

**SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS****PART 1 – GENERAL:****1.1 DESCRIPTION:**

This section specifies flue gas exhaust system and all accessories from the boiler outlet to the stack outlet to the atmosphere. Flue gas recirculation (FGR) ductwork (if required by burners furnished) is also specified.

1.2 RELATED WORK:

- A. Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS,
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- C. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

1.3 QUALITY ASSURANCE:

- 1. Provide scale drawings showing nominal dimensions and weight of the systems.
- 2. One United States manufacturer shall completely engineer the entire system and supply the breeching, stack, and related components. Manufacturer's representative shall provide installation instructions prior to start of construction train the installers and certify in writing to the Resident Engineer (RE)/Contracting Officers Technical Representative (COTR) that the entire installation complies with the official standards of the manufacturer and with the project specifications.
- 3. Breeching, stacks, and free-standing stacks to be welded by AWS Certified welders.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Design, materials, weights, construction, pressure and temperature limitations of breeching and stack systems, flue gas recirculation system.
- C. PE stamped drawings provided by one manufacture showing all components, system arrangement and dimensions.

- D. Design, construction, allowable movements, movement forces, pressure, and temperature limitations of expansion joints.
- E. Damper design, construction, pressure and temperature limitations, pressure loss at design flow, and leakage of closed damper.
- F. Support designs, locations and loads for entire assembly.
- G. Plans, Elevations and Details of Stack.
- H. Base Plate Details.
- I. Provide calculations checked and stamped by a Professional Engineer licensed in the project State to verify stack design and safety of the structure.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Institute of Steel Construction (AISC):
Manual for Steel Construction, Load and Resistance Factor Design, Third Edition.
- D. ASME Steel Stack Standard STS-1-2021.
- E. SMACNA 1031 Guide for Steel Stack Design and Construction, 1996.
- F. ASTM International (ASTM):
A36/A36M-05.....Carbon Structural Steel
A242/A242M-04e1High-Strength Low-Alloy Structural Steel
A307-07a.....Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A563-07Carbon and Alloy Steel Nuts
A568/A568M-07.....Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For
- G. American Welding Society (AWS):
D1.1/D1.1M-2008.....Structural Welding Code-Steel
- H. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
SP-58-2002Pipe Hangers and Supports – Materials, Designs and Manufacturing.
- I. National Fire Protection Association (NFPA).

PART 2 – PRODUCTS:**2.1 BREECHING, STACKS, FREE STANDING STACKS:**

- A. Refer to drawings for arrangement and dimensions. Connections to boilers and economizers must comply with the written recommendations of the boiler and economizer manufacturers. Ninety-degree tee sections are not permitted. Intersections must be made with lateral tees.
- B. Pre-engineered, Pre-Fabricated, Double-Wall System:
1. Complete factory-built system, all components and installation engineered and provided by manufacturer of system.
 2. The factory built modular chimney shall be laboratory tested and listed in accordance with Underwriters Laboratories Standard UL 103 for use with building heating equipment burning gas, solid or liquid fuels with flue gases not exceeding 1400°F continuous operations and 1800°F intermittent operation.
 3. Factory-built standard sections, connected in the field with joining system designed and provided by system manufacturer. Sections shall be sealed with banded flanges and silicone joint sealant for temperatures up to 600°F
 4. System manufacturer's engineered support system, attached to structural members of the building, with expansion joints between rigid supports. Thermal expansion shall be handled by adjustable length sections. Thermal expansion and weight of system shall not impose loads in excess of that allowed by manufacturer of boiler, economizer, or any other equipment.
 5. UL-Listed for the following clearance to combustibles:

| Section Inside Diameter | 1000°F(560°C) Chimney* | 1400°F(760°C) Chimney |
|----------------------------|---------------------------|--------------------------|
| 5"-6" | 1/2" (13mm) | 1/2" (13mm) |
| 7"-10" | 1" (25mm) | 1" (25mm) |
| 11"-14" | 2" (51mm) | 2" (51mm) |
| 15"-18" | 3" (76mm) | 3" (76mm) |
| 19"-24" | 4" (102mm) | 4" (102mm) |
| 25"-28" | 5" (127mm) | 5" (127mm) |
| 29"-32" | 6" (152mm) | 6" (152mm) |
| 33"-36" | 7" (178mm) | 7" (178mm) |
| 37"-40" | 8" (203mm) | 8" (203mm) |
| 41"-48" | 9" (229mm) | 9" (229mm) |

6. Inner shell material shall be Type 304 stainless steel for natural gas and number 2 oil fired appliances. Type 316 stainless steel shall be used for coal, number 4, number 5, and number 6 oil fired appliances. Inner shell thickness shall be .036" for 6" to 36" diameter systems and .048" for 38" to 48" diameter systems. All inner shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot-welded seams are not permitted.
7. Outer shell material for indoors shall be aluminized steel with a thickness of .034" for 6" to 36" diameter systems and .052" for 38" to 48" systems. Chimney sections exposed to atmospheric conditions shall be painted or be type 304 stainless steel with a thickness of .030" for 6" to 36" diameter systems and .048" for 38" to 48" diameter systems. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot-welded seams are not permitted.
8. Insulation Between Walls: there shall be a minimum 2" of 1600°F rated low conductivity ceramic fiber insulation. The insulation is to be securely attached to the inner shell with steel straps. Stainless steel centering clips shall be welded to the outer shell to maintain the 2" spacing and ensure concentricity of the shells.
9. Bands for Joining Sections: Same material as section being joined. Utilize sealant provided by system manufacturer.
10. Stack Outlet: Provide as shown, double cone rain cap or other type termination designed by manufacturer of the stack system.

C. Freestanding Stacks

1. Fabricate freestanding chimney according to ASME STS-1-2021. Design for minimum **X**-feet high and **Y**-inch diameter single wall construction from **A36 carbon steel** materials.
2. Structural design requirements: Design chimney structure and anchorage to foundation system for wind velocity, importance factor and exposure for the area. Wind forces shall be calculated in accordance with ASCE 7-05. Anchor rods shall be designed in accordance with Appendix D of ACI 318-05.

3. Stack natural frequencies and associated critical vortex shedding velocity shall be clearly identified. If this value is deemed unacceptable, the stack shall be designed with wind strakes or other sufficient means.
4. Construction: Inner liner shall be supported both vertically and laterally to resist seismic and wind loads.
5. Outer stack shell: **ASTM A36 carbon steel** with continuously welded joints complying with NFPA 211 for minimum thickness.
6. Provide cleanout doors from compatible materials.
7. Provide low point drain connection.
8. Provide stack entrance at base.
9. Stack shall meet Lightning Protection requirements of ASME STS-1-2021.

D. Method of Construction: **Free-Standing** Stack

1. The stack shell shall be cylindrical in shape and shall be assembled by welded construction. Welding shall be in accordance with ASIC specifications and in accordance with the applicable requirements of AWS D1.1.
2. Circumferential reinforcing rings shall be provided and incorporated in to the design to satisfy shell ovaling criteria.
3. No reinforcing members shall extend into the flue gas stream or in any way restrict gas flow.
4. All openings in the shell, including breeching openings and access doors, shall be continuously reinforced with rigid type frame construction.
5. The stack shall be supplied with a flanged extension at the breeching opening located at a minimum of 6" from the outer face of the outer shell.

E. Steel Stacks

1. Provide 0.0625" corrosion allowance in thickness of steel. All calculations to be based on fabricated steel thickness minus 0.0625"
2. Stack breeching connection – bolted, **carbon steel**.
3. Steel sections shall be welded and shall conform to the requirements of AWS D1.1 with a minimum grade of **ASTM A-36**:
4. Stack Base: **double** ring steel base spaced with gussets per anchor bolt.

5. Provide reinforced stainless steel false bottom at stack base with 2” minimum NPS stainless steel drain connection.

2.3 EXPANSION JOINTS

- A. Provide sufficient types, quantities, and locations of expansion joints to completely absorb all thermal expansion of the system without imposing excessive loads on equipment or building structure. On factory fabricated double wall stack or breeching system, use slip type expansion joints engineered by designer of the stack and breeching system.
- B. Construction, Factory Fabricated Double-Wall System Joints:
 1. Materials: Same as factory fabricated breeching system.

2.4 ACCESSORIES

- A. Drains: Provide threaded pipe connection to allow drainage at all low points and drain connections in stack and breeching systems. Slope piping system to the drain. Pipe size shall be 25 mm (1 inch) minimum.
- B. Instrument Ports: Locate on individual stack or breeching serving each boiler. Locate in non-turbulent zone within 3600 mm (12 feet) of boiler room floor between boiler and economizer (when economizer is provided) or locate accessible from platform. Provide separate ports for the following:
 1. Flue gas oxygen analyzer: Coordinate with analyzer furnished.
 2. Opacity monitor (if required): Coordinate with sensor furnished. Locate downstream from oxygen analyzer.
 3. Stack temperature sensor: Coordinate with sensor furnished.
 4. Draft gauge: 25 mm (1 inch) diameter coupling, plugged.
 5. Test instruments: 25 mm (1 inch) diameter coupling, plugged.
- C. Stack to be supplied with the following:
 1. **Standard bolted clean-out arrangement for access into the stack base. Door shall be 24” x 24” minimum.**
 2. Two NPS 4” test ports and blind flanges with 150# bolt pattern shall be installed per the requirements of Appendix 1 of ASME STS-1-2021.

2.5 SURFACE PREPARATION AND PAINTING – STEEL STACK

- A. Clean in accordance with SSPC-SP6
- B. A minimum blast profile of 50 microns (2 mils) is specified and not to exceed 75 microns (3 mils).
- C. All coated surfaces shall be clean and dry before over-coating.
- D. Primer shall be an inorganic zinc applied spray application at 2-3 mils dft.
- E. Mid-coat shall be a fast dry polyamide epoxy applied by spray application in one coat to a dry film thickness of 100-150 microns (4-6 mils).
- F. Top-coat shall be a high gloss polyurethane applied at 3-5 mils dft.
- G. Total dry film thickness shall be 225 microns (9 mils) minimum and 350 microns (14 mils) maximum.
- H. No coating material shall be applied when the steel temperature is less than 40° F or less than 5° F above the dew point.
- I. All coating materials shall be supplied by the same manufacturer. Different lots of materials shall be kept to minimum consistent with the manufacturer's production facilities for the product.
- J. The contractor shall provide a quart minimum size or gallon maximum size, paint for touch up purposes after stack field erection and transport.

PART 3 - EXECUTION

3.1 INSTALLATION - PRE-ENGINEERED, PRE-FABRICATED DOUBLE WALL SYSTEM

- A. Supports: Completely support all systems from the building structure without overloading the building structure or the connected equipment. Support system shall be engineered by the system manufacturer and shall accommodate thermal expansion.
- B. Factory-Fabricated Stack or Breeching System:
 - 1. Install in accordance with manufacturer's printed instructions.
 - 2. Deliver a copy of the instructions to prior to commencing the installation.
 - 3. Representative of manufacturer shall provide field training on all installation techniques to all installers.

- C. Connect 25 mm (1 inch) minimum pipes with ball valves to breeching and stack drains.
Extend to floor drain.
- D. Boiler or Economizer Outlet Dampers: Locate so that there is no restriction in the flow of flue gas recirculation (if provided).

3.1 INSTALLATION - GENERAL

- A. Follow manufacturer's and SMACNA installation recommendations for shop fabricated components and stacks.
- B. Coordinate with the stack and boiler manufacturers.
- C. Provide bolted breeching connections at the economizers, stacks, and construction joints.
Seal weld the inside of construction joints.

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