

## Generator Enclosure Specifications, revised February 2009

### Responsibility Definitions

- D1 Packager. Designer manufacturer of the generating set package.
- D2 Installer. Client or Client contractor receiving and offloading the package and installing the same into the location in which the equipment is to be used.

### 1.0 Weather Ingress Protection (IP Code) and Testing

- 1.1 Weather protection shall be IP12 as defined in BS EN 60529. (See exhaust para 1.5)
- 1.2 Intake air velocity shall be no greater than 1000 ft/min (5.08 mtrs/sec) at any first point of entry or air into the enclosure.
- 1.3 Wet area's (e.g. air discharge plenum if fitted) shall have a continuous fall to permanent open water run off drains.
- 1.4 Exhaust silencer shall be internally mounted.
- 1.5 Exhaust tail pipe if vertical gas discharge (preferred) shall be fitted with rain flap.
- 1.6 Exhaust tail pipe if horizontal shall be 450 mitered and fitted with ingress protection IP2X per BS EN 60529.
- 1.7 The exhaust tailpipe when transiting the roof shall have an air gap between the exhaust pipe and roof panel with a minimum 1 inch up-stand and weather guard attached to the pipe. The weather guard lower edge shall have a minimum of 1" clearance above the roof. Exhaust tail pipe shall not make contact with any part of the roof so not to provide a heat transfer path to protect the integrity of the painted steel.
- 1.8 Hinged doors shall be fitted with a continuous bubble door seal of 0.625" diameter.
- 1.9 Bolted access covers to dry areas shall be neoprene gasketed at a minimum dimension of 2.000' x 0.125 thick.
- 1.10 In the event that the enclosure is to be attached to a supporting fabrication the supporting fabrication shall have a anti capillary ingress barrier attached and sealed to the periphery of enclosure mating face inboard of the enclosure internal edge at a minimum height of 1.500'. This to prevent water entering the dry area via the enclosure to supporting fabrication joint.
- 1.11 Enclosure shall be nitrile rubber gasketed at a minimum dimension of 0.250" thick x width of the enclosure flange between the enclosure and the supporting fabrication.
- 1.12 If the enclosure is to be affixed to a concrete foundation pad; the concrete pad flatness variance is to be within 0.250" across the mating surfaces. An anti capillary system similar to that outlined in 1.9 shall be provided by installer. Gasketing as described in 1.10 should be used to aide corrosion resistance (abrasion avoidance) by installer.
- 1.13 The completed enclosure shall be leak tested prior to shipment per practicable application of pertinent procedure outlined in BS EN 60529
- 1.14 The concrete pad on which the enclosure or supporting structure is to be installed shall have a side to side fall of 0.50 (max 1.50) or 10 (max 20) end to end promote water run off.

## 2.0 Construction (Structural, Enclosure and Supporting structure and package lifting)

- 2.0 Panel material: 12 gauge sheet steel to ASTM A569. Note. Panel depth 2" down to 85 @ 1 mtr noise level. Depth to increase below this noise level. See Section 3.0.
- 2.1 Enclosures greater in length than 20 feet shall have horizontal footer rails no less than 6 inches in height, manufactured from 7 gauge ASTM A569 and no shorter than 6 feet.
- 2.2 Enclosures greater in height than 120 inches, horizontal header rails no less than 6 inches in height manufactured from 12 gauge ASTM A569, no shorter than 6 feet shall be used above vertical panels.
- 2.3 Excepting enclosure extremities ends of header and footer rails shall not align with vertical panel joints.
- 2.4 The panels shall be of interlocking panel type with the objective of increasing weather protection joint strength.
- 2.5 Maximum deflection at panel joint with weight across two joints to be 0.0000108 inch/lb/foot.
- 2.6 Sufficient internal bracing shall be provided to prevent undue racking integrity for prevailing wind loading (typical wind loading 150 mph) and or structural integrity for installed components.
- 2.7 Appropriate structural integrity shall be "added back" where doors or apertures are positioned.
- 2.8 Corners / Return flanges of folded Panels / Doors to be fully welded. Welds associated with any mating surfaces are to be ground flush and finished to grit grade 60.
- 2.9 Any externally visible welds shall be finished ground to 240 grit grade.
- 2.10 Appropriate additional structure shall be incorporated where necessary for mounting of internally or externally mounted equipment or project wind rating.
- 2.11 Panels shall be bolted using flanged lock nuts at 12-inch centers.
- 2.12 Roof panels shall be flange lock nut bolted on 6 inch centers using 0.250" thk x 1.750" diameter load spread washers on both sides of joint.
- 2.13 Roof panels shall have two formed 7 gauge ASTM A569 sheet steel C section stringers running the length of the equipment area roof. Stringers shall be flange lock nut bolted to each roof panel joint.
- 2.14 Stringers shall be attached to lateral anti-racking bracing and shall be used for suspending the silencer.
- 2.15 Lateral anti racking beams shall be manufactured from 7 gauge ASTM A569 and shall have a minimum depth of 10".
- 2.16 Panels shall be full mating face continuously bonded at assembly, following finish coating, using an IC Polyurethane 260 psi tensile strength, (ASTM D 412). Sealant shall have a 12.5% movement accommodation factor, and a continuous temperature service rating of -400 F to + 1950 F (-400 + 900 C). Sealant 1 Hour rating shall be 2850 F.
- 2.17 Access doors shall be suitably braced to prevent excessive torque twisting for both resistance to fatigue stress and maintenance of door seal integrity.
- 2.18 Lifting points to lift enclosure complete with exhaust silencer or other installed on enclosure equipment shall be provided.
- 2.19 Where the enclosure is to be mounted on a supporting e.g. skid or tank, max deflection when supported at C of G (one pivot point per side) of the supporting fabrication shall be 0.016 inch/ft, or 0.600" total deflection along the length if longer than 30 feet.

- 2.20 1.5g rated lifting facilities of the supporting structure shall be designed to lift the completed package total weight and shall incorporate a total of 8 lifting eyes for proportional share of total load. The 8 lifting eyes shall be arranged in 4 pairs, 2 mirrored pairs each side. The lifting eyes comprising a pair shall nominally be 60 inches apart. The centre of each pair shall be a minimum of 120 inches from the package C of G.
- 2.21 Lifting eyes shall be suitable for appropriately rated readily available shackles with a close fitting shackle pin.
- 2.22 Enclosure width shall not exceed 119". Supporting structure-lifting eyes, hardware and similar protrusions can extend beyond 119' bearing in mind these extensions should be minimized to avoid disproportionate increase in transport cost.
- 2.23 Enclosure height shall likewise be minimized.

### 3.0 Acoustic Performance and Attenuation Construction Methods

#### Definition of acoustic performance

Specified noise requirement is based upon average noise level in free field conditions when running at 75% load. Average noise level is defined as: The sum of the all measurements divided by the number of measurements as described herein in db(A), (using 1/1 Octave band Hz spectrum). Measurements: All at 48 inches above ground measured at 39 inches (1 Mtr) away from the enclosure outer surfaces; 2 positions (1/3rd and 2/3rd along the length from one end) each side plus one at the center of each end plus 1 48 inches above the enclosure roof , 39 inches away from the edge of the exhaust tailpipe.

Note - Extrapolation calculations for distances greater than 1 mtr from noise source shall use "Plane Source" log.

- 3.1.1 Construction. Noise levels @ or > 90db(A)@1mtr. YES Air path system 2 - Vertical Intake and discharge hoods (no noise specification i.e. weather protective enclosures; delete foam).**
- 3.1.2 1-1/2 inches of sound absorbing black surfaced foam attached to inside of panels/ doors.
- 3.1.3 Foam shall be attached using galvanized glue nails on approx 18 inches ctr's and adhesive bond between foam and pre-coated steel.
- 3.1.4 Foam shall be neatly cut and edges taken into return flanges to inside panel edge. Coverage of internal panel surface area shall be >95%.
- 3.1.5 Exposed foam edges to be covered with black anodized aluminum trim work.
- 3.1.6 Foam shall be a minimum of 6 inches from exhaust silencer.
- 3.1.7 Foam in the air discharge duct to be fitted with glue nails on 12 inch ctr's.
- 3.1.8 Interlocking panel joints to be riveted.
  
- 3.2.1 Construction. Noise Levels @ or > 85 db(A)@ 1mtr but < 90db(A)@1mtr. YES Air path System 2 (per above).**
- 3.2.2 2 inches of Rockwool 6lb/ft<sup>3</sup> in all panels. Coverage 100%.
- 3.2.3 Rockwool to be faced using galvanized perforated sheet. Coverage 100%.
- 3.2.4 Perforated sheet shall be neatly cut with no unsafe exposed edges.

3.2.5 Perforated sheet shall be riveted to interlocking panel joints.

**3.3.1 Construction. Noise Levels < 85db(A) down to 75db(A) @ 1 mtr. YES Air path System 3 - Horizontal or Vertical attenuators, at inlet and outlet as space permits.**

3.3.2 Attenuator splitter length to suit required noise level (approx 4 feet).

3.3.3 Attenuator splitters to have approx 50% free area.

3.3.4 Splitter width to be equal to airspace between splitters.

3.3.5 Splitters constructed from 16 gauge, ASTM 653 galvanized formed tray with 16 gauge galvanized perforated sheet in filled with 8lb/ft<sup>3</sup> Rockwool. (Left unpainted).

3.3.6 Enclosure panel depth shall be 3".

3.3.7 3 inches of Rockwool 8lb/ft<sup>3</sup> in all panels. Coverage 100%.

3.3.8 Rockwool to be faced using galvanized perforated sheet. Coverage 100%.

3.3.9 Perforated sheet shall be neatly cut with no unsafe exposed edges.

3.3.10 Perforated sheet shall be riveted to interlocking panel joints.

**3.4.1 Construction. Noise Levels < 75db(A) down to 65db(A) @ 1 mtr. YES Air Path System 4 - Horizontal or Vertical attenuators, at inlet and outlet as space permits.**

3.4.2 Attenuator splitter length to suit required noise level (approx 6 feet).

3.4.3 Attenuator splitters to have approx 50% free area.

3.4.4 Splitter width to be equal to airspace between splitters.

3.4.5 Splitters constructed from 16 gauge, ASTM 653 galvanized formed tray with 16 gauge galvanized perforated sheet in filled with 8lb/ft<sup>3</sup> Rockwool. (Left unpainted).

3.4.6 Enclosure panel depth shall be 4".

3.4.7 4 inches of Rockwool 8lb/ft<sup>3</sup> in all panels to incorporate a flexible dampening membrane. Coverage 100%.

3.4.8 Rockwool to be faced using galvanized perforated sheet. Coverage 100%.

3.4.9 Perforated sheet shall be neatly cut with no unsafe exposed edges.

3.4.10 Perforated sheet shall be riveted to interlocking panel joints.

**4.0 Ventilation / temp rise from ambient to radiator core. Exhaust Connection.**

4.1 4.1 (Typ) Heat rejection (kWt) from the internally mounted exhaust silencer shall not exceed 0.01% of generator kW<sub>e</sub> electrical output. Exhaust silencer shall be internally insulated to achieve above.

4.2 Double element stainless steel low spring rate exhaust flex shall be used to connect engine to the silencer.

4.3 Internally positioned connecting pipe-work / flex bellows to and from the silencer shall be lagged with exhaust blankets.

4.4 Irrespective of 4.1, design shall be based upon a max temp rise of 15 deg F above ambient to radiator core, (assuming radiator airflow is sufficient to achieve this delta T with heat inherent heat rejection from the generating set).

- 4.5 (Typ) Static pressure within the enclosure shall not exceed 0.5"WC.
- 4.6 Irrespective of 4.5 total static pressure shall not exceed fan capability of radiator fan (Typ 0.75")
- 4.7 Care should be taken on high air volume applications (Typ 2 mWe and above) to ensure that cross sectional area of the enclosure is not overly occupied thereby adversely increasing velocity pressure.
- 4.8 Note in view of 4.7 unless special attention proves otherwise (e.g. additional fan capability above 0.75") items such as switchgear cabinets should not be installed in an enclosure having a max width of 10'.
- 4.9 The radiator shall be connected to the enclosure using a flexible duct of sufficient temperature and pressure rating. No recirculation of air is permitted.
- 4.10 In exceptionally cold climates (<350F) motorized intake louvers (120 Vac energized to close/ failsafe open) and lightweight gravity flap louvers shall be installed to retain heat.

## 5.0 Corrosion Protection

- 5.1 Panels that are exposed to wet areas such as the discharge duct shall incorporate drain holes.
- 5.2 All panel surfaces shall powder coated at a minimum DFT of 2 Mils.
- 5.3 Powdercoat shall be standard polyester with a gloss rating of 50% loss between 12 and 24 months of south Florida weathering.
- 5.4 Enclosure must be bonded to generator ground potential.
- 5.5 Installer must inspect surface coating on completion of start up and make coating repairs per enclosure maintenance document to be supplied by YPP.
- 5.6 Supporting fabrication to be prepared and painted in a suitable for application wet paint treatment.
- 5.7 Any enclosure penetrations shall be sealed using bonding material as specified in 2.0.
- 5.8 See comments ref space heating in 7.1.

## 6.0 Access and hardware

- 6.1 Walk-in Enclosures. 24 inches of access shall be maintained to the key areas e.g. side of engine, controls and or electrical distribution. 36 inches of clearance shall be provided from the front of any control panel or distribution board, per NFPA 70.
- 6.2 Walkways shall be furnished with diamond plate with kick plates where appropriate if a supporting fabrication is involved.
- 6.3 Skin Tight Enclosures. Access doors shall be provided / positioned such that routine maintenance activities may be carried out and that access to control or electrical distribution shall meet NFPA 70 with doors in the open position.
- 6.4 All door access shall be provided for adequate access. Minimum of 2 doors, 1 each side plus that needed for special equipment access.

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- 6.5 Walk-in enclosure hardware. Hinges and padlockable handles to be of "Kason" or equivalent, refrigeration door gear type. Doors shall be slam shut. Doors that can be opened from the inside shall be fitted with luminescent slam open release that will function from inside if locked on the outside.
- 6.6 Skin Tight enclosure hardware. Powdercoated hinges appropriate to door weight shall be used. Doors locks shall be of the stainless steel recessed type.
- 6.7 One half of double doors shall utilize a two point latch mechanism.
- 6.8 Doors seals. See Section 1.0.