress the edges into place. Apply Armaflex 520, 520 Black, or HT 625 Adhesive to the butt-edges of the insulation.
 - c. Insulation seams shall be staggered when applying multiple layers of insulation.
5. Exposed Outdoor Duct:
- a. All outdoor exposed ductwork shall be finished using one of the following applications: For all the application methods described below it is very important that the exterior horizontal surfaces shall be sloped to prevent ponding on the top surface of the coated insulation. If the substrate is not sloped make the necessary adjustments to provide for a slope. DO NOT compromise the Armaflex insulation thickness to achieve the necessary slope.
6. Armaflex WB Finish
- a. All outdoor ductwork shall be finished with a minimum requirement of two coats of Armaflex WB Finish.
 - 1) Rectangular ductwork
 - a) The surface of the insulation must be clean and dry.
 - b) Apply first coat of Armaflex WB Finish at a rate of 400 square feet per gallon.
 - c) Allow to dry at least four hours.
 - d) Apply second coat at a rate of 400 square feet per gallon.
- O. Finish for Exposed Insulation:
1. The term "exposed" is hereby defined as any place outdoors, as well as any place indoors in Mechanical Rooms, Storage Rooms, Janitor's Closets, etc., where located within 7 feet of floor or access platforms.
 2. All exposed pipe, valve and fittings insulation shall have 0.016 inch thick corrugated aluminum jacket banded with 1/2" s.s. bands spaced 12" o.c. Piping, fittings and valves exposed in building, within seven feet of the floor or access platform, shall have 0.016" thick aluminum jacket banded with 1/2" aluminum bands spaced 12" o.c. or two bands per section. Joints and jacket shall provide complete weatherproof protection either by mechanical contact or by use of Foster 95-44 or Childers CP-76 metal jacketing sealant (gallon cans only; no tubes).
 3. All calcium silicate pipe insulation, all insulated condenser water piping exposed to weather and all other insulated pipe exposed to weather shall have 0.016 inch thick aluminum jacket banded with 1/2" s.s. bands spaced 12" o.c. This shall include pipe, fittings and valves.
 4. As an alternative to the use of 0.016" aluminum cladding on outdoor duct insulation, if AP Armaflex insulation is used, the ArmaTuff laminated sheet and roll insulation may be used. ArmaTuff laminated Armaflex sheet and roll

insulations may be used for insulating exterior applications such as duct, tanks, vessels and large pipes. Refer to section 3.06 for further installation details. ArmaTuff is a laminate of white polymeric material on Armaflex insulations, which offers durability and resistance to weathering, ultraviolet, acid rain and chemicals. The laminate is 0.013 inches (13 mils) thick. The seams must be installed in compression and sealed with Armaflex 520, or 520 Black contact adhesive. Cover the seams using ArmaTuff 6" Seal Tape.

3.03 PROTECTION

- A. The installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 23 07 00