



# GENERATING SET INSTALLATION GUIDE

4016 Quartz Drive  
Santa Rosa, CA 95405  
Phone: 707 539-9003  
Fax: 707 539-5212  
Email: sales@generatorjoe.NET  
Web www.generatorjoe.NET

## GeneratorJoe

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# A - UNLOADING AND HANDLING

## I - UNLOADING

### A - UNLOADING SAFETY

In order to remove the generating sets from their transport with optimum safety and efficiency, you must ensure that :

- The hoisting devices are appropriate for the required tasks.
- The slings are correctly positioned in the lifting lugs provided or the fork lift arms are positioned centrally under the frame.
- The ground is able to withstand the weight of the generating set and its hoisting device (if not, sturdy planks must be laid).
- The set is lowered as close as possible to its service or transport position in an open and easily accessible area.

### B - EXAMPLES OF EQUIPMENT

- Crane, slings, spreader, lifting hook and shackles.
- Lift truck.

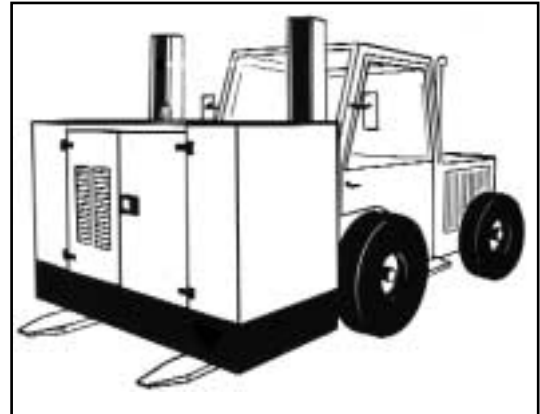
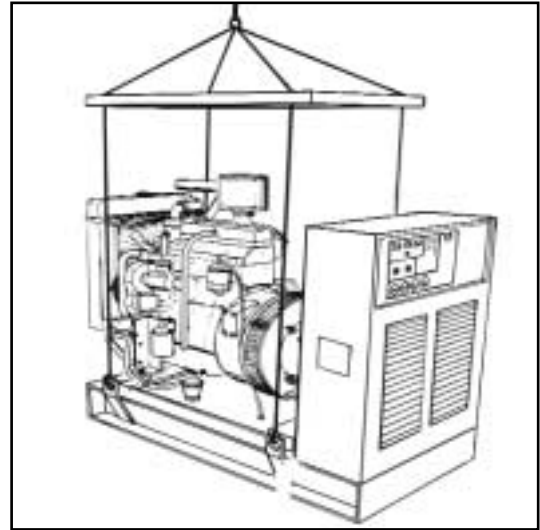
### C - UNLOADING INSTRUCTIONS

#### 1 - Slinging

- Attach the hoisting device slings to the generating set lifting lugs designed for this operation.
- Slowly tighten the slings.
- Make sure the slings are evenly attached and strong enough.
- Slowly hoist the generating set.
- Move the set to the chosen site and place in position.
- Bring it down slowly while maintaining it in the right position.
- Loosen the slings, unhook and remove the shackles.
- Use at least 2 people.

#### 2 - Lift truck

- Position the arms of the lift truck under the frame, making sure only the mainframe is resting on the arms.
- Lift and handle the equipment slowly.
- Set down the generating set in its final position.
- Use at least 2 people, one of whom is the lift truck operator.



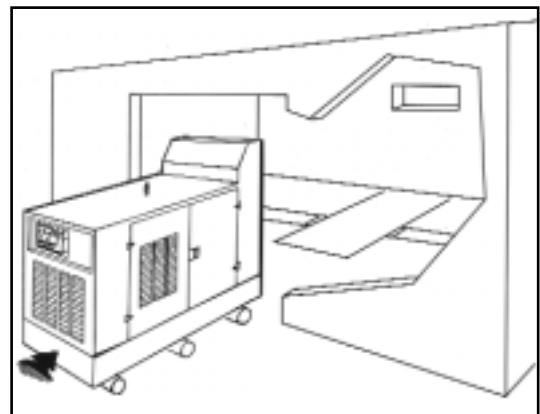
## II - HANDLING

### A - HANDLING INSTRUCTIONS

- Chock the generating set at the alternator end.  
Slightly lift the generating set at the engine end with two jacks and slide two tubes under the frame.
- Let the frame rest on the tubes and move the generating set into the room by pushing it manually or pulling it with a winch or pulley system attached to the bedframe.
  - As the generating set moves along, take the free tubes and slip them back under the frame.
  - When it gets to its final location, position the generating set, chock and jack it up.
  - Remove the tubes and lower the generating set ensuring it remains in the correct position and remove the jacks.

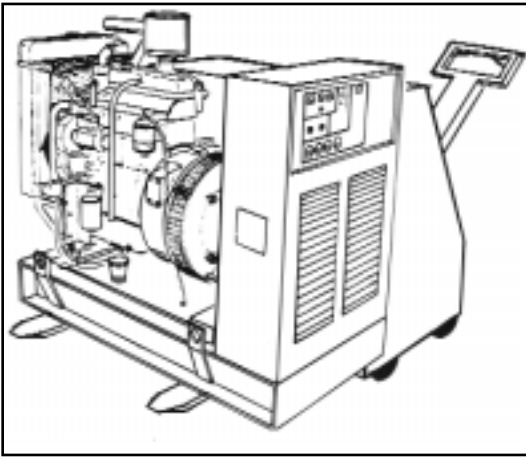
### B - EXAMPLES OF EQUIPMENT

- 2 jacks, three 60 mm thick walled tubes, the same width as the frame and 1 winch or pulley system.
- Manpower : at least 2.

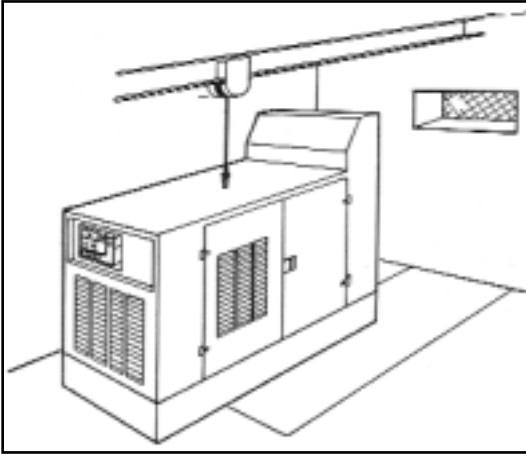


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- If ground is uneven or the hauling distance too far, use a lift truck with arms longer than the frame width.
- Manpower : at least 2, one of whom is a lift truck operator.



- Once you are in the engine room you have the use of a crane rail and a travelling block, follow the instructions in Section 1-C-1.

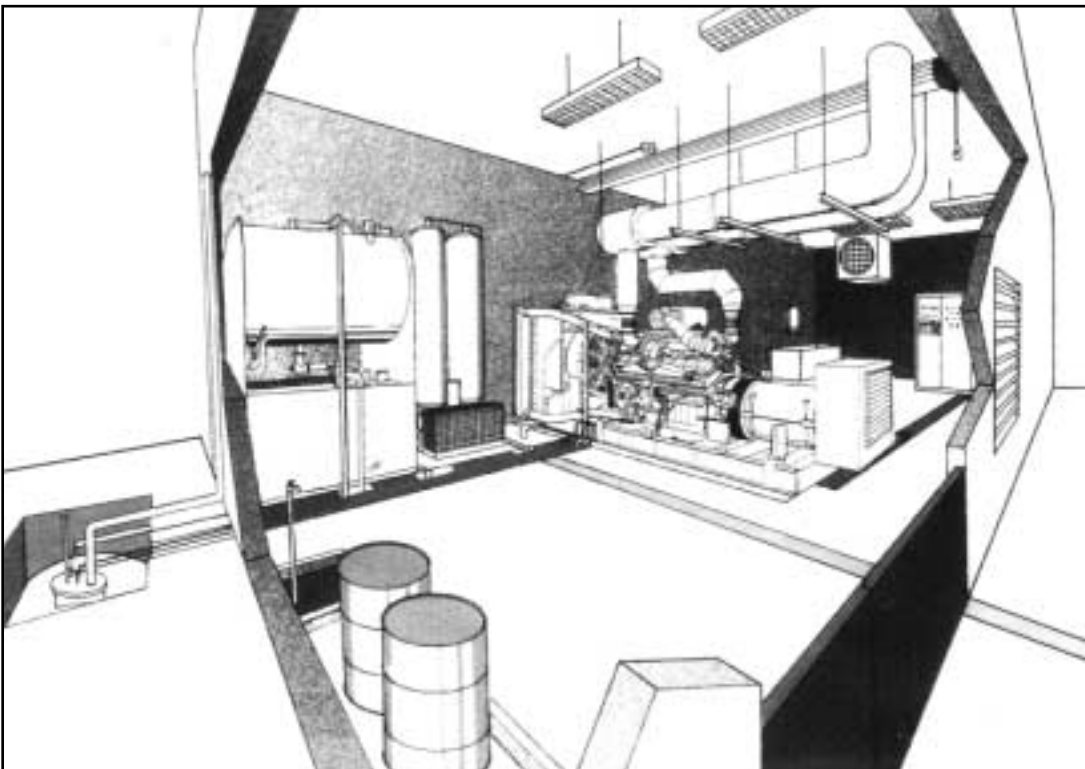
## B - INSTALLING PERMANENT GENERATING SETS

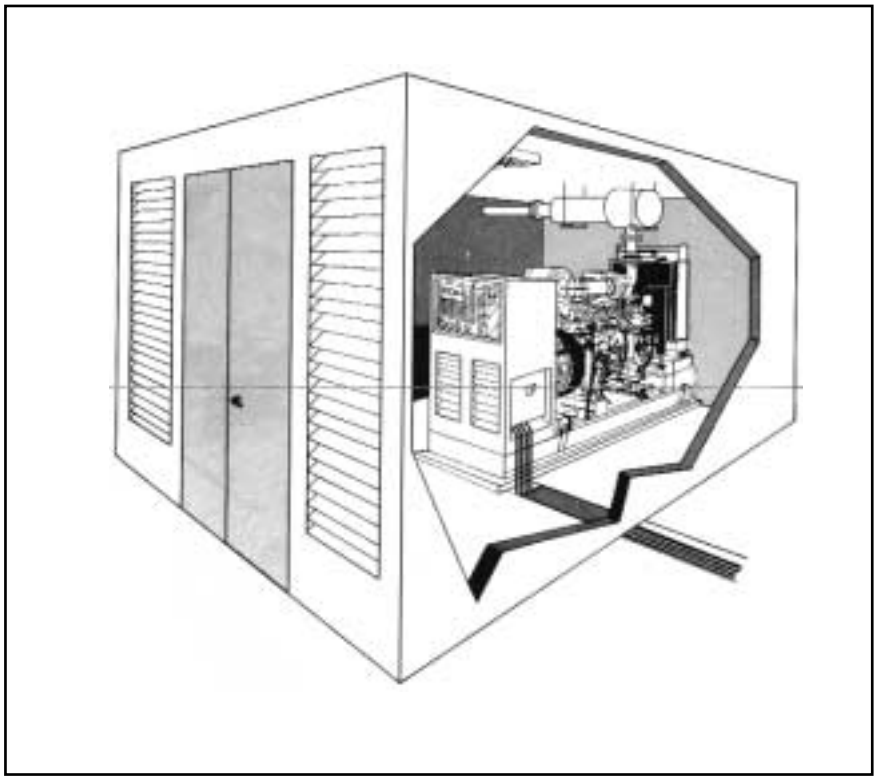
### PREPARATION :

The installation of a generating set must follow certain rules, which must be strictly adhered to in order to get equipment to operate properly.

The whole equipment is liable to sustain damage and abnormal wear if these basic principles are not followed.

This manual lists the main installation requirements for a "conventional" generating set built with an I.C. engine, a generator and a control panel. In case of special applications our Technical Department will advise you and study your specific needs. The regulations provisions and laws in effect on the installation premises should also be complied with.





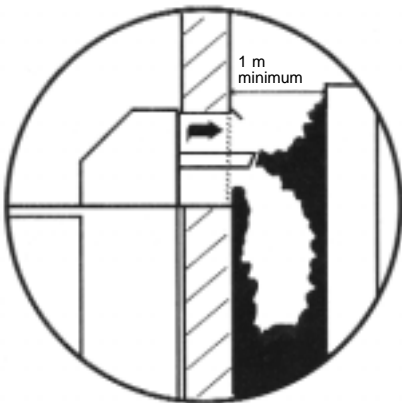
# I - SITE

## A - LOCATION

It should be decided by the application. There are no special rules in selecting the location, other than the proximity of the control panel and the noise reduction. Nevertheless, fuel supply, correct ventilation of the site, exhaust gas, direction of radiator hot air and noise must be taken into account.

Do not wait until the last moment to plan the installation of the generating set. It should not be forgotten that a generating set may be the most important piece of machinery designed to back up faulty mains supply and to ensure the continuing operation of the vital functions of a company, factory or hospital.

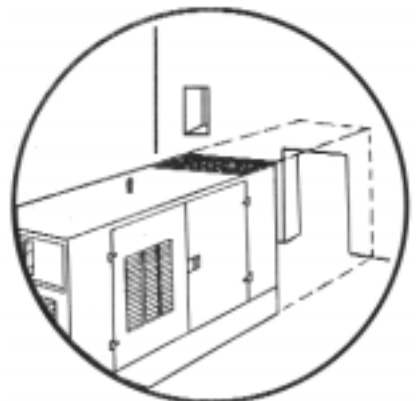
The choice of positioning should be based on a well planned site.



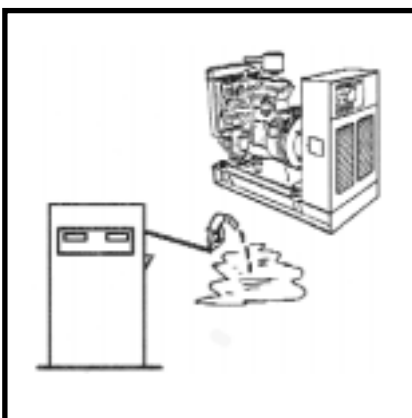
Incorrect exhaust and ventilation



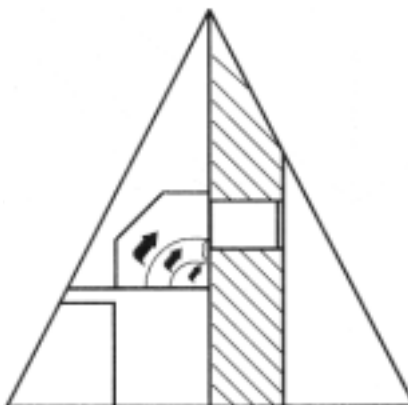
Incorrect base



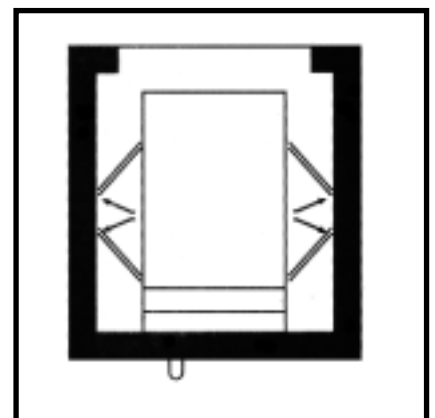
Undersized access



Fuel refill impossible



Incorrect ventilation and exhaust openings



Door opening, maintenance and repair are impossible

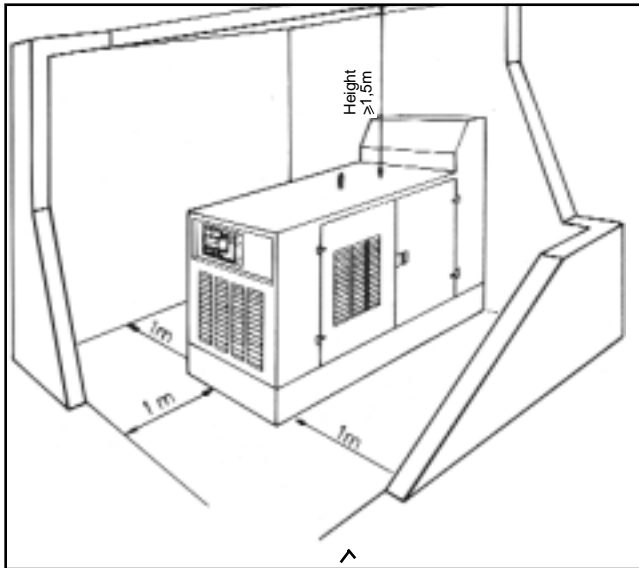
## B - DIMENSIONS AND LAYOUT

Depends on two types of requirements :

### 1 - Static

These requirements relate to the size of the equipment installed with its peripherals, namely : daily tank, control panel, exhaust muffler, batteries, etc.

**CAUTION : PLEASE CONTACT OUR DESIGN OFFICE FOR CERTIFIED DIMENSIONS.**



### 2 - Dynamic

These requirements relate to the space around each set to allow for maintenance and possible removal.

A 1 m clearance around the generating set must be considered as the minimum requirement for problem free maintenance. Make sure the doors of the canopy can be opened completely, the equipment is easily accessible for maintenance and the generating set can be removed from the room.

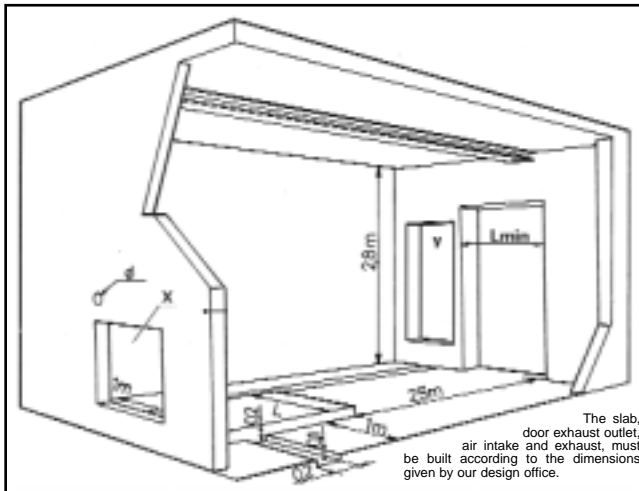
### 3 - Building

Various room layouts can be considered for housing the generating set.

- If sound level and start up speed are not important the set can be installed under a simple shelter to protect it from the weather (snow, rain, thunder, etc.).

- If a lower sound lever and a rapid start up is essentiel (e.g. emergency set or noise sensitive area) special care should be taken to build the room with at least 20 cm cast concrete, covered with absorbent fireproof insulating material such as rockwool.

**NOTE : Fire resistance must comply with the legislation related to the type of building used.**



### 4 - Generating set foundation

A generating set in operation produces a certain amount of vibration which makes its way towards the concrete slab, via the frame. Our generating sets are supported on inbuilt rubber mounts and not normally require a special slab. The slab should be level and smooth after casting and isolated from the building. Sample size of a generating set room for a set without a canopy. The slab, door exhaust outlet, air intake and exhaust, must be built according to the dimensions given by our design office.

### 5 - Openings

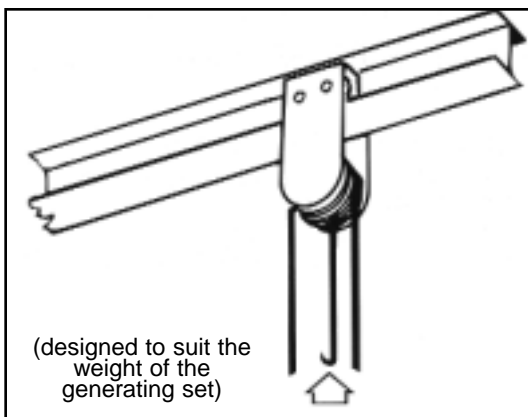
A generating set room must have a number of openings essential for its operation.

5.1 - A door in line with the generating sety plinth to move the generating set and accessories in and out.

5.2 - Ventilation openings (fresh air inlet, warm air outlet) sited so that the air blows in the Alternator → Engine direction. The size general weather conditions, selected cooling system and possible soundproofing system.

depends on the power of the generating set to be installed,

5.3 - Exhaust pipe, fuel lines and electric cables.



### 6 - Hoisting

Normally the hoisting equipment should be part of the building and should comprise a moving block on an I beam rail sealed into the walls and ceiling. This will make handling easier and is usually installed above, along the axis of the set, towards the door.

## 7 - Soundproofing

The best quality / price ratio is achieved when soundproofing is part of the initial design of the room. On the other hand if soundproofing is added to an existing room, it will inevitably be more expensive and not as good. Two techniques should be used to soundproof the genset room.

### 7.1 - Insulation

Its purpose is to prevent sound travelling through the walls by providing mass and adequate thickness.

### 7.2 - Absorption

Sound energy is absorbed by specialist materials and reduces reverberation. For a soundproofed room the openings have to be larger and carefully designed to provide adequate ventilation without allowing excessive noise to pass through the openings. A properly designed soundproofed door is also needed.

#### General

- Building structure: cast concrete or concrete blocks, min. 20 cm thick.
- Anti-vibration mounts under the generating set, when installed close to sensitive areas.
- Walls and ceiling may be lined with absorbent materials such as rockwool.
- Selection of one or more suitable exhaust mufflers.
- When required soundproof doors should be fitted to reach the required sound level.
- Noise attenuators mounted in the air inlet and outlet openings.

#### EXAMPLES : Measures to be taken.

- Basic noise level of genset : 105 to 111 ODBA 1m.

\*Non sensitive areas

Generating set soundproofing by means of a canopy bringing the noise down to 85dBA at 1 m (useful for low and medium powered sets), or Room soundproofing : noise attenuator on air inlet, about 1m long, soundproofed access door, 30dB exhaust muffler. Outside noise level : 75dBA about 1m.

\* Noise sensitive areas (in town, close to houses)

Noise reduction depends on the distance between the noise source and the sensitive areas 6dB on average every time you double the distance : 1m (0); 2m (-3dB); 4m (-12dB); 8m (-18dB).

This calculation done, the following elements must be specified :

#### - From 60 to 70dBA at about 1m

- walls and ceiling made of 20 cm concrete blocks or cast concrete,
- noise attenuators about 1.80 m long,
- high efficiency soundproof door,
- 40 and 19dB mufflers in series

#### - From 40 to 60dBA at about 1m

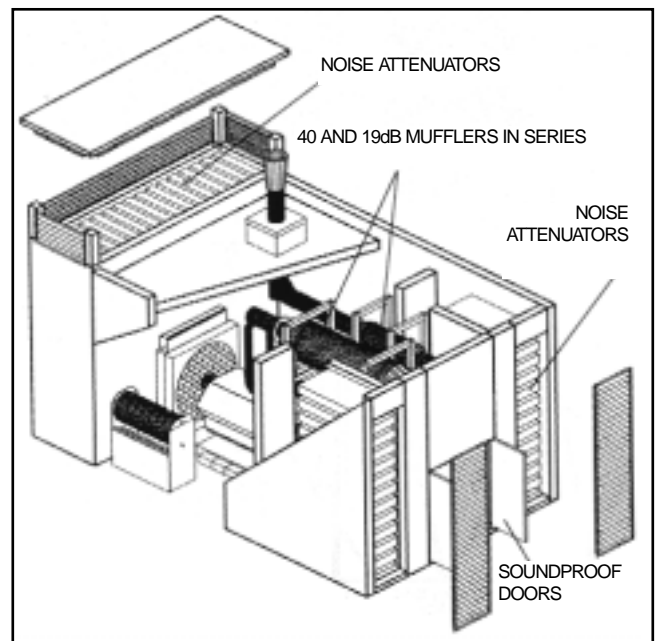
noise attenuators (about 2.50 m) with baffles in ventilation shafts if possible.

- inside walls and ceiling lined with absorbent material.
- soundproof door and airlock.
- floating slab beneath the generating set (vibration).
- 40 and 30dB mufflers in series. Sometimes 40dB and 19dB mufflers are sufficient.

or generating set soundproofed by means of a canopy, in which case, the sound traps are smaller and the airlock unnecessary. When lower noise levels are required a special study must be carried out.

#### SOUND LEVEL REGULATIONS

Please refer to appropriate regulations in your area.

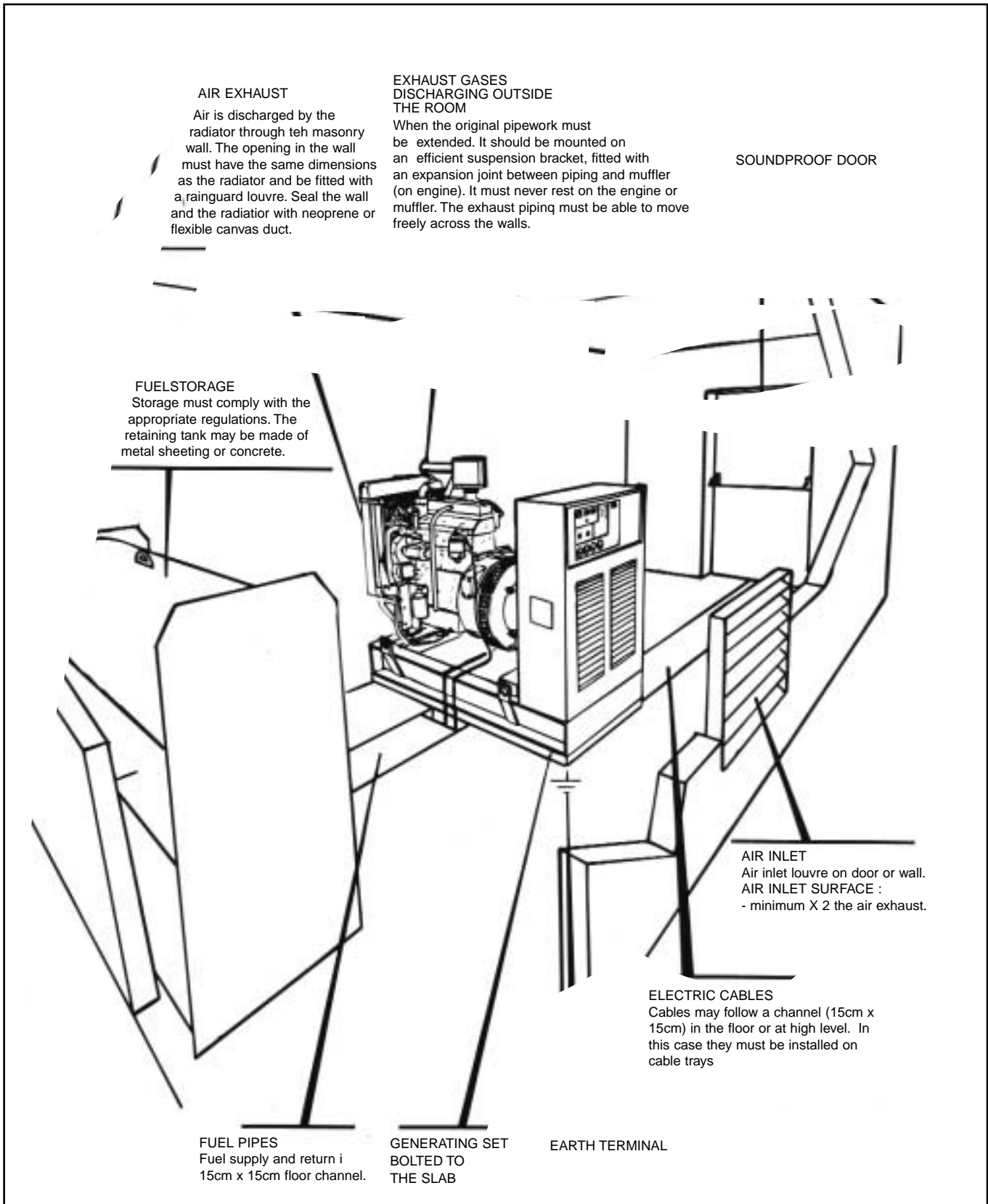


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# II - EXAMPLE OF GENERATING SET INSTALLATION

## A - EXAMPLE OF INSTALLATION (indoor fuel tank and control panel)



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**B - EXAMPLE OF INSTALLATION (control panel, muffler and Tank under canopy. Soundproof type room and underground fuel storage tank).**

**AIR EXHAUST**

Hot air from the generating set is discharged from the room through a hot air duct (optional) fitted in an opening in the wall the same size as the duct. The hot air discharge opening is protected from any obstruction, penetration or infiltration of foreign elements by a metal louvre.

Use a neoprene foam to seal the hot air discharge duct in the wall. The exhaust pipe is fitted in the hot air discharge duct. Hot air from the radiator passes through the canopy roof.

SOUNOPROOF DOOR

AIR INLET  
Air inlet louvre on door or Wall.

AIR INLET SURFACE  
- minimum x 2 the exhaust air area.

ELECTRIC CABLES  
Cables may follow a channel (15cm x 15 cm) or a high level path in this case they must be installed on cable trays.

GENERATING SET BOLTED TO THE SLAB

EARTH TERMINAL

**EXHAUST GASES DISCHARGE OUTSIDE THE ROOM**

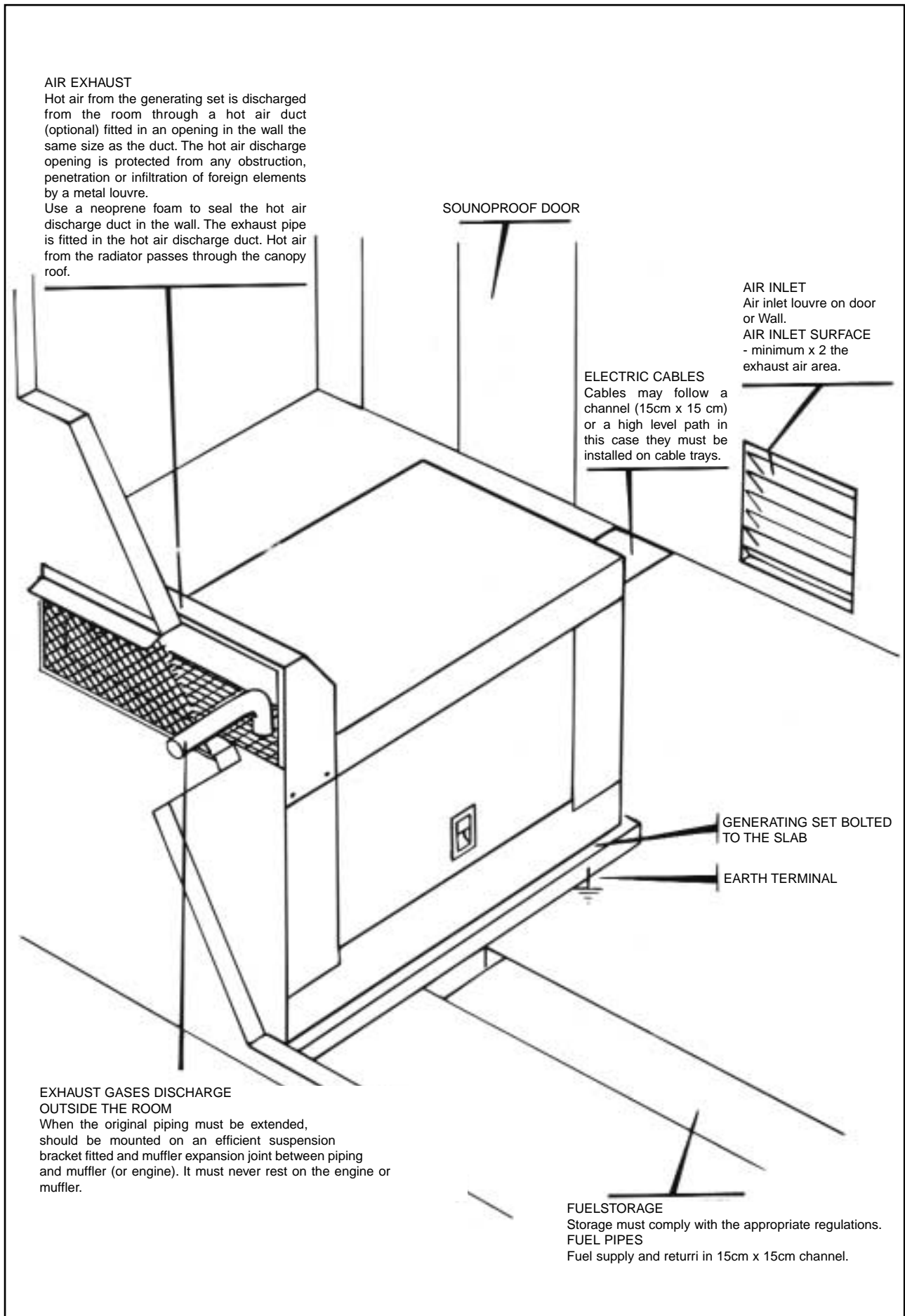
When the original piping must be extended, should be mounted on an efficient suspension bracket fitted and muffler expansion joint between piping and muffler (or engine). It must never rest on the engine or muffler.

**FUELSTORAGE**

Storage must comply with the appropriate regulations.

**FUEL PIPES**

Fuel supply and return in 15cm x 15cm channel.



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# III - VENTILATION

An I.C. engine generates considerable heat which must be discharged from the room to ensure operation. Heat is released from a number of sources :

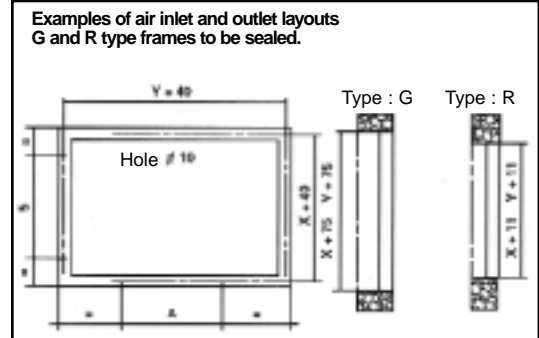
- radiator cooling,
- engine, exhaust pipework and radiator,
- alternator cooling.

If its necessary to fit the room with air inlets and outlets specifically designed for the cooling system and local operating conditions. Insufficient ventilation will cause an increase in room temperature, which will lead to an engine power loss or the set stopping (in some cases auxiliary fans will be required). The cooling air should sweep the generating set room in the direction Alternator→Engine→Radiator. This not only allows for the discharge of the heat produced by the generating set, but also supplies the fresh air required for combustion. The openings will have to be large. The air inlet and outlet should be as direct as possible. The cooling system should be tightly connected to a ventilation shaft or the outlet duct to avoid hot air recirculating.

Air inlet and outlet must never be located close to each other.

**The air inlet and outlet layout should be approved by our design Office**

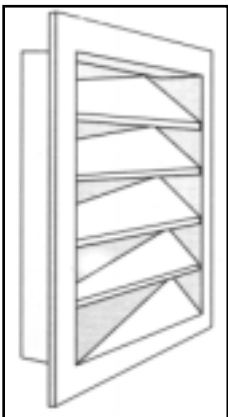
- For G type frames
- minimum reserve is X + 75 and Y + 75
  - inner path is X + 5 and L + 5
- For R type frames
- minimum reserve is H + 11 and Y + 11
  - inner path is X + 5 and Y + 5



Frame size	Dim X	345	445	510	610	675	775	840	940	1005	1105	1170
	Dim C	2 x 165	2 x 165	3 x 165	3 x 165	4 x 165	4 x 165	5 x 165	5 x 165	6 x 165	6 x 165	7 x 165
GR Height		1070	1070	1070	1070	1070	1070	1070	1070	1070	1070	1070
Frame size	Dim Y	400	500	600	700	800	900	1000	1100	1200		
	Dim A	2 x 165	2 x 165	2 x 165	2 x 165	4 x 165	4 x 165	4 x 165	6 x 165	6 x 165		
GR lenght		1070	1070	1070	1070	1070	1070	1070	1070	1070		

**Air inlet and outlet rainguard Louvre (G and R type)**

The following table indicates the pressure loss through the Louvre (in dPa). The air velocity (in m/s) refers to the rated section (H X L).



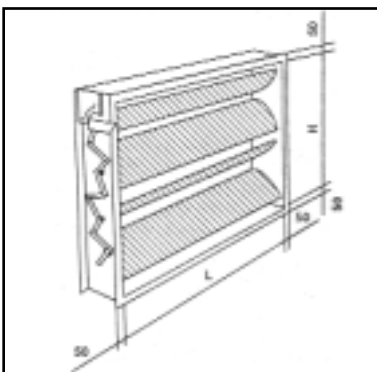
Pressure losses related to H x L

Air velocity	1	1.5	2	2.5	3	3.5	4	4.5	5
Pressure loss for use air inlet	0.3	0.7	1.2	1.9	2.7	3.7	4.8	6.1	7.5
Pressure loss for use as air	0.35	0.9	1.5	2.3	3.3	4.5	5.8	7.4	9

**GR Dimension (in mm)**

**Heigh (H) :** 245 - 345 - 410 - 510 - 575 - 675 - 740 - 840 - 905 - 1005 - 1070 - 1170 - 1235 - 1335 - 1400 - 1500 - 1565 - 1665 - 1730 - 1830 - 1895 - 1995  
**Width (L) :** 400 à 2000 de 100 en 100 mm  
**Thickness :** 90 mm.

CDO Dimensions



**Dimensions**  
**Frames in mm**  
**Height (H) :** 345 - 510 - 675 - 1005 - 1170  
 1335 - 1500 - 1500 - 1665 - 1995

**Width (W) :**  
 300 a 2000 de 100 em 100 mm

**Depth :** 185 mm  
 Drive shaft Ø 12  
 with 8 mm width flat section  
 Louvres : 175 deep ; 165 between centers  
 Frame : 2 mm tick



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## IV - FUEL

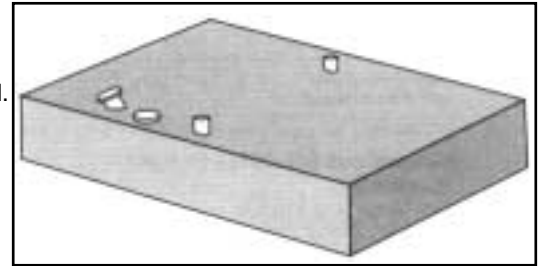
Diesel fuel is classified as a "Dangerous product" and storage and distribution are subject to a number of rules and regulations. Please refer to the local legislation.

On permanent installations it is usual to fit a day tank and a main storage tank. These two tanks can be combined into one if the fuel requirements of the generating set are low.

### A - TANK WITH MANUAL FILLING

This is convenient for a manual start generating set which is visually checked. Often part of the generating set assembly this tank is fitted either with a dipstick or fuel level gauge, a filler, breather and drainage outlet.

**The required tank capacity may be calculated on the basis of an estimated consumption of 0.2 litres/kW/hour.**



### B - TANK WITH AUTOMATIC FILLING LOCATED INSIDE THE ROOM

This is recommended for automatic start generating sets. The tank is refilled automatically by an electric pump from the main storage tank.

This type of equipment is subject to regulations. It must be equipped with a fuel tank bund having the same capacity as the tank for collecting any fuel leakage. A waste pipe returning to the main tank must be installed, with a section of at least twice the fuel supply pipe (supply  $\varnothing$  20/27 mm, return  $\varnothing$  33/42 mm typically).

The tank is mounted slightly higher than the diesel engine crankshaft (except in covered parking areas) in order to keep the pump primed.

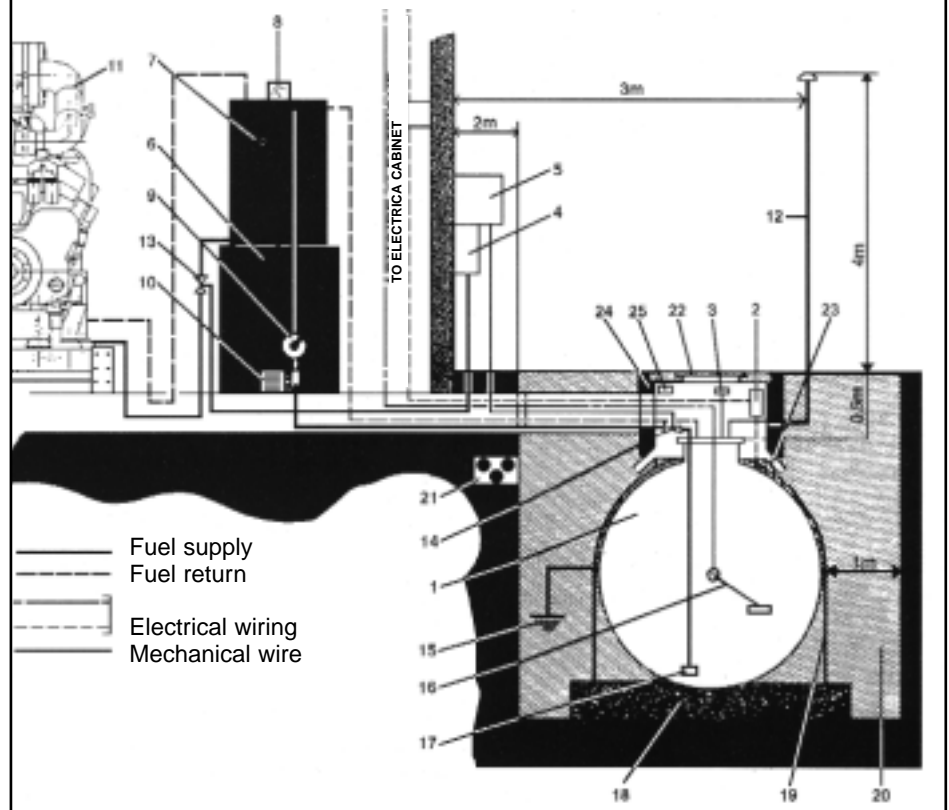
This tank must be fitted with a fire valve controlled from outside the room.

For safety purposes the supply and should run smoothly from the main tank to the daily tank so that no airlocks exist which would slow down supply to the daily tank. If the storage tank is located higher than the daily tank a safety valve and an anti-syphon device must be installed on the pipeline with the daily tank.

The tank should not be at a level higher than 1m above the diesel engine crankshaft. If the tank is located at a lower level than the engine the suction head should not exceed 1 metre.

Fig. 5 : Main fuel tank, daily service tank and sedimentation tank

- |                                      |  |
|--------------------------------------|--|
| 1 - Double wall main fuel tank       | 14 - Fire fighter fuel valve           |
| 2 - Leakage sensor cell              | 15 - Earth point                       |
| 3 - Refill opening                   | 16 - Electric fuel level gauge sender  |
| 4 - Police fuel shut off point       | 17 - Foot valve and screen             |
| 5 - Fire fighter fuel shut off point | 18 - Concrete base                     |
| 6 - 600 litre sedimentation tank     | 19 - Anchoring bolts                   |
| 7 - 500 litre daily service tank     | 20 - Excavation                        |
| 8 - Gauge with level contactor       | 21 - Pipe duct                         |
| 9 - Manual pump                      | 22 - Inspection plate                  |
| 10 - Electric pump                   | 23 - Drains                            |
| 11 - Generating set                  | 24 - Minimum diameter 0,7 x 0,7 metres |
| 12 - Air vent                        | 25 - Type and capacity label           |
| 13 - Police fuel valve               |  |



## V - EXHAUST GAS

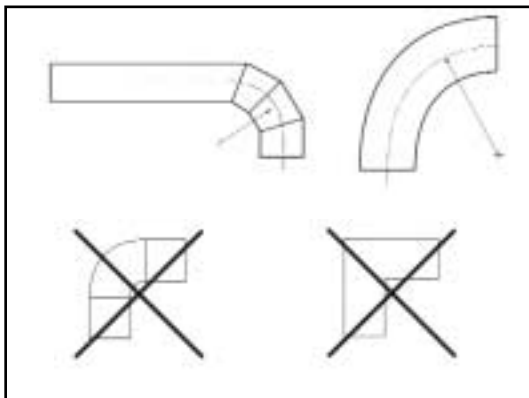
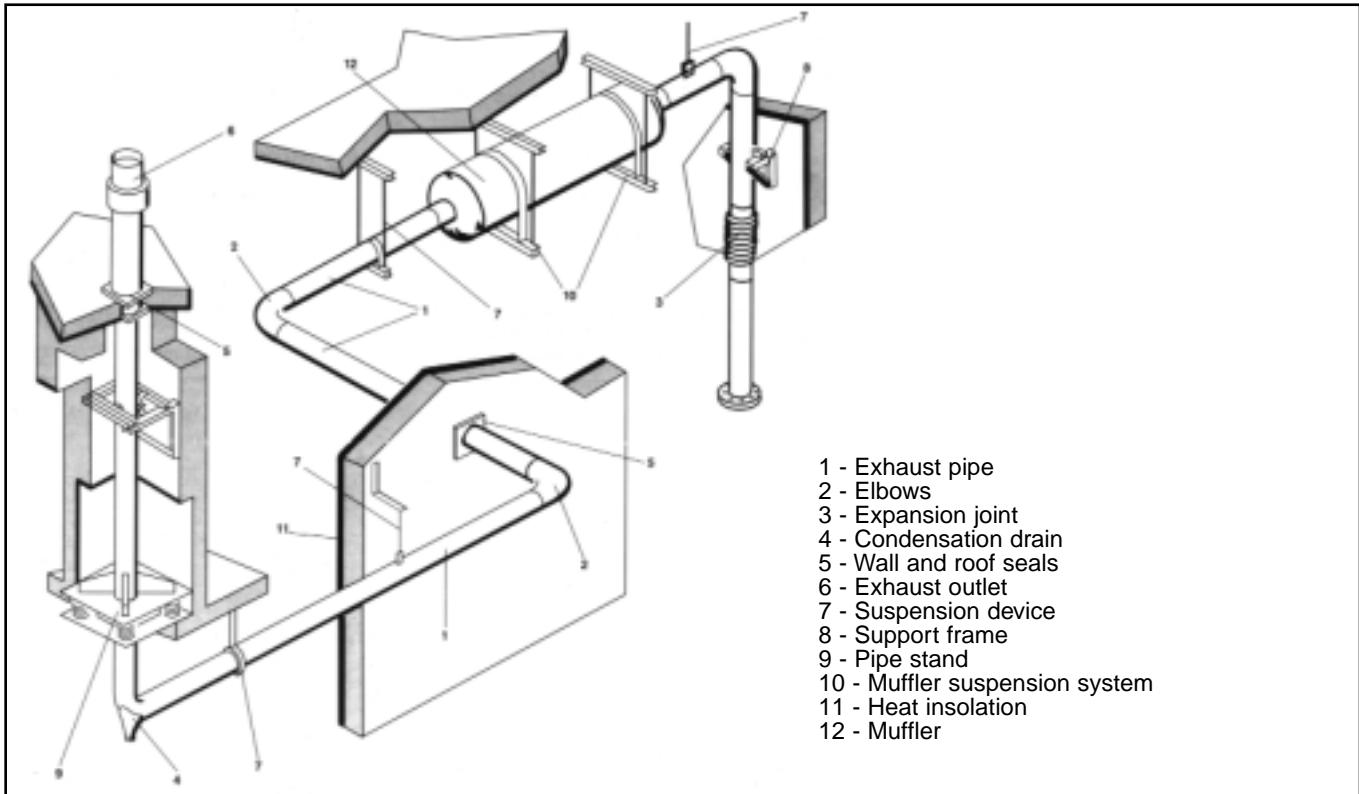
### A - GENERAL

The design of the exhaust pipe from the generating set is a serious matter and should be calculated carefully. If you need assistance please consult us.

A number of constraints must be taken into account such as pressure loss, insulation, suspension, noise level and air pollution. Please note that the more bends the higher the pressure loss, therefore a larger diameter pipe should be used. diâmetro será importante, por isso pesado e os seus suportes e silenciadores dispendiosos.

**NOTE : Generating sets equipped with built in mufflers must be fitted with an exhaust expansion joint. This expansion joint or flexible exhaust should be mounted on the canopy exhaust outlet.**

## B - MAIN COMPONENTS



## C - PIPING

### - Item 1 : Pipe

We recommend using unwelded pipe: for weight reasons, however, rolled sheet piping may be convenient (helicoval from Vallourec or Cofratol). In any case, welding seams must be avoided inside the conduit ( $\Delta p$  increase).

### - Item 2 : Elbows

Elbows must have a minimum bend radius of  $6-8 \times D$ , in one element if possible. If the elbow is made of welded sheet, make sure it comprises 2 to 4 sections for a  $90^\circ$  elbow.

### - Item 3 : Expansion and flexible exhaust

- Flexible exhaust : allows for sideways deflection, but little longitudinal movement.
- Expansion exhaust : absorbs mainly longitudinal movement due to expansion.

Reminder : the following table gives the expansion in mm per metre as an exhaust when it is heated.

- For stainless steel multiply by 1.5

This component must not support exhaust pipe weight; make sure it is in perfect alignment to prevent breakage.



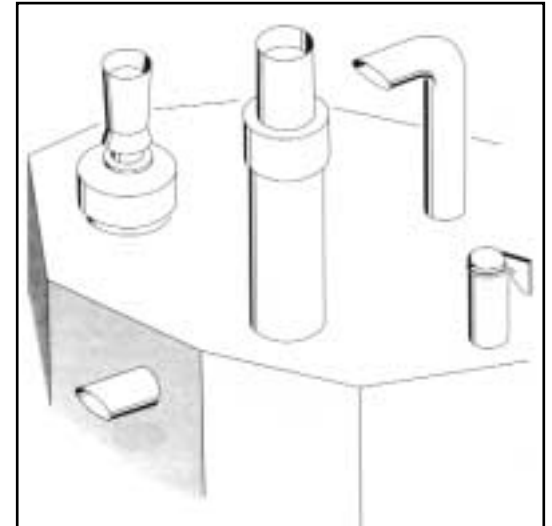
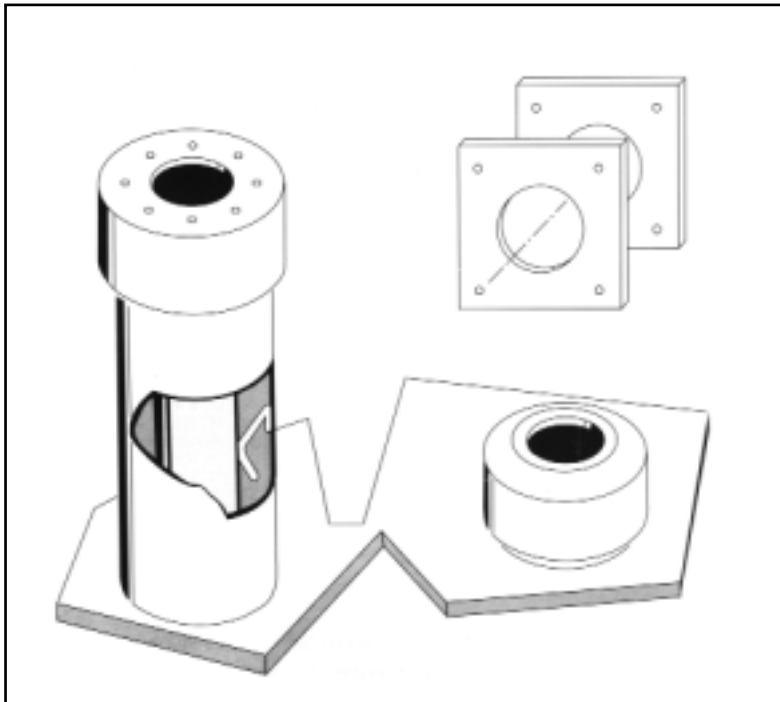
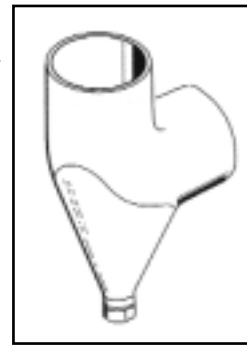
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°
0°	0,00	0,06	0,12	0,18	0,24	0,31	0,37	0,43	0,49	0,55	0,61	0,68	0,74	0,81	0,87	0,93	0,99	1,06	1,12	1,19
100°	1,25	1,32	1,38	1,45	1,52	1,59	1,65	1,72	1,78	1,85	1,92	1,99	2,06	2,13	2,19	2,26	2,33	2,40	2,47	2,54
200°	2,61	2,65	2,75	2,83	2,90	2,97	3,04	3,12	3,19	3,26	3,33	3,41	3,48	3,56	3,63	3,71	3,78	3,86	3,93	4,01
300°	4,08	4,16	4,23	4,31	4,38	4,46	4,54	4,62	4,69	4,77	4,85	4,93	5,01	5,09	5,17	5,25	5,33	5,41	5,49	5,57

- **Item 4** : Condensation and rainwater drain.

Must be fitted at the lowest point of the installation and at any horizontal / vertical path change, in order to protect the exhaust muffler and the engine.

- **Item 5** : Wall seals and roof outlet

To be installed at each wall piercing and on the roof outlet.



- **Item 6** : Exhaust outlets

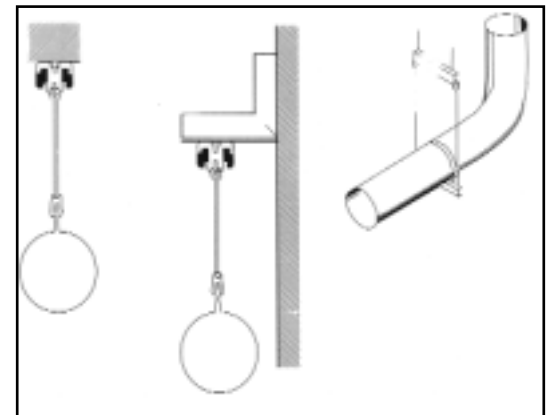
The exhaust outlets are used to discharge into the atmosphere and to protect the inside of the pipes from bad weather.

**D - PIPES AND MUFFLERS, MOUNTING AND SUSPENSION**

The useful life of an installation depends on correct design and appropriate pipe supports

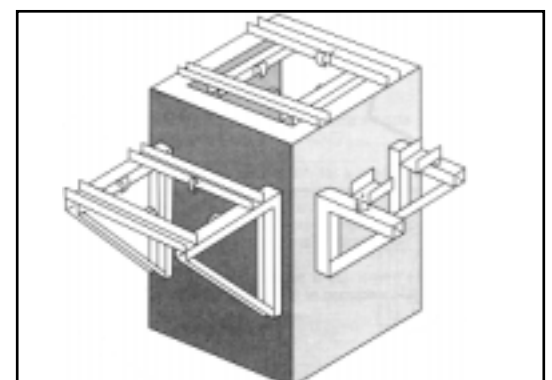
- **Item 7** : Pipe Support System

Made of a flat iron clamp secured to the ceiling, the suspension system is designed to allow for a free expansion of the pipes.



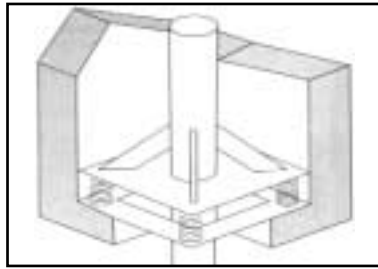
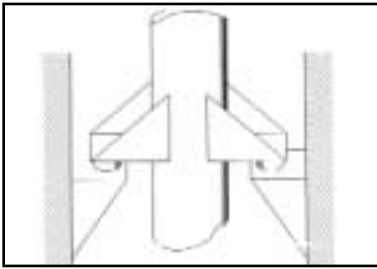
- **Item 8** : Guide frame

For vertical sections the guide frame is designed to allow the piping to expand while maintaining it laterally.



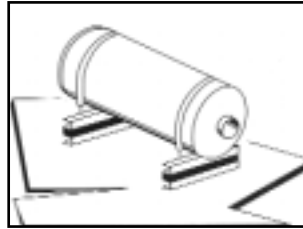
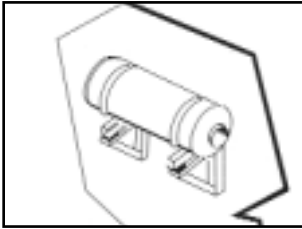
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4016 Quartz Drive  
 Santa Rosa, CA 95405  
 Phone: 707 539-9003  
 Fax: 707 539-5212  
 Email: sales@generatorjoe.NET  
 Web www.generatorjoe.NET



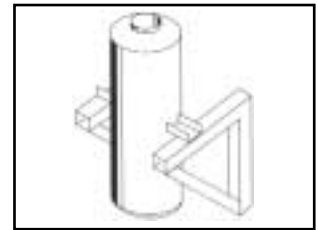
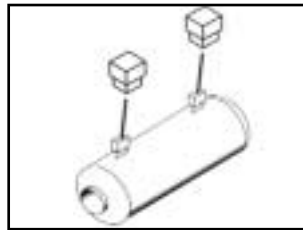
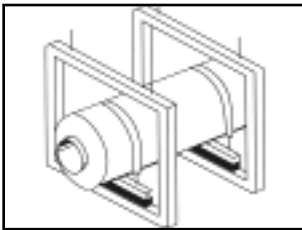
**- Item 9 : Pipe stand**

The pipe stand is designed to support the weight of the vertical piping.



**- Item 10 : Muffler suspension**

The muffler suspension is designed to support the weight of the muffler. It may be vertical or horizontal.



**E - HEAT INSULATION (item 11)**

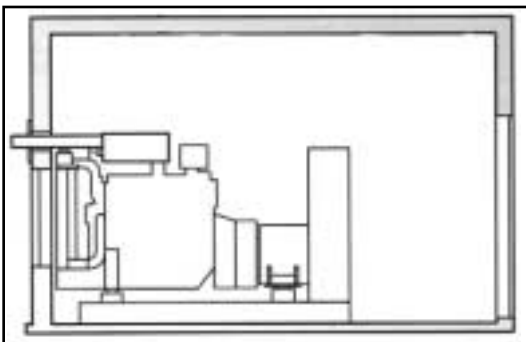
Depending on the type of installation it may be necessary to insulate the pipes. The heat emitted by the exhaust pipe(s) inside the room may affect the cooling system, it may also be dangerous for the safety of the maintenance staff. Once insulation is complete the surface temperature must not exceed 70 °C, the material used for the insulation being rockwool (excluding asbestos). This may be covered with thin aluminium in order to improve the appearance and support the insulating material.

A 50 mm thick glass wool layer should be considered as a minimum requirement.

**F - MUFFLERS (Item 12)**

**- General**

Reduces noise by absorbing the sound wave or reacting with it (refer to manufacturers instructions : BOET, BURGESS, MANNING, LUCHAIRE).



The exhaust pipe should be properly suspended, brackets must not be mounted on the generating set (except for original assemblies). An exhaust expansion coupling should be fitted on the engine outlet. The pipe diameter should never be smaller than the generating set exhaust outlet (please consult us for lengths longer than 6 m).

If the exhaust pipe has to be extended for installation reasons an expansion bellows must be fitted between the generating set and the pipe.

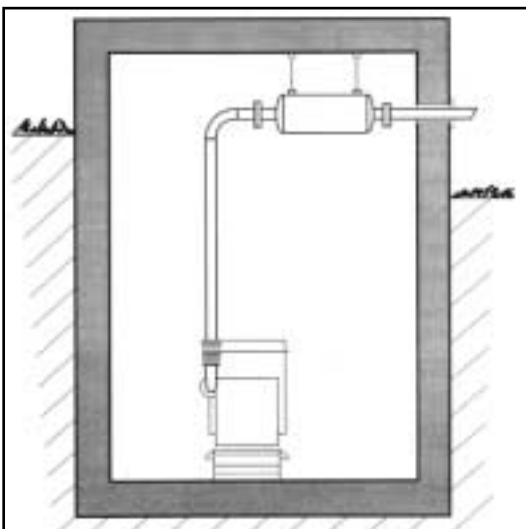
The piping should be installed so that its weight does not press on the flexible bellows, the latter must be perfectly in line (any misalignment will cause the bellows to crack).

**- 'Mounted' mufflers**

A "mounted" muffler is mounted directly on the generating set or the canopy. The brackets are fitted on the generating set and an expansion bellows is fitted between the silencer and the engine.

**- Absorption mufflers**

The gases pass through a muffler made of highly efficient sound absorbing material and protected with perforated sheet sometimes called a straight through muffler.



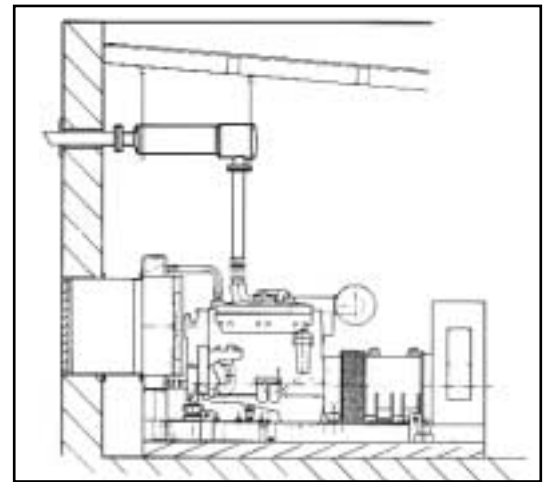
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4016 Quartz Drive  
Santa Rosa, CA 95405  
Phone: 707 539-9003  
Fax: 707 539-5212

Email: sales@generatorjoe.NET  
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**- Absorptive reactive muffler**

Before the gases go through the absorbing soundproof section they enter into an expansion chamber filled with reactive baffles.



## VI - STARTING

Starting an engine is easy when it succeeds, but may cause untold problems when unsuccessful. The operation of highly complex equipment may depend on the reliability of the genset particularly in applications such as hospitals, factory processes and building protection systems.

That is why there are many starting processes and devices on a generating set to ensure reliable starting every time. We make a distinction between a manual start procedure and an emergency start procedure, which is triggered by the failure of the mains supply (generally in automatic mode three 5 second cranks are provided). The starting system design depends on the engine temperature. For a start in very cold temperatures it is sometimes necessary to use starting aids, such as heating the intake air, heating the fuel, injecting ether into the air intake. As well as these the engine coolant is heated, and in very cold conditions also the oil is kept warm.

Generating sets can be provided with three types of start systems

**- Electric starting :** This is the most widely used system and consists of a 12V or 24V starter motor supplied by one or more lead acid, or in exceptional cases, alkaline batteries. The starter motor rotates the ring gear of the engine flywheel moving on receiving the signal from an electric contact. Once the diesel engine has started and the flywheel has run up to its required speed, the starter motor pinion disengages automatically from the ring gear. The batteries are recharged automatically by an alternator or static charger.

**- Pneumatic starting :** Pneumatic starting relies on an air starter that is operated by a flow of compressed air from one or two compressed air bottles and an air compressor. The engine is started in the same way as for electric starting. The air bottles and air compressor are located as near as possible to the generating set.

**- Mechanical starting :** Several mechanical starting system exist, i.e. spring, crank, inertia etc. All of these are only used with low power generating sets. The three systems above can be coupled to each other in the following way:  
 - electric/pneumatic starting  
 - electric/mechanical starting.

## VII - ELECTRIC SYSTEM

### A - CONNECTIONS - General

Just as for low voltage electrical equipment installation and maintenance must comply with the regulations standard or equivalent.

### B - POWER CABLES

May either be of the single core or multi core type according to the generating set power. Power cables should be type installed in a duct or a cable tray designed for that purpose. The following table will help you determine the minimum section required for your generating set power. REMINDER : Current is calculated as follows :

$$\text{1 phase system } \frac{\text{KVA} \times 1000}{\text{V}} = \text{A} \quad \text{where A = amperes} \quad \text{3 phase system } \frac{\text{KVA} \times 1000}{3\text{V}}$$

kVA = genset output  
V = single phase voltage

Note : if 3 phase voltage is 400V, then 1 phase voltage is  $\frac{400}{3} = 231\text{V}$   
 Quick calculation for 3 phase (A) = kVA x constant (C)

VOLTAGE	415	400	380	346	220
WHERE C =	1,39	1,44	1,52	1,67	2,62

### C - BATTERY CABLES

Install the battery(ies) near the electric starter. The cables shall be directly connected between the battery terminals and the starter terminals. The first thing to watch is to make sure you match the + and - polarities on the battery and on the starter. The minimum cable section shall be 70 mm<sup>2</sup>. This varies according to the generating set size but also the distance between the batteries and the generating set.

## D - REMOTE CONTROL CABLES

They usually are multi core cables installed as the power cables in a duct or on a cable tray. Their minimum sections are given for a maximum length of 4 m between generating set and panel :

- Safety . . . . .1,5 mm<sup>2</sup>
- Starting control . . . . .4,0 mm<sup>2</sup>
- Battery voltage supply . . . . .4,0 mm<sup>2</sup>
- Fuel solenoid . . . . .4,0 mm<sup>2</sup>
- Heating . . . . .2,5 mm<sup>2</sup>

For longer cables please consult our Technical Department.

## E - AUTOMATIC START GENERATING SET

In this case do not forget to connect :

- The main voltage sensing or the remote control signal for starting the generating set.
- The power supply for the plant auxiliary equipment (fuel pump, charger) should be taken from the load side of the changeover panel. This power supply should be protected by a fuse or MCB.

Earth connections shall comply with the local standards. Similarly, make sure the generating set neutral rating is identical to the one used in your equipment.

Your equipment should also be protected against lightning.

## F - CABLE SELECTION TABLE (duct installation)

CABLE SECTION H07RNF OU PRC	Acceptable amperes for ambient temperature of :			
	30°	40°	50°	60°
5x16mm <sup>2</sup> Multi-core	96	86	77	64
5x25mm <sup>2</sup> Multi-core	127	114	101	85
1x25mm <sup>2</sup> per single Core phase	142	128	113	95
1x35mm <sup>2</sup> ...	175	157	140	117
1x50mm <sup>2</sup> ...	212	191	169	142
1x70mm <sup>2</sup> ...	270	243	216	181
1x95mm <sup>2</sup> ...	327	294	261	219
1x120mm <sup>2</sup> ...	379	341	303	254
1x150mm <sup>2</sup> ...	435	391	348	291
1x185mm <sup>2</sup> ...	496	446	397	332
1x240mm <sup>2</sup> ...	584	525	467	391
2(1x35mm <sup>2</sup> ) per single Core phase	297	267	238	199
2(1x50mm <sup>2</sup> ) ...	360	324	288	241
2(1x70mm <sup>2</sup> ) ...	459	413	367	307
2(1x95mm <sup>2</sup> ) ...	555	500	444	372
2(1x120mm <sup>2</sup> ) ...	644	579	515	431
2(1x150mm <sup>2</sup> ) ...	739	665	591	495
2(1x185mm <sup>2</sup> ) ...	843	758	674	564
2(1x240mm <sup>2</sup> ) ...	992	893	794	665

# VIII - COOLING

Heat needs to be dissipated from three sources:

- the water used to cool the engine
- the air used to ventilate the engine room
- the exhaust gases.

The systems described below enable this heat to be dissipated or ducted away.

### - ENGINE DRIVEN RADIATOR

The engine cooling system is connected to a tube and fin radiator mounted on the chassis.

- This radiator is cooled by the fan driven directly by the engine. The fan often displaces enough air to ensure adequate ventilation of the engine room on its own.

Air is always blown from the fan to the radiator.

The engine room is cooled by the cold air circulating inside it and air circulation can be controlled in several ways.

### - ELECTRIC MOTOR DRIVEN RADIATOR

The engine cooling system is connected to a separate electric motor driven radiator located either inside or outside the engine room.

- If the unit is inside the room it works in the same way as the engine driven radiator but the fan is driven by an electric motor.
- When the electric motor driven radiator is located outside the engine room or on a roof top, extra lengths of cooling water pipe are required. These have to be accurately sized and the room ventilation system will be separate from the engine cooling system.

Such systems require great care to ensure proper extraction of gases from the engine room.

### - WATER HEAT EXCHANGER

This type of cooling system uses a considerable amount of water so extra overheads need to be taken into account. It is suited when local conditions provide a sufficient flow of water and where proper ventilation cannot be ensured by an air cooled radiator or air cooling unit system.

Water cooling systems consist mainly of a tubular heat exchanger connected to the engine cooling system. This exchanger has an expression chamber and one of its circuits vented to the outdoor air. The water is circulated by the engine water pump. The exchanger's second circuit is connected between the building water supply system and the drain. A valve upstream of the exchanger opens or shuts.

#### - ENGINE ROOM VENTILATION

Exhaust fans and/or blowers can be used to cool the engine and draw fresh air into the engine room and over the equipment housed there.

If fans are used, more effective temperature control can be achieved with several fans rather than one large fan.

The ventilation of the engine room requires detailed engineering calculations.

- In all the above cases, the system shall be in accordance with the consulting engineer's or manufacturer's drawings, recommendations and instructions.

## IX - SPECIAL PROTECTION

However, the installation of SOULE type 8134 or 8137 variable resistance lightning arresters may be considered, keeping in mind that these devices do not offer full protection.

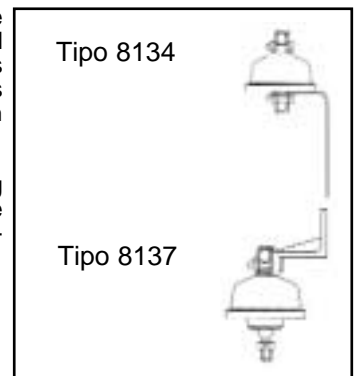
We wish to draw your attention to the fact that this protection concerns the power station itself but not the overhead distribution system that might be connected to it.

This solution may be offered as an option. This type of protection device does not ensure full safety.

#### A - SOULE LIGHTNING ARRESTER OPERATION

When there is an overvoltage on the lightning arrester, the spark gap is pre-ionized by the formation of a corona at a voltage much lower than the lightning strike. The gap is bridged without any noticeable delay whatever the rise time of the lightning. The discharge current flows to the earth through the Carbosial semi-conductor resistor, the resistivity of which decreases very rapidly with the applied voltage. A very high current of 4 to 5 kA may then flow to earth without the instantaneous voltage on the resistor exceeding 2500V.

When the voltage decreases, after the overvoltage, and gets closer to the normal operating value, the de-ionization stops almost instantly in the carbosial semi-conductor resistor and the current becomes so low that the leakage current is close to 0 and the arc is spontaneously de-energised in the spark gap.



OUR GENERATING SETS ARE NOT EQUIPPED WITH PROTECTION DEVICES AGAINST OVERVOLTAGE DUE TO LIGHTNING OR OTHER SIMILAR CONDITIONS. THE COMPANY IS NOT RESPONSIBLE FOR ANY DEFECTS RESULTING FROM SUCH PHENOMENA.

## C - TEMPORARY INSTALLATION OF GENERATING SETS ON SITE

### I - GENERAL

Apart from the local rules and recommendations for stationary generating sets there are some specific requirements which should be followed for "WORK SITE" generating sets.

### II - SPECIAL PROVISIONS

A base shall be provided to install the generating set.

It must be flat and firm enough to prevent the generating set from sinking. It may be made of concrete or very large planks assembled together.

PLEASE NOTE : A generating set that does not rest properly on its bedplate (frame or trailer) will be subjected to vibration that may cause the equipment to suffer.

The generating set shall be located on the worksite so that it is easy to get fuel to. The operator should have easy access and the power supply should be easy to distribute to the site operators.

Access to the generating set shall always remain free for safety and maintenance purposes.

The generating set ventilation must not be masked by miscellaneous objects left in the vicinity. It could lead to dangerous overheating and power loss.

Exhaust gases must escape freely and the exhaust system must not be positioned so that it recirculates into the air filter or cooling system.

Earthing should be with a metal spike driven deep into the ground.

The set should be protected against bad weather with an adequate shelter (see previous chapters).

# D - ROAD TRAILER

## I - TRAILER HITCHING

Before hitching the trailer check the tractor tow facility which should fully match the trailer towing eye/hook/ball.

**CAUTION : Towing a trailer using illegal means is dangerous. Do not use rods, cables and ropes which may cause a serious accident**

### Also check :

- for signs of breakage or serious wear,
- the locking device is operating correctly.

### To hitch the trailer proceed as follows :

- chock the wheels to prevent the trailer from moving,
- lift the rear stands and lock them,
- release the parking brake,
- loosen the tow bar locking levers and adjust the towing head to the same level as the tractor towing eye/hook/ball,
- hitch the trailer remove the wheel chocks and fully lift the jockey wheel using its handle,
- connect the trailer electrics to the tractor,
- hook the handbrake safety cable to the tractor towing eye/hook/ball.

## II - PRE-TOWING CHECKS

Carry out the following checks before towing:

- wheel nut tightness,
- trailer and tractor are properly locked together,
- tyre pressures,
- side, turning and stop lights operate correctly,
- canopy doors are closed,
- parking brake released,
- front jockey wheel and rear stand raised,
- tow bar locking levers tightened and pinned,
- for "Road" type trailers, check the overrun/air brakes,
- install the brake safety cable.

## III - DRIVING

- "WORKSITE" Type trailer.

The maximum road speed for a "WORKSITE" type trailer is 27km/h (16mph).

These trailers are not equipped with running brakes and therefore have no braking capability on the road ; the tyres are designed for a speed of 27km/h. This speed must never be exceeded.

- "ROAD" type trailer.

Driving speed must be adapted to road conditions and trailer behaviour.

Driving at a high speed causes the tyres to overheat; it is advisable to stop from time to time to check them. Excessive overheating may result in a blow out and a serious accident. When in reverse never forget to lock the overrun brake.

### IMPORTANT NOTE :

**Particular attention should be paid to tightening new vehicle wheels. Brake drum heating will cause wheel loosening during the first few kilometers.**

**IT IS ESSENTIAL TO TIGHTEN WHEEL NUTS EVERY 10 KILOMETERS UNTIL LOOSENING CAN NO LONGER BE DETECTED. Wheel tightening should be checked before each towing and during the trip.**

## IV - TRAILER UNHITCHING

This operation must be done on level ground :

- chock the wheels,
- lower the front jockey wheel,
- lock the handbrake,
- disconnect the trailer electrics,
- raise the trailer hitch with the jockey wheel to disconnect the tow hitch from the tractor towing eye/hook/ball,
- remove the tractor.

## V - SETTING UP FOR SERVICE

(Also refer to the relevant section of the generating set installation guide.)

- Make sure the ground is hard enough to prevent the assembly from sinking.
- Using the jockey wheel or stands ensure the generating set is level.
- Lock the handbrake.
- Lower the rear stands and lock them.

**Certain special types of trailer may require different manoeuvring to that described above. In such cases you should refer to the instructions supplied for operating and manoeuvring the trailer.**



## Generator Joe

4016 Quartz Drive  
Santa Rosa, CA 95405

Phone: 707 539-9003

Fax: 707 539-5212

Email: sales@generatorjoe.NET

Web www.generatorjoe.NET