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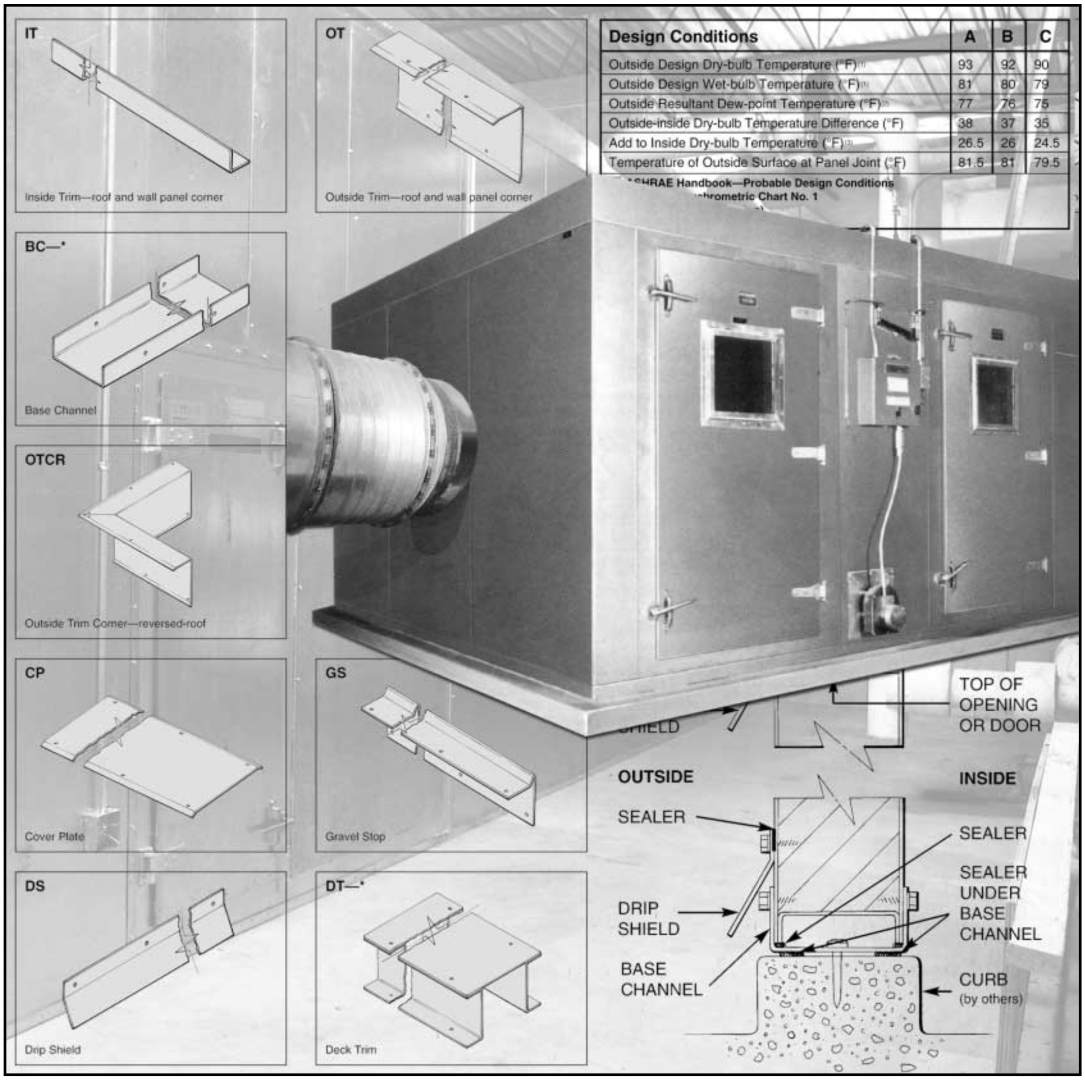


Engineering Considerations and Recommended Specifications

for UNI-HOUSING™ Pressurized Enclosures

McGill AirSilence LLC

An enterprise of United McGill Corporation — Founded in 1951

Contents

UNI-HOUSING PRESSURIZED ENCLOSURES

The products depicted in this specification booklet were current at the time of publication. As a quality-conscious manufacturer, McGill AirSilence continually seeks ways to improve its products to better serve its customers. Therefore, all designs, specifications, and product features are subject to change without notice.

Part 1: Engineering Considerations

Performance Considerations

Thermal Control

Thermal control information for the McGill AirSilence™ SOUNDSCREEN® Type SL (snap-lock joint) and Type TG (tongue-and-groove joint) panels used to construct UNI-HOUSING enclosures has been generated in an extensive testing program conducted at an independent laboratory. Type SL and Type TG panels were tested according to ASTM Designation C236 *Standard Method of Test for Thermal Conductance and Transmittance of Built-up Sections by Means of the Guarded Hot Box*. Both forced and free convection conditions were generated, and data were taken over a 120°F temperature differential range.

The insulating materials used in Type SL and Type TG panels have the maximum thermal conductances at a mean temperature of 75°F as shown in **Table A**.

Table A

Thermal Conductance (BTU/hr—ft^2—°F)
(a) 4-inch panel construction—0.06 BTU/hr—ft^2—°F
(b) 2-inch panel construction—0.12 BTU/hr—ft^2—°F

Condensation Control

In certain situations (e.g., plenum systems downstream of cooling coils and outdoor housings), the possibility of moisture condensation exists.

In the case of plenum systems downstream of cooling coils, the condensation may occur at utility penetrations that are not properly insulated, or at the joint interface between adjoining enclosure panels.

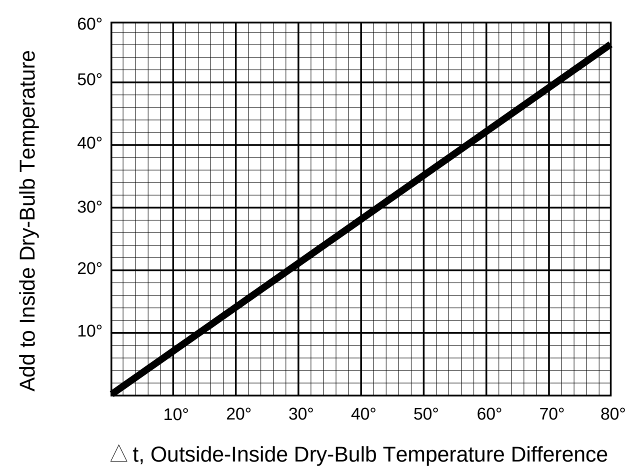
Potential condensation at the interface between adjoining enclosure panels can be evaluated using the data presented in **Figure 1**. Three reference temperatures need to be considered in evaluating the possibility of condensation at these interfaces: the outside dry-bulb temperature, the outside dew-point temperature, and the inside dry-bulb temperature.

To determine whether or not condensation is likely to occur, calculate the difference in outside and inside dry-bulb air temperatures and, from **Figure 1**, find the value that must be added to the inside dry-bulb temperature to obtain the outside skin temperature at the joint interface. This outside-joint temperature should be compared with the outside dew-point temperature.

If the joint temperature is higher than the dew-point temperature, condensation will not occur. If the joint temperature is at or lower than the dew-point temperature, condensation is likely and corrective measures are recommended. Joint interface condensation can be controlled by the use of insulated joint covers or by placing a strip of insulation in the tongue rail of the panel prior to making the joint connection.

Figure 1

Temperature of Outside Surface at Panel Joint



The dewpoint temperature outside the plenum is a function of the humidity ratio and barometric pressure or the wet-bulb/dry-bulb temperature combination. Dewpoint temperature can be determined using psychrometric equations, tables, or charts. Data given in charts such as the climatic condition charts shown in the *ASHRAE Fundamentals Handbook* are often used to evaluate potential moisture condensation problems. The designer should determine if these values are representative of the actual conditions for the installation.

Example: Evaluate the possibility of condensation on a UNI-HOUSING enclosure located in New Orleans, Louisiana, using design considerations A, B, and C from **Table B**. The airflow downstream of the cooling section has a 55°F inside dry-bulb temperature.

In this example, the panel-joint surface temperatures are warmer than the corresponding dew-point temperatures, and no problem with condensation would be predicted.

Table B

Design Conditions	A	B	C
Outside Design Dry-bulb Temperature (°F)(1)	93	92	90
Outside Design Wet-bulb Temperature (°F)(1)	81	80	79
Outside Resultant Dew-point Temperature (°F)(2)	77	76	75
Outside-inside Dry-bulb Temperature Difference (°F)	38	37	35
Add to Inside Dry-bulb Temperature (°F)(3)	26.5	26	24.5
Temperature of Outside Surface at Panel Joint (°F)	81.5	81	79.5

(1) ASHRAE Handbook—Probable Design Conditions
(2) ASHRAE Psychrometric Chart No. 1
(3) Figure 1 (this publication)

There may be situations in which the relative humidity in enclosed mechanical equipment rooms is higher than the ASHRAE data would predict. In such situations, relative humidity must be taken into account. If condensation does occur, ambient conditions both inside and outside should be measured to determine corrective actions.

Acoustical Control

For those applications in which UNI-HOUSING enclosures are used to provide effective control of excessive noise levels, two acoustical control properties should be evaluated. These are the internal sound absorbing capabilities of the panels and the control of the transmission of sound from the interior to the exterior of each panel.

Sound Absorption

Panels with perforated inner liners will provide sound attenuation within the enclosure, while at the same time preventing excessive reverberant buildup of noise levels (which can lead to erroneous calculation of design sound levels transmitted through enclosure walls).

The standard test procedure to determine the acoustical absorption efficiency of a panel is ANSI/ASTM C423 *Standard Method of Test for Sound Absorption of Acoustical Materials in Reverberation Rooms*. As tested at an independent acoustical facility (Riverbanks Acoustical Laboratories), the absorption coefficients of Type SL and Type TG panels are as shown in **Table C**:

It should be noted that in various design situations (especially in the design of pressurized plenum systems), the optimum design that prevents both noise and/or airflow short-circuiting will require the use of a mixture of both solid and perforated inner liners. Within certain constraints, the use of solid metal-surfaced panels and doors has little effect on the overall sound absorption characteristics of any enclosure. If a given enclosure with 100 percent perforated-lined panels was converted to use 25 percent solid liners and 75 percent perforated-lined panels, the increased noise levels in any frequency would be only 1 dB.

Table C

Sound Absorption Coefficients (20s/22p) Standard							
Octave Band Number	2	3	4	5	6	7	NRC*
Center Frequency (Hz)	125	250	500	1000	2000	4000	—
Absorption Coefficients							
(a) 4-inch panel construction**	0.63	1.09	1.17	1.08	1.03	0.97	1.09
(b) 2-inch panel construction***	0.22	0.64	1.06	1.06	0.98	0.87	0.94

*The noise reduction coefficient (NRC) is the average of the coefficients at 250, 500, 1000, and 2000 Hz, expressed to the nearest integral multiple of 0.05, but not exceeding 1.00.
**RAL Test No. A 71-31 (No. 4 Mounting)
***RAL Test No. A 82-8 (No. 4 Mounting)

Sound Transmission Loss

Equally important as the internal control of sound levels in the design of noise enclosures is the prevention of excessive transmission of noise to the exterior environment.

The standard test procedure to determine the sound transmission loss of a panel is ASTM E-90 *Standard Recommended Practice for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions*. As tested at an independent testing facility (Riverbanks Acoustical Laboratories), the transmission losses of Type SL and Type TG panels are as outlined in **Table D**:

Table D

Sound Transmission Loss (20s/22p) Standard							
Octave Band Number	2	3	4	5	6	7	STC*
Center Frequency (Hz)	125	250	500	1000	2000	4000	—
Transmission Loss (dB)							
(a) 4-inch panel construction**	16	24	35	45	53	58	37
(b) 2-inch panel construction***	18	21	29	38	49	55	33

*The sound transmission class (STC) is determined by comparing test data to a set of standard STC contours as described in ASTM Standard E413, Standard Classification for Determination of Sound Transmission Class.
**RAL Test No. TL 71-39
***RAL Test No. TL 82-6

Structural

All structures are subjected to various loading conditions. In some cases these are due only to the weight of the components of the assembly. In other instances there are additional distributed loads, for example, pressure differentials, and, in the case of exterior structures, wind and snow loads. The structural design of all enclosures is dependent on these loading conditions, and it is important that the design engineer specify each load condition accurately to avoid excessive costs and needless overdesigns while still providing for a safe and sound structure.

McGill AirSilence's standard practice is to design the total enclosure to be free of problems at the loading conditions specified by the design engineer. If necessary, the Type SL and Type TG panels used to construct UNI-HOUSING enclosures can withstand a 20-inch wg pressure differential.

It is recommended that the maximum allowable panel deflection shall not exceed L/200, where L is the unsupported panel span or length. When other deflection standards are required, the enclosure will be designed accordingly. In lieu of added optional structural steel supports, thicker enclosure panels may be more economical.

Contact McGill AirSilence for design information and recommendations concerning structural support requirements for UNI-HOUSING enclosures.

Installation Considerations

Outdoor Installation

Outdoor applications introduce additional design considerations. Among the more important considerations in outdoor designs are wind and snow loading, temperature differential reversal, design for weather protection, and the use of special materials.

Wind and Snow Loading

Outdoor structures may be subjected to severe structural design criteria when the effects of wind and snow loading are considered. For an excellent discussion of these two specialized design conditions, refer to the American National Standard A58.1-1972 *Building Code Requirements for the Minimum Design Loads in Buildings and Other Structures*.

The designer also is referred to local building codes for more specific information on local requirements. It is recommended that all loading conditions be specified explicitly.

Temperature Differential Reversal

In the design of UNI-HOUSING enclosures for outdoor applications, consideration must be given to possible interior condensation during periods of extremely cold weather.

In such a situation, the condensation is not likely to appear on the inner liner of the panel, but may occur at an intermediate plane in the internal insulation or on the inside surface of the outer skin. If such a situation is foreseen, a standard panel with a perforated interior skin should not be used without some type of protection. There are two methods of controlling this problem:

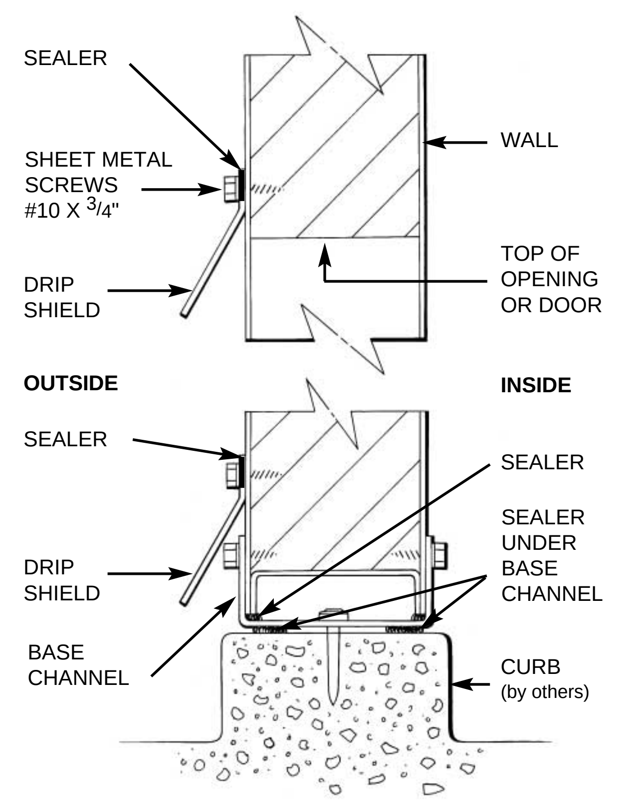
1. Use of panels with solid metal on both sides.
2. Use of membranes for vapor barriers if a perforated interior skin is needed for acoustical control.

Guidelines for Weather Protection

Weather protection should include a weatherproof roof, plus base channel flashing, drip shields over doors (as depicted in **Figure 2**), and provisions to prevent water runoff into the air intake louver and other undesirable locations. Proper roof design is especially important to prevent unnecessary pooling of rain water and needless leakage through the roof assembly. The roof design should include both a sloped roof and a built-up weatherproof/waterproof roof cover as shown in **Figure 3**.

Figure 3

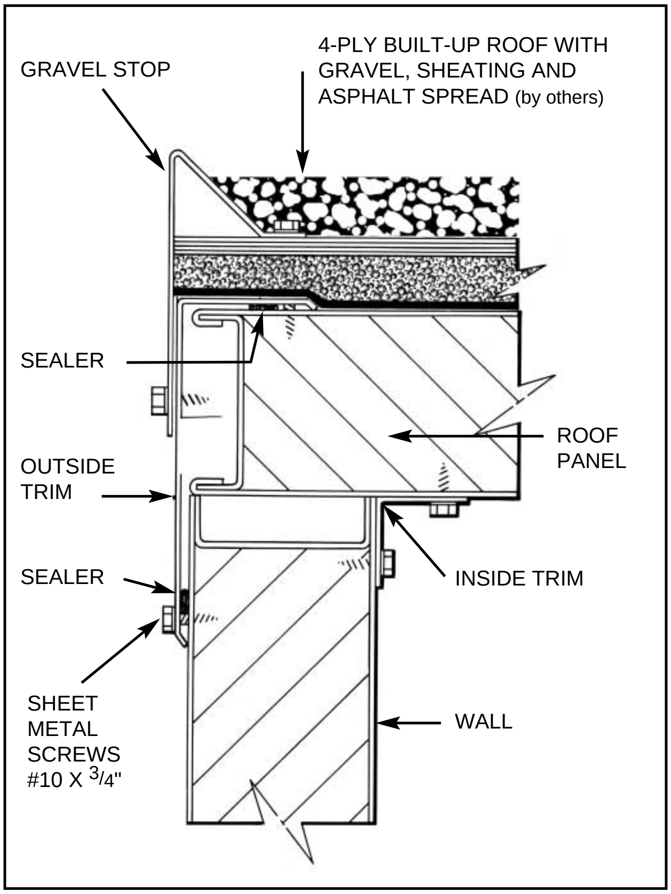
Drip Shield Detail



Many rubber-based sealer compounds are not intended for use in areas of strong sunlight since ultraviolet light rays and solar heat gain can cause early deterioration of these compounds. The recommended joint and trim sealer for outdoor applications is McGill AirSeal's UL-Classified UNI-WEATHER™ duct sealer, which provides long-term ultraviolet, heat, and ozone resistance.

Figure 3

Built-Up Roof Detail



Design Considerations

General

Provide sufficient space in floor plan layout to result in a rectangular enclosure. Non-rectangular panels, odd angles, and sloping roofs will cost more to erect.

Allow adequate room for maintenance when locating equipment.

Allow for access around the complete enclosure for maximum economy. Avoid placing panels directly against building walls, beams, or ceilings.

Do not specify electrical conduit to be concealed within the panels.

Follow McGill AirSilence's recommended specifications to assure a top-quality enclosure.

Pressurized Enclosures

Specify a curb for the enclosure base and provide floor drains. This will provide long-range benefits of easier maintenance and correction in the event of operating problems.

Specify and locate access doors into each compartment. Whenever possible, use standard 24-inch by 60-inch doors and indicate door swing — in or out and left or right. Doors should close in the same direction as the pressure differential to provide better leakage protection and to prevent accidents due to door operation while the system is still pressurized. Specify glass observation windows if desired. Arrange equipment to allow for a 7-inch variance of door location, horizontally left or right, to accommodate modular panels. Do not specify the inside of the door to be perforated metal: this does not help the acoustical control significantly and decreases the construction quality of the door.

In plenums, if airflow velocities through the cooling coils are sufficient to cause moisture entrainment, solid metal panels should be specified for downstream areas adjacent to coils and other possible entrainment areas. Solid metal skins provide the most efficient moisture barrier. Up to 25 percent of the plenum surface area can be solid metal without serious degradation of the acoustical properties. (See Section 4.6 for details.)

Specification of septum panels for common walls usually is not necessary. The solid metal skin that will appear on one side when using a standard panel for a common wall will not seriously alter the sound absorption efficiency if the 25 percent solid-surface factor is considered.

If required, McGill AirSilence can provide (at additional cost) factory-installed, standard-design, small-diameter penetrations. However, experience indicates that it is difficult to predetermine the precise location for small openings. Field penetration for such small diameters is more accurate and efficient. Job specifications can assure the proper quality of workmanship on such field penetrations.

Internal transitions and complicated configurations made with panels should not be specified. Conventional sheet metal fittings are adequate and far less expensive.

Use a keyed legend to indicate surfaces that are to be double-walled panels. Use of a double-line, cross-hatched legend is suggested to clearly define the double-wall panel sections and to avoid costly mistakes.

Part 2: Recommended Specifications for UNI-HOUSING™ Enclosures

Section1: **General**

1.1 Double-wall (insulated) enclosures shall be provided as specified on drawings. All panels and components shall be prefabricated and supplied by a nationally-recognized manufacturer with published standards of construction, assembly, and technical performance. The manufacturer shall have produced a standardized, prefabricated panel system for at least 10 years. Construction and performance of the installed system and components shall conform to all specifications listed in this document. The system and components shall not be susceptible to damage from extended exposure to airflow, pressure differentials, vibration, air temperature, or humidity.

Section 2: **Joint Construction**

2.1 Enclosure panels shall have either a snap-lock joint construction or a tongue-and-groove joint construction. Panels with snap-lock joint construction shall be such that adjacent panels are held together rigidly with an integral, continuous, self-locking joint on both inside and outside panel surfaces. Panels with tongue-and-groove joint construction will be held together with fasteners such as screws. Neither panel types should require H-connectors, tape, or any other type of additional connectors.

Section 3: **Panel Construction**

3.1 All enclosure panels shall be 2 or 4 inches thick, as noted on the drawings, with a solid galvanized steel exterior shell, and a solid or perforated interior galvanized steel shell as noted on the drawings.

3.2 The outer and inner shells shall be tack- or spot-welded to perimeter and internal longitudinal steel channels and box-end internal closures, in such a manner and spacing that the panel will not fail at the maximum operating loads specified in 5.2 (Structural Performance).

3.3 The outer shell shall be constructed of galvanized steel with a minimum 20-gauge thickness.

3.4 The inner shell shall be constructed of galvanized steel (solid or perforated) with a minimum 22-gauge thickness.

3.5 Perforated material shall have a 23 percent open area.

3.6 All perimeter and internal longitudinal steel channel member shall be constructed of ASTM Type A-653 commercial-quality galvanized steel with a minimum 18-gauge thickness.

3.7 All steel panel surfaces, internal channels, and trim items shall be fabricated from zinc-coated steel with a dipped galvanized coating (minimum G-60 coating class as determined by ASTM A-924) and shall meet all requirements of ASTM A-653 for commercial-quality galvanized carbon steel.

3.8 Each enclosure panel shall be completely filled with acoustical/thermal insulating material that is noncombustible, inert, mildew-resistant, and vermin-proof. Insulation shall not settle within the enclosure panel. No insulating materials shall be used that have a flame spread greater than 25 or a smoke developed greater than 50.

3.9 Where specified on drawings, septum panels shall consist of a solid galvanized steel sheet (minimum 20-gauge thickness) centrally sandwiched between layers of insulating material and perforated galvanized steel outer sheets (minimum 22-gauge thickness). The solid steel inner sheet shall be framed and sealed so that air does not leak through the enclosure when a pressure differential exists.

Section 4: **Components and Installation**

4.1 All base channels shall be installed on a level concrete curb, the dimensions of which shall be determined from plan-view shop drawings of the system provided by the system manufacturer. Spacing of base channel attachments shall be as outlined in the manufacturer's standard details of assembly.

4.2 All enclosure trim items shall be constructed of hot-dipped galvanized steel (minimum 18-gauge thickness) and furnished in standard lengths to be field cut to the required dimensions. Spacing of sheet metal screws, application of duct sealant, and positioning of trim shall be in accordance with the manufacturer's published erection and installation details.

4.3 All mechanical joints and external trim items shall be sealed with a UL-Classified duct sealant in accordance with Section 4 or 5. In order to show that joints have been sealed properly, enough sealant shall be used so that excess sealant is extruded from all completed external joints.

4.4 For enclosures to be installed indoors, joints and trim shall be sealed with United Duct Sealer (Water Based), formulated to withstand temperatures from -25°F to +200°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a UL Classification marking with flame spread of 5 and smoke developed of 0 when applied to 18-gauge galvanized steel or inorganic reinforced cement board, both at a coverage of 31 square feet per gallon. Sealant shall exceed 500 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb).

4.5 For enclosures to be installed indoors and outdoors, joints and trim shall be sealed with UNI-WEATHER solvent-based duct sealant that is a neoprene-phenolic mastic formulated to withstand temperatures from -20°F to +300°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 5 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 53 square feet per gallon. Sealant shall exceed 1,000 hours under ASTM-D572 test conditions (oxygen bomb) without becoming brittle and 500 hours in QUV accelerated-exterior-aging apparatus without degradation (under ASTM-C732 test conditions).

4.6 Personnel access doors shall be provided where specified on drawings and shall be 24 inches wide by 60 inches high unless otherwise indicated. All doors shall be the same nominal thickness as the adjacent panels. All access door panels and doors shall be constructed with an 18-gauge solid inner and outer shell. Each door shall have a minimum of two ball-bearing hinges and two wedge-lever door latches. All levers shall be installed to open against the air pressure differential. Doors shall seat against neoprene gasket materials, installed around the entire perimeter of the door frame in such a manner that door operation will provide direct compression with no sliding action between the door and gasket.

4.7 Where shown on drawings, doors shall be furnished with windows, which are composed of double-glazed layers of wire-reinforced safety-glass, separated by an air space, and sealed against acoustical and air leakage by interior and exterior rubber seals. Windows shall be 12 inches wide by 12 inches high unless otherwise indicated.

4.8 Openings for pipe and conduits shall be field cut to ensure proper positioning. All framing members, collars, and bellmouth fittings shall be insulated, welded, and sealed according to the manufacturer's published installation details.

Section 5: **Structural Performance**

5.1 The entire enclosure shall be designed by the manufacturer to be self supporting. Where roof spans and wall loadings require additional structural strength, it shall be provided by heavier panel skins, additional internal longitudinal reinforcing members, or additional structural members and necessary supporting pipe columns. The installer shall furnish and install all structural members and pipe columns according to the drawings and published installation details provided by the manufacturer.

5.2 The finished enclosure shall be able to withstand a positive internal static pressure of ( ) inches wg and a negative internal static pressure of ( ) inches wg. Installations subjected to the effects of weather shall be able to withstand a wind loading of ( ) pounds per square foot.

5.3 Under the conditions specified in the previous section, the assembled structure shall not exhibit any panel joint deflections in excess of L/200, where L is the unsupported span length of any panel section within the completed enclosure.

Section 6: **Acoustical Performance**

6.1 The manufacturer shall provide certified testing data obtained from an acoustical laboratory, listing sound absorption and transmission loss characteristics of the enclosure. When requested by the engineer, the manufacturer shall arrange to have a copy of all pertinent acoustical laboratory reports forwarded directly from the laboratory to the engineer.

6.2 When tested according to ANSI/ASTM C423 or a subsequent version of the standard, the enclosure shall have minimum sound absorption coefficients, as shown in **Table A**, in the $^{1}/_{3}$ octave band center frequencies. The coefficients used shall be those reported by the acoustical laboratory.

Table A

Sound Absorption Coefficients							
Octave Band (Hz)	125	250	500	1000	2000	4000	NRC
(a) 4-inch panel construction	0.63	1.09	1.17	1.08	1.03	0.97	1.09
(b) 2-inch panel construction	0.22	0.64	1.06	1.06	0.98	0.87	0.94

6.3 When tested according to ASTM E90 or a subsequent version of this standard, the enclosure panel shall have minimum airborne sound transmission losses in the combined full octave band center frequencies as listed in **Table B**.

Table B

Sound Transmission Losses							
Octave Band (Hz)	125	250	500	1000	2000	4000	STC
for 4-inch panels	16	24	35	45	53	58	37
for 2-inch panels	18	21	29	38	49	55	33

Section 7: **Thermal Performance**

7.1 Insulating materials used in all prefabricated enclosure panels shall have the following maximum thermal conductances at a mean temperature of 75°F: 0.06 BTU per hour per square foot per °F (for 4-inch panels) and 0.12 BTU per hour per square foot per °F (for 2-inch panels).

Acceptable product: McGill AirSilence UNI-HOUSING enclosures

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