SECTION 20 07 16 – Equipment insulation

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
				2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
			2. SUMMARY
				1. Perform all Work required to provide and install equipment insulation and covering indicated by the Contract Documents with supplementary items necessary for proper installation.
			3. REFERENCE STANDARDS
				1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
				2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
				3. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

ASTM B209 ‑ Aluminum and Aluminum‑Alloy Sheet and Plate.

ASTM C168 - Terminology Relating to Thermal Insulation Materials.

ASTM C177 ‑ Steady‑State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded‑ Hot‑Plate Apparatus.

ASTM C195 ‑ Mineral Fiber Thermal Insulating Cement.

ASTM C335 ‑ Steady‑State Heat Transfer Properties of Horizontal Pipe Insulation.

ASTM C449 ‑ Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

ASTM C518 ‑ Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

ASTM C534 ‑ Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

ASTM C547 ‑ Mineral Fiber Pipe Insulation.

ASTM C552 ‑ Cellular Glass Thermal Insulation.

ASTM C553 – Mineral Fiber Blanket and Felt Insulation.

ASTM C578 – Rigid, Cellular Polystyrene Thermal Insulation.

ASTM C591 – Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

ASTM C612 – Mineral Fiber Block and Board Thermal Insulation.

ASTM C921 ‑ Jackets for Thermal Insulation.

ASTM C1126 – Faced or Unfaced Rigid Celluar Phenolic Thermal Insulation.

ASTM D1056 ‑ Flexible Cellular Materials ‑ Sponge or Expanded Rubber.

ASTM D1667 ‑ Flexible Cellular Materials ‑ Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

ASTM D2842 ‑ Water Absorption of Rigid Cellular Plastics.

ASTM E96 ‑ Water Vapor Transmission of Materials.

NFPA 90 – Air Conditioning and Ventilation Systems.

NFPA 255 ‑ Surface Burning Characteristics of Building Materials.

UL 723 ‑ Surface Burning Characteristics of Building Materials.

* + - 1. QUALITY ASSURANCE
				1. All equipment requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.
				2. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor’s submittal data for this section of the Specifications. No material shall be used that, when tested by the ASTM E84‑89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
				3. Application Company Qualifications: Company performing the Work of this Section must have minimum three (3) years experience specializing in the trade.
				4. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.
				5. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy Work will not be acceptable.
			2. SUBMITTALS
				1. Product Data:

Provide product description, service application, list of materials, “k” value, “R” value, mean temperature range, and thickness for each service and location.

Manufacturer’s Installation Instructions: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.

* + - * 1. Operation and Maintenance Data:

Provide manufacturer’s recommendations for care and protection.

* + - 1. DELIVERY, STORAGE AND HANDLING
				1. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer’s identification including product thermal ratings and thickness.
				2. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.
				3. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.
				4. Maintain required ambient temperature during and after installation for minimum period of 24 hours.
1. PRODUCTS
	* + 1. GENERAL
				1. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
			2. Manufacturers
				1. Owens‑Corning (Type E1/Type E2).
				2. Certainteed Corporation (Type E1 / Type E2).
				3. Knauf Corporation (Type E1 / Type E2).
				4. Johns Manville Corporation (Type E1 / Type E2).
				5. Dow Chemical Company (Type E3).
				6. Industrial Insulation Group, LLC (Type E4).
				7. Armstrong/Armacell (Type E5).
				8. Koolphen Products Company (Type E6).
				9. Resolco International bv (Insul-Phen) (Type E6).
				10. Pittsburgh Corning (Type E7).
				11. Aluminum Jacket: Fosters/Childers or acceptable substitution.
			3. Insulation materials
				1. Type E1: Flexible fiberglass or mineral fiber blanket; ASTM C553; 'k' value of 0.24 at 75 degrees F; 2.0 lb/cu ft density.
				2. Type E2: Rigid fiberglass or mineral fiber board; ASTM C612; 'k' value of 0.24 at 75 degrees F; 6.0 lb/cu ft density.
				3. Type E3: Molded closed cell poyisocyanurate insulation; ASTM E96, ASTM C177, 'k' value of 0.18 at 75 degrees F; ASTM D2842, maximum water absorption value of 0.05 lb/ft2.
				4. Type E4: Mineral Wool; ASTM C 547; preformed insulation high temperature insulation; 'k' value of 0.35 at 300 degrees F.
				5. Type E5: Closed cell, chemically neutral, neoprene insulation, 'k' value of 0.27 at 75 degrees F; sheet form.
				6. Type E6: Phenolic closed cell, ASTM C1126 rigid foam, 2.2 lbs. nominal density, CFC free; ASTM C518, 'k' value of 0.13 at 75 degrees F.
				7. Type E7: Rigid cellular glass; ASTM C552; ‘k’ value of 0.29 at 75 degrees F; 7.5 lb/cu ft density. 0 permeability (Wet Cup Method) ASTM E96.
			4. accessories
				1. Adhesives: Non‑shrinking, permanently flexible, compatible with insulation. Use Childers CP-82 adhesive for general purpose. For calcium silicate, use Childers CP‑97 fibrous adhesive.
				2. Sealants: For general purpose to seal the end of insulation, use Childers CP‑30 L.O. sealant.
				3. Insulating Cement: ASTM C195; hydraulic setting mineral wool; Ryder one‑coat.
				4. Wire Mesh: Corrosive‑resistant metal; 1 inch hexagonal pattern.
				5. Primer: Use Childers CP‑50 diluted 50 percent with water primer to seal over insulating cements and fibrous adhesives prior to finish coating.
				6. Finish Coats: For general purpose, use Childers CP‑30 L.O., reinforce with glass cloth. For calcium silicate, use Childers CP‑50 finish coat reinforced with canvas jacket. For finish coat over closed cell elastomeric, use Childers CP‑17 or Armstrong "Finish" acrylic finish.
2. PREPARATION
	* + 1. preparation
				1. Verify that surfaces are clean, foreign material removed, and dry.
				2. Maintain required ambient temperature during and after installation for minimum period of 24 hours.
				3. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.
			2. INSTALLATION
				1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
				2. All installation shall be in accordance with manufacturer’s published recommendations.
				3. Do not insulate factory insulated equipment.
				4. On exposed equipment, locate insulation and cover seams in least visible locations.
				5. Apply insulation close to equipment by grooving, scoring and beveling insulation. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.
				6. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
				7. For insulated cold equipment containing fluids below ambient temperature:

Provide vapor barrier jackets, factory applied or field applied.

Finish with glass cloth and vapor barrier adhesive.

Insulate entire system.

* + - * 1. For insulated equipment containing fluids above ambient temperature:

Provide standard jackets, with or without vapor barrier, factory applied or field applied.

Finish with glass cloth and adhesive.

For hot equipment containing fluids 140 degrees F or less, do not insulate flanges or unions, but bevel and seal ends of insulation.

For hot equipment conveying fluids over 140 degrees F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union.

* + - * 1. Inserts and shields:

Application: Equipment 2 inches in diameter or larger.

Shields: Galvanized steel between hangers and inserts.

Insert location: Between support shield and equipment and under the finish jacket.

Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

Insert material: Heavy density insulating material suitable for the planned temperature range.

Manufacturer shall be responsible to size the length of shield required to prevent insulation from breaking.

* + - * 1. Finish insulation at supports, protrusions and interruptions.
				2. For equipment in mechanical equipment rooms or in finished spaces, finish with aluminum jacket. The longitudinal joint of the jacketing shall be placed with overlap directed to bottom of pipe. The jacketing shall be overlapped a minimum of 3 inches, and it shall be held in place using ¾ inch bands applied at 12 inches on center. Securing of the jacket shall be made by the use of 1-inch x 0.016-inch aluminum or stainless steel bands and seals. The shields at support points shall be secured with 1/2-inch or 0.020 inch stainless steel bands and seals. Ferrous metal surfaces shall be primed with a red lead oxide primer. The metal jacketing and fitting covers shall be fabricated of 9.016 inch aluminum or stainless steel with a smooth finish.
				3. For exterior applications, provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
				4. Each chilled water pump shall be insulated up to the face of the flanges on the piping connection to the pump and any bare metal that projects over the bed plate of the pump and from which condensation might drip onto the floor. Each heating hot water pump and condensate return pump shall be insulated, but the insulation of the connecting piping shall be beveled to the face of the pipe flange connection to the pump flange.
			1. TESTING
				1. Verify that equipment has been tested before applying insulation materials.
			2. EQUIPMENT INSULATION APPLICATION AND THICKNESS SCHEDULE

| Equipment | Application | Insulation Type | Insulation Thickness |
| --- | --- | --- | --- |
| Domestic Hot Water Storage Tanks | All | E2, E3 or E7 | 1-½” |
| Domestic Cold Water Storage Tanks | All | E2, E3 or E7 | 1-½” |
| Domestic Cold Water Pressure Tanks | All | E2, E3 or E7 | 1-½” |
| Hot Thermal Storage Tanks | All | E4 | 2” |
| Boiler Feed Water Storage Tanks | All | E4 | 2” |
| Steam Condensate Receivers | All | E4 | 1-½” |
| Condensate Tanks | All | E1, E2, E3 or E7 | 1” |
| Hot Water Expansion Tanks | All | E6 or E7 | 1” |
| Heat Exchangers/Converters | 35-75 Deg F | E7 | 2” |
| 75-150 Deg F | E2 | 2” |
| 151-300 Deg F | E3 | 2-½” |
| Above 300 Deg F | E4 | 3” |
| Chilled Water Expansion Tanks | All | E6 or E7 | 1” |
| Air Separators | All | E6 or E7 | 1” |
| Deaerators | All | E4 | 2” |
| Flue Gas Breeching | All | E4 | 3” |
| Induced Draft Fan Scrolls | All | E4 | 3” |
| Flue Stacks to Roof | All | E4 | 3” |
| Boiler and Flue Boxes | All | E4 | 3” |
| Boiler Drum Heads | All | E4 | 3” |
| Chiller Cold Surfaces (Not Factory Insulated) | All | E5 or E7 | 1-½” |
| Chilled and Hot Water Pump Bodies | All | E6 or E7 | 1-½” |
| Chemical Feed (Chilled/Hot Water) | All | E5 | ¾” |
| Muffler | All | E4 | 4” |

END OF SECTION 20 07 16