



Genset Installation Recommendations

Our energy working for you.™



Beneficial purpose

Whatever the use of the on-site power is intended to be, reliability of service from the on-site equipment, performance, and cost effectiveness are primary concerns of the users.

Any event or project needs a right start, which leads to the winning position. Generating set/s installation and commissioning recommendations means exactly the same "The Right Start". This is bound to lead to achieve expected reliability, durability, economy, serviceability, equipment uptime, better aesthetics, safety and better working conditions.

The purpose of this manual is to provide guidance to system and facility designer for the right start. However, this manual details typical installations and it is not possible or practical to cover specific details to many variables in an application. In such cases, the user is requested to contact Cummins or GOEMs (Generating set Original Equipment Manufacturers) at address given on the back cover.

Always keep in mind that the installations should comply with State / Central Government and other applicable statutory requirements.

About this manual

This manual provides installation and commissioning general guidelines/recommendations for Cummins Diesel Generating Set housed in an Acoustic Enclosure. In this manual different types of installations (roof-top, basement, room housed etc.) have been considered while preparing the guidelines / recommendations. However, any new, uncommon or critical installation needs to be consulted with Cummins network.

The information is supported by different photographs, diagrams and reference information tables. The information has been compiled together for adequate information but still keeping in mind to make this manual crisp, handy and user's friendly.

We are sure, this manual will be useful to the installer and in-turn to equipment user to achieve desired performance of the generating set/s.

Basic reference information

In order to have instant availability of basic information which is needed during installation, operation and maintenance of the generating set, the information is compiled in a list form and should be available to the operator / user near the installation, preferably visible all the time.

Following information should be available :

1. Project Details
2. Reference Literature

A. Project Details:

- I User - Name, Address, Contact Person, Phone / Mobile Nos., Email
- I Consultant - Name, Address, Contact Person, Phone / Mobile Nos., Email
- I Supplier - Name, Address, Contact Person, Phone / Mobile Nos., Email
- I Service Provider - Name, Address, Contact Person, Phone / Mobile Nos., Email
- I Equipment major details:
 - l Engine number and make
 - l AC Generator number and make
 - l Equipment number and make
 - l Major specifications
 - l Major loads – kVA/ kW ratings, starting type and normal loading sequence
 - l Language for instructions

B. Reference Literature / Information:

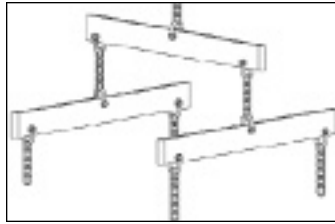
- I Site drawing
- I Installation and commissioning recommendations plus Installation drawing
- I Operation and Maintenance manual
- I Logbook
- I Relevant approvals and certificates from the concerned authorities like CPCB, SEB, Municipal Corporation, Fuel Authority etc.



Preliminary design

Loading and Unloading

A. Provision for lifting is provided on the acoustic enclosure. Unload damage free by lifting with proper lifting tackle / nylon sling / steel rope of suitable capacity.



B. Spreader bar / spacer plate of suitable size may be required to avoid damages.

C. Ensure lifting or hoisting equipment has appropriate tires for the terrain to avoid becoming stuck or tipping over.

D. Use a suitable lift truck with arms longer than the acoustic width if ground is uneven or the hauling distance too far.



E. Ensure that lateral movement of the enclosure is minimum during transportation.

F. Use lift points on the acoustic enclosure which provide support to the equipment when it is moved. This makes it easier to set them up on a trailer base or on the ground.

G. Use a hoist and an adjustable lifting beam in order to lift. All supporting members (chains and cables) should be parallel to each other and as perpendicular as possible to the top of the object being lifted.



H. Ship / transport dry genset including batteries i.e. without the lube oil and jacket water coolant.

I. Center of gravity calculation is important, especially when the gensets are hoisted by overhead cranes.

Foundation

A. Do not install acoustic enclosure on loose sand or clay.

B. Base / foundation should be designed considering safe bearing capacity of soil.

C. The length and breadth of base / foundation should be at least 150-300 mm (6-12") more than acoustic enclosure length and breadth respectively.



D. Ensure that the concrete is completely set and hardened before positioning the enclosure.

E. It is recommended to have base / foundation height about 100-150 mm above ground level, it helps to maintain cleanliness.

F. Check the base / foundation level diagonally as well as across the length for even flatness and same should be within ± 0.5 degrees of any horizontal plane.

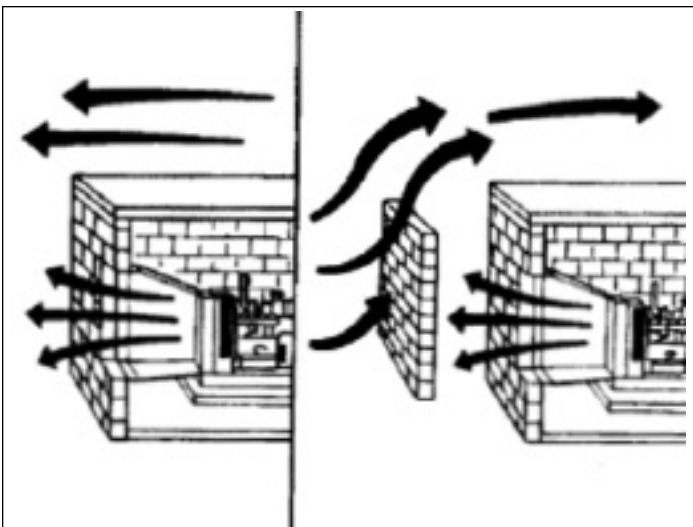
G. The installation design must provide a proper base / foundation to support the acoustic weight and to prevent damaging or annoying levels of vibration energy from migrating into the building structure. In addition, the installation should assure that the supporting infrastructure for the generator set does not allow vibration from the enclosure to migrate into the stationary portion of the equipment.

H. Whenever seismic events are a consideration, a qualified structural engineer should be consulted.

Preliminary design

Site location

- A.** Determine whether the location of the acoustic enclosure will be inside a building or outside in a shelter or housing. The overall cost and ease of installation of the power system depend upon the layout and physical location of all elements of the system — generator set, fuel tanks, ventilation ducts and louvers, accessories, etc.
- B.** Road and access to site needs to be checked before transport. Road closure or transport escort also needs to be considered before physical movement.
- C.** Crane reach or crane height needs to be checked or alternatively rolling needs or fork lift arrangements are to be made.
- D.** Fuel supply tank design and installation in many areas is controlled by regulations that are generally written for two separate purposes: environmental protection and fire protection. Regulations, their enforcement and exemptions vary by location, it is necessary to research and understand local requirements.
- E.** Acoustic enclosure should be located considering wind direction ensuring that there is no obstruction to natural wind flow and the prevailing wind do not enter into the radiator / exhaust outlet. If this is not possible, install a wind barrier. Distance of the wind barrier from the enclosure should be at least 2.5 - 3 times radiator side opening height.
- F.** Enclosure should be located away from polluted atmosphere like acidic fumes, cement dust, stone dust cotton fibres, furnace chemicals etc. wherever possible. In case location is dusty or polluted, contact OEM/ Cummins. Heavy duty air cleaner is must for such installations. Heat exchanger cooled system is recommended for such installations as radiator gets clogged in dusty atmosphere.
- G.** For humid / coastal atmospheric applications, anti condensation heaters are mandatory for alternator.
- H.** Consider issues of security from flooding, fire, icing, and vandalism.
- I.** Proper access is important for
 - Initial product delivery and installation.
 - Service i.e. for general maintenance and inspections.
 - Working space for major work such as overhauls or component removal/replacement.
- J.** Rooftop installations require further planning and structural design consideration. Vibration and fuel storage / delivery may be problematic with rooftop installations.
- K.** For aesthetic reasons, consider exhaust placement in relation to the building. Over a period of time, exhaust gas carbon deposits will tend to accumulate on any nearby wall or structure.



Wind barrier

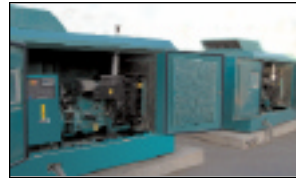


Preliminary design

Enclosure placement / Enclosure room

- A. Ensure sufficient lighting / illumination at the installation space.
- B. Provide suitable , safe access / staging to elevated items.
- C. Provide auxiliary AC supply together with the associated AC distribution panel and may be with motor control unit (MCC) where applicable.
- D. Standard tool kit should be available easily and quickly. It should be protected from corrosion and stored in a dry place.
- E. If spares are supplied alongwith the equipment, they should be protected from corrosion and stored in a dry place.
- F. In case of multiple enclosures provide minimum 2 meters or sufficient clearance to open adjacent doors simultaneously of two enclosures.
- G. While making the layout, provision should be made for :
 - I. Cables
 - II. Fuel lines
 - III. Breather vent
 - IV. Coolant / lube oil drain
 - V. Oil storage
 - VI. Spares storage
- H. Normally, all entry / exit provisions of above are considered in enclosure design. Try to avoid additions. If it is required to have additional entry / exit provisions, ensure for proper sealing of noise, temperature and entry/exit of foreign particles.

- I. Access and clearance
 - i. Enough opening / shutters should be provided so that entry and placement of the enclosure is easily possible.
 - ii. Generator sets will require access for service to both sides of the engine as well as the control/ alternator end of the machine. Local electrical codes may require specific working space for electrical equipment. Allow for working space equal to the width of the genset on both sides and rear. Also ensure sufficient overhead clearances are provided.
- J. Please refer table for typical acoustic enclosure sizes.
- K. Future expansion plans should be considered while deciding total area.
- L. The generator room / area around enclosure should not be used for storage purposes.
- M. Avoid installing the enclosure beside heat generating equipment, or directly below water or steam pipes or in the vicinity of corrosive substances or vapours, metal particles and dust.



Typical acoustic enclosure dimensions*

Genset Model	Prime Rating (kVA)	Engine Model	Enclosure Dimensions		
			Length (mm)	Width (mm)	Height (mm)
C 15 D5 P	15	X 1.7 G1	2200	900	1375
C 20 D5 P	20	X 2.5 G1	2200	900	1375
C 25 D5 P	25	X 2.5 G2	2200	900	1375
C 30 D5 P	30	S 3.8 G2	2800	1150	1450
C 35 D5 P	35	S 3.8 G3	2800	1150	1450
C 40 D5 P	40	S 3.8 G4	2800	1150	1575
C 50 D5 P	50	S 3.8 G6	2800	1150	1575
C 62.5 D5 P	62.5	S 3.8 G7	2950	1150	1575
C 75 D5 P	75	6BT 5.9 G1	3850	1150	1700
C 82.5 D5 P	82.5	6BT 5.9 G1	3850	1150	1700
C 100 D5 P	100	6BTA 5.9 G1-I	4000	1150	1700
C 125 D5 P	125	6BTA 5.9 G2-I	4000	1150	1700
C 140 D5 P	140	6BTAA 5.9 G1-I	4000	1150	1700
C 160 D5 P	160	6CTA 8.3 G1-I	4500	1500	1850
C 180 D5 P	180	6CTA 8.3 G2-I	4500	1500	1850
C 200 D5 P	200	6CTAA 8.3 G1-I	4500	1500	1850
C 250 D5 P	250	6CTAA 8.3 G4	4850	1700	2050
C 320 D5 P	320	NTA 855G2-I	5500	2000	2450
C 380 D5 P	380	NTA 14 G3	5500	2000	2450
C 500 D5 P	500	KTA 19 G9	6500	2000	2300
C 600 D5 P	600	VTA28 G3-I	7000	2500	2925
C 625 D5 P	625	VTA28 G5-I	7000	2500	2925
C 750 D5 P	750	KTA 38 G2-I	7500	2500	2925
C 800 D5 P	800	KTA 38 G3-I	7500	2500	2925

* Dimensions of the enclosure are excluding the silencer.

Preliminary design

Normal precautions and safeties

- A.** Safety involves three aspects: human safety, safe operation of the generator set itself (and its accessories) and reliable operation of the system. Reliable operation of the system is related to safety because equipment affecting life and health is often dependent on the generator set e.g. hospital life-support systems, building ventilators, elevators, fire pumps, security etc.
- B.** Ensure that equipment is correctly and safely installed, fully complies with all central, state and local codes and any person operating this equipment has been properly trained.
- C.** The fire protection system must comply with the requirements of the authority.
- D.** Hot exhaust gasses must never be directed toward anything that may catch fire or explode.
- E.** Never operate the generator unless all guards, covers, shields and other safety items are properly installed.
- F.** Never operate the engine when the air cleaner is removed. An engine backfire can cause serious burns.
- G.** Never "jump start" a generator to start the engine. If the battery charge is insufficient to start the engine, charge or replace the battery and try to restart. Jump starting a battery can cause the battery to explode.
- H.** Unauthorized modification of a generator set may make the unit unsafe for operation or may impair the operation of the unit. Never start a generator set that has been modified or tampered with. Be sure that all covers and guards are properly installed and that the unit is safe before starting the engine.
- I.** Keep generator away from flammable or hazardous materials (trash, rags, lubricants, explosives, paints etc.) and grass or leaf build up.
- J.** Operator should use safety glasses with side shields and hearing protection.
- K.** Disconnect all connections to the control system on engine / genset before doing any welding work.
- L.** Do not tamper control system in case of any problem. There are no user serviceable parts inside the various controls supplied along with Cummins engine / genset. Call the nearest Cummins office / dealer for help.
- M.** Disconnect the battery's ground terminal before working in the vicinity of the battery or battery wires during installation and maintenance.
- N.** Be sure all wiring / cabling complies with the all regional and local codes / regulations / standards.
- O.** Be sure the system is properly grounded before applying power.
- P.** Physically separate the generator feeders from the normal wiring feeders to prevent possible simultaneous destruction as a result of a localized catastrophe such as a fire, flooding, or shear force. Bypass-isolation transfer switch equipment so that transfer switches can be maintained or repaired without disruption of critical load equipment.
- Q.** Large stiff cables may not provide sufficient ability to bend even though they are considered flexible. This is also true of some conduit types. Failure to allow sufficient flexibility will result in damage to enclosures, leads, cables, insulation, or connection points.
- R.** Seismic Areas: In seismic risk areas, special electrical installation practices are required, including seismic mounting of equipment – contact concerned consultant/s.

Preliminary design

Ventilation

- A. Cross ventilation and free flow of cool, clean and fresh air should flow from alternator end to engine.
- B. Additional ventilation arrangement may be required for radiator cooled engines installed in acoustic enclosure because acoustic enclosure traps radiated heat, decreasing cooling capabilities. Hence these sets may need bigger ventilation fans. Radiator cooled engines may create slight negative pressure inside the genset room / enclosure. Maximum static restriction should not increase 6-mm of water column.
- C. For basement installations, supply of fresh air and forced ventilation through air ducts is required to remove heat.
- D. Refer to table for values of air required and fan flows for various gensets rated at 1500 rpm. Values mentioned in table are with lagged exhaust piping in the room and silencer fitted outside the room.
- E. Maximum allowed temperature rise above ambient in genset enclosure is :
Max. ambient allowable temp. rise upto 40°C is 10°C and above 40°C is 5°C
- F. Adequate capacity natural ventilators can be used for acoustic enclosure room.



Natural Ventilators

G. Field Check for Proper Ventilation

1. Run the engine on full load / typical load for about 1 hour so that temperature in the enclosure gets stabilized.
2. Measure the ambient air temperature (ambient temperature should be measured outside the enclosure in shade).
3. Measure the temperature inside the enclosure. Enclosure temperature should be measured near air cleaner inlet of engine.
4. Calculate temperature difference between enclosure temperature and ambient i.e. delta T. Sometimes to ensure proper ventilation, it may be necessary to measure actual airflow by anemometer.

Engine Model	Rating (0.8 pf)	Total Air (Ventilation + Breathing) requirement for Genset		Radiator Fan flow in
		Max. amb. above 40°C (rise 5 °C)	Max. amb. below 40°C (rise 10 °C)	Genset room
	kVA	lit./sec	lit./sec	lit./sec
QSK60 - G4	2000	41915	22090	32285
QSK60 - G3	1875	38525	20310	32285
KTA50 - G8 - I	1500	34955	18275	28400
KTA50 - G3	1250	31475	16420	27375
KTA38 - G5	1000	26980	14050	23855
KT38 - G2 - I (2300)	750	21795	11395	22655
VTA28 - G5	625	17770	9270	22655
VTA28 - G3	600	17405	9060	18880
KTA19 - G4	500	14410	7480	20280
KTA19 - G3	450	13110	6800	13000
KTA1150 - G	380	12070	6255	10385
NTA14 - G3	380	11110	5750	10385
NTA855 - G2 BC	320	9385	4855	10070
NT855 - G6 BC	285	8975	4650	10070
NT855 - G5 BC	250	8285	4300	10070
NT855 - G4 BC	225	7305	3795	10070
6CTAA8.3 - G1 - I	200	6245	3225	7385
6CTA8.3 - G2 - I	180	6035	3115	5540
6CTA8.3 - G1 - I	160	5565	2880	5540
6CT8.3 - G2 - I	140	4955	2555	5540
6BTA5.9 - G2 - I	125	4920	2525	4000
6BT5.9 - G2 - I	82.5	3420	1760	2880
S3.8 - G7	62.5	2450	1260	1880
S3.8 - G6	50	2090	1075	1880
S3.8 - G5	45	2090	1075	1880
S3.8 - G4	40	1715	890	1880
S3.8 - G3	35	1420	730	1880
S3.8 - G2	30	1240	640	1880
X2.5 - G2	25	1060	542	1250
X2.5 - G1	20	930	475	1250
X1.7 - G1	15	670	345	1050

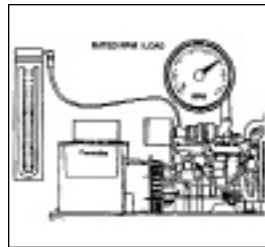
Mechanical design

Air System

A. Vacuum indicator is supplied with all engines to indicate choked filter. Max air intake restriction with clean and choked filter is as follows :

	X Series	S Series (Naturally Aspirated)	S Series (Turbo charged)	All Engines with medium duty A/c	All Engines with heavy duty A/c	Gas engine
	mm/wc (in/wc)	mm/wc (in/wc)	mm/wc (in/wc)	mm/wc (in/wc)	mm/wc (in/wc)	mm/wc (in/wc)
Clean filter	250 (10)	250 (10)	250 (10)	250 (10)	380 (15)	200 (8)
Choked filter	400 (15.7)	380 (15)	500 (20)	635 (25)	635 (25)	380 (15)

B. Heavy duty air cleaners should be used for dusty environment. Contact OEM / Cummins if enclosure is to be kept in dusty environment. Please note that gensets are supplied with medium duty air cleaners as standard scope.



C. If fibrous conditions exist, care should be taken to prevent the fibers getting entered into the enclosure / air cleaner and no such fibre element shall enter/ block the air flow of alternator.

Exhaust System

A. Exhaust system should create minimum total back pressure.

B. Limits for exhaust back pressure

Model	mm (In.) of Hg
KTA50G8/QSK60/S Series/Gas Engines	51 (2)
KTA50G3/KT2300G/VTA28/K19/ NT/N14/B/C/X	76 (3)

New installations should have back pressure lower by 12 mm (0.5”) of Hg than limit mentioned above.

C. Exhaust piping outside the enclosure should be lagged along with aluminum sheet cladding. Typical thickness of lagging is 50 mm.

D. If exhaust pipe length is more than 7 m, then additional flexible bellow / provision for expansion should be provided.

E. It is recommended to use 'Schedule B' MS/ prefabricated stainless steel pipes and long bend elbows. Please refer Table for pipe sizes. If number of bends are more than 4 or pipe length is more than 10 meters than contact OEM / Cummins for piping arrangement.

(See table in next column)

Engine Model	Rating (0.8 pf)	Exhaust pipe size max. 4 Bends Max. Length 10 mtrs. Min. ID	Exhaust Gas flow (No. of banks x flow per bank)
	kVA	No. x mm	No. x lt. /sec
QSK60 - G4	2000	2 x 325	2 x 2805
QSK60 - G3	1875	2 x 325	2 x 2700
KTA50 - G8 - I	1500	2 x 250	2 x 2220
KTA50 - G3	1250	2 x 250	2 x 1910
KTA38 - G5	1000	2 x 250	2 x 1460
KT38 - G2 - I (2300)	750	2 x 200	2 x 1245
VTA28 - G5	625	2 x 125	2 x 945
VTA28 - G3	600	2 x 125	2 x 930
KTA19 - G4	500	1 x 200	1 x 1600
KTA19 - G3	450	1 x 200	1 x 1460
KTA1150 - G	380	1 x 125	1 x 1095
NTA14 - G3	380	1 x 125	1 x 1055
NTA855 - G2 BC	320	1 x 125	1 x 990
NT855 - G6 BC	285	1 x 125	1 x 1160
NT855 - G5 BC	250	1 x 125	1 x 960
NT855 - G4 BC	225	1 x 125	1 x 860
6CTAA8.3 - G1 - I	200	1 x 100	1 x 610
6CTA8.3 - G2 - I	180	1 x 100	1 x 550
6CTA8.3 - G1 - I	160	1 x 100	1 x 540
6CT8.3 - G2 - I	140	1 x 100	1 x 470
6BTA5.9 - G2 - I	125	1 x 100	1 x 225
6BT5.9 - G2 - I	82.5	1 x 100	1 x 225
S3.8 - G7	62.5	1 x 75	1 x 190
S3.8 - G6	50	1 x 75	1 x 150
S3.8 - G5	45	1 x 75	1 x 150
S3.8 - G4	40	1 x 75	1 x 150
S3.8 - G3	35	1 x 75	1 x 115
S3.8 - G2	30	1 x 75	1 x 115
X2.5 - G2	25	1 x 50	1 x 75
X2.5 - G1	20	1 x 50	1 x 75
X1.7 - G1	15	1 x 50	1 x 50

F. The exhaust outlet should be in the direction of prevailing winds.

G. There should be rain trap to avoid rain water entry. If rain cap is used the distance between exhaust pipe and rain cap should be higher than diameter of pipe. It is also recommended that horizontal run of exhaust piping should slope downwards away from engine to the condensate trap. Silencer should be installed with drain plug at bottom.

Location : Optimum Silencer (when fitted outside enclosure) Location of the silencer in exhaust system has very definite influence on both silencing and back pressure imposed on the system. The preferred silencer locations are given in the Table where 'L' is length of the total exhaust system measured from exhaust manifold in meters.

Please note that locating the silencer as per optimum silencer location is not mandatory. For high rise buildings suitable arrangements may have to be provided in consultation with acoustic engineer.

(See table in next page)

Mechanical design

Optimum Location of Silencer		
	In-line Engine	'V' Engine
Best	$2L / 5$	$\frac{4L - 5}{5}$
Second best	$2L / 5$	$\frac{2L - 4.5}{5}$
Worst Location of Silencer		
	In-line Engine	'V' Engine
Worst	$\frac{L}{5}$ or $\frac{3L}{5}$	$\frac{3L - 10}{5}$

Where 'L' = Length

- I. Common exhaust system for multiple sets is not recommended due to soot, condensation, excessive suction pressure, entry of exhaust gases in non working engine, increased back pressure and lack of fail safe system availability. However exhaust of two banks of V-engines can be connected, after silencer. Ensure that area of common pipe is greater than sum of the areas of individual pipes. Exhaust of engines can be directly connected to chimney at different levels as shown.



Common exhaust piping (not recommended)



Exhaust Rain Cap

- J. Installation of explosion relief valve is recommended, particularly for bigger sets.
- K. The exhaust system outlet direction should also be carefully considered. Hot exhaust gasses must never be directed towards undesirable locations like cafeteria, play ground, school or public place etc. or towards combustible surface. Exhaust from a diesel engine is hot and will contain soot and other contaminants that can adhere to surrounding surfaces. It is highly recommended that the exhaust system be carried up as high as practical on the downwind side of buildings in order to discharge straight up to maximize dispersal.

Fuel system

- A. Ensure that fill point is accessible and clean all the time. Provide proper lid and lock. Ensure that all piping is leak free.
- B. Service storage tank should be located such that piping will have minimum and controlled restriction. This is more important and difficult in case of roof-top installation.
- C. Fuel transfer pump, preferably automatic is recommended than manual.
- D. Avoid fuel spillage. Do not overfill the fuel tank. Fuel expands when warm and may overflow.
- E. Ensure proper fuel disposal arrangement.
- F. Ensure that fuel dilution and theft does not occur. Care should be taken in the purchase of fuel and filling of tanks to prevent ingress of dirt and moisture into the diesel fuel system.
- G. Install fuel treatment plant depending upon available quality of the fuel (mixed with water or sediments like rust, scale, weld slag, dirt and other debris).
- H. Ensure that cavitation does not take place in the system.



Poor routing of fuel hoses

Cooling system

- A. Ensure initial fill + top up water used in cooling system has recommended properties as mentioned in operation and maintenance manual.
- B. Water softening / demineralizing plants should be used, if water quality is not acceptable.

Mechanical design

Starting system

Cranking torque and starting time is affected by the following:

- A.** Auxiliary loads vary depending upon the type of application. The auxiliary torque curve will affect the time to accelerate cranking speed.
- B.** Fuel with low energy content will need more time to crank because of slower burning and erratic firing.
- C.** Colder ambient temperature increase starting torque requirement. Glow plugs and/or ether starting aids are recommended when temperatures fall below certain levels, refer O & M. Install jacket water heaters to maintain the jacket water at a temperature high enough to allow for easy starting of the engine.
- D.** Increased lube oil viscosity because of cold conditions, increase starting torque demand and in turn increasing starting time. Lube heaters may used if required.
- E.** Parasitic loads affect stating torque needs.
- F.** Batteries supplied with genset are generally dry and uncharged. First charging of uncharged batteries is very important and should be done from authorized battery charging center. It takes about 72-80 hours to completely charge a new battery.

Model	Battery Capacity AH	Cable Size mm ²	Electrical System Volts
KV and above	360	70	24
V28 / K19	180	70	24
N14 / 855 / N8 / C	180	50	24
B 5.9	150	50	12
S 3.8	120	50	12
X Series	88	35	12

Electrical design

Genset / Engine Controls

The generator set is controlled locally by a dedicated Generator Control Panel. This incorporates the control systems, metering, alarm indications and customer connections.

Two types of control system are currently available; Engine Governing, Control System and Power Command Control.

- A. Make sure that the polarity of the battery connections are correct before applying power to the all Electronic Controls.
- B. Do not test wire leads to see if they are 'live' by flashing them on either engine body or the Control mounting stand.
- C. Disconnect all connections to the control system on engine / genset before doing any welding work on set.
- D. There are no user serviceable parts inside the various controls supplied along with Cummins engine / genset. Call the nearest Cummins office / dealer for help.
- E. Turn off or remove AC power from the battery charger and then remove -ve battery cable from the engine / genset battery. This will avoid possible damage and someone else starting engine / Genset accidentally.
- F. Make sure the battery area is well ventilated before servicing the battery. Arcing can cause explosion due to hydrogen gas given off by batteries.
- G. Always refer to the wiring diagram and product manual supplied with the engine / genset for details.

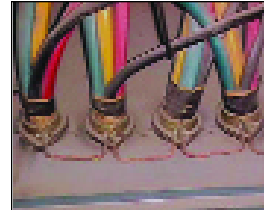
Electrical protection

If the overload and short circuit protection is provided by a circuit breaker, care must be taken with the protection settings. Circuit breakers are designed for operation with the utility supply, which can provide much higher and longer fault levels than a generator. The circuit breaker overcurrent and short circuit settings should therefore be set according to the overcurrent/short circuit curves of the circuit breaker and not the overcurrent/short circuit dials on the circuit breaker. The generator overload and short circuit settings on the protection should be set so that they are below the thermal damage curve for the generator.

Cabling

- A. Overheating due to loose thumbing / undersize cables causes most of electrical failures, hence power cabling between alternator and control panel and control panel and change over switch to mains should be done with correct size of cables and thimbles.

- B. While terminating cables avoid any tension on the bolts / busbars.
- C. While terminating R.Y.B. phase notations should be maintained in the alternator and control panel for easy maintenance.
- D. Crimped cables should be connected to alternator and control panel through cable glands.



Earthed cable glands for crimped cables



Proper cable terminations

- E. For AMF application, use 8/10 core 2.5 sq. mm armoured copper cable for control cabling.
- F. Typical cable sizes for 415 V application are provided in the table which are indicative, please refer to cable manufacturers for details. For HT installations, kindly contact GOEM's for details on sizing.

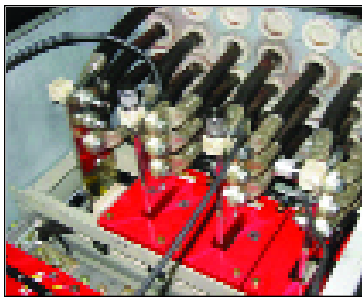
Typical Cable Sizes for DG Sets				
kVA Rating	Amp Rating	Cable size Sq. mm x Runs		
2000	2782	500 x 10	--	--
1800	2504	400 x 10	--	--
1500	2087	400 x 8	300 x 9	240 x 10
1250	1739	400 x 7	300 x 8	240 x 9
1000	1397	300 x 6	225 x 7	--
750	1043	400 x 4	240 x 5	185 x 6
650	904	300 x 4	225 x 5	150 x 6
625	870	300 x 4	185 x 5	120 x 6
600	835	240 x 4	185 x 5	120 x 6
500	696	300 x 3	185 x 4	120 x 5
450	626	240 x 3	150 x 4	95 x 5
380	529	400 x 2	185 x 3	120 x 4
320	445	300 x 2	150 x 3	95 x 4
285	396	225 x 2	120 x 3	70 x 4
250	348	400 x 1	185 x 2	95 x 3
225	313	400 x 1	185 x 2	95 x 3
200	278	300 x 1	--	--
180	250	240 x 1	--	--
160	223	185 x 1	--	--
140	195	150 x 1	--	--
125	174	120 x 1	--	--
100	139	95 x 1	--	--
82.5	115	70 x 1	--	--
75	104	50 x 1	--	--
62.5	87	35 x 1	--	--
50	70	25 x 1	--	--
30	42	16 x 1	--	--
25	40	10 x 4	--	--
20	40	10 x 4	--	--
15	32	6 x 4	--	--
25 (Single Phase)	125	50 x 2	--	--
20 (Single Phase)	80	35 x 2	--	--
15 (Single Phase)	63	25 x 2	--	--

Notes:

1. Use 3 1/2 core armoured power cables with aluminium conductor (AYFY).
2. Current rating of cables are taken based on operating temperature of 70°C.
3. For multiple runs of cables, deration factor of 0.75 is considered i.e. 25% deration applied.
4. AYFY: Aluminium conductor, PVC insulation, Steel strip armour, PVC outer sheath.
5. Cable sizes mentioned are in square mm.
6. For sets above 1000 kVA, use of proper busbars in bus ducts is recommended.
7. Earthing as per IEC rules to be provided.

Electrical design

- H.** The terminal box is most conveniently glanded on either right or left hand side. Both panels are removable for drilling/punching to suit glands/or glanding boxes. If single core cables are taken through the terminal box side panel, an insulated or non-magnetic gland plate should be fitted.
- I.** Incoming cables should be supported from either below or above the box level and at a sufficient distance from the centre line of the generating set. This would avoid a tight radius at the point of entry into the terminal box panel, and allow movement of the generator set on its anti-vibration mountings without excessive stress on the cable. Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test. When making connections to the terminals the incoming cable termination should be placed on top of the winding lead termination/s and clamped with the nut provided.



Cable access from either side or above

- J.** Care to be taken, that weights of cables should not fall on alternator / base rail. It is recommended to support output cables on separate structure on ground.
- K.** External wirings, when provided for remote voltage / excitation monitoring / droop CT etc. shall be screened sheathed type. Maximum length of such wiring should not exceed 5 meters.
- L.** Power cables should be type installed in a duct or a cable tray.



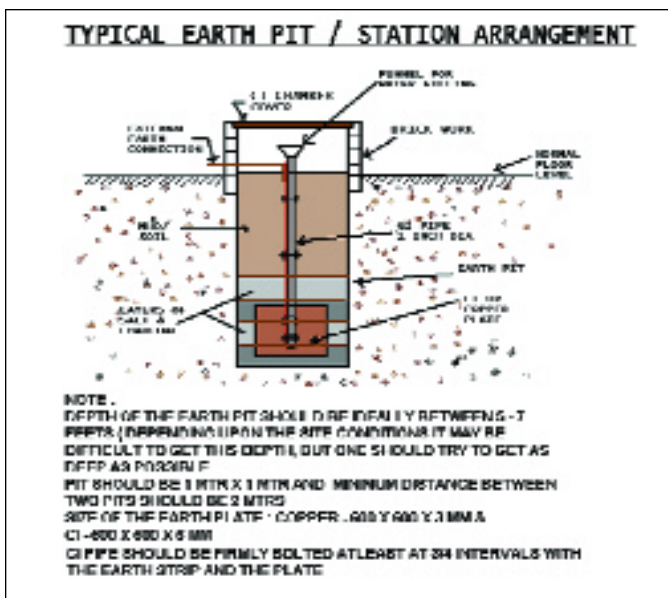
Overhead Cables

Earthing


- A.** The generating set should be connected to earth in accordance with local regulations.
- B.** All metal-work of the generating set should be bonded so that there is a continuous low impedance path from all parts of it, including the engine and bed-plate, back to the earth point.
- C.** The size of the cable used for the main earth connection should be of adequate size.
- D.** If residual current protection is required for personnel protection it should not be fitted to the generator circuit breaker. This can cause spurious tripping, but should be fitted to the sub circuits requiring the protection.
- E.** If residual current protection is fitted to the generator circuit breaker, care should be taken for the earth cable connection, as the connection point will determine whether the generator windings and the load are protected, or only the load is protected.
- F.** When fitting residual current protection care should be taken to ensure that there is only ONE earth path to the main earth point.
- G.** Earthing all metal-work WITHOUT connecting it to the generator star point will not give earth protection for the generator load.
- H.** If the generators are operating in parallel the star points can be connected in parallel provided this does not cause parallel paths for the earth protection, or cause excessive circulating currents
- I.** The generating set and all associated equipment, control and switch gear panels must be earthed before the set is put into operation.
- J.** 4 numbers earth pits are required as per Indian Electricity rules or local electricity board.
 - ┆ 2 earthing pits for genset / control panel body
 - ┆ 2 earthing pits for neutral
- K.** GI strips of suitable size may be used for earthing. Earthing should be checked at earth strip and the resistance should be less than 1 ohm. For gensets with AVM's between engine / alternator and base rail, the earthing MUST be done at the engine / alternator and NOT at base rail.
- L.** The neutral of the generator is not bonded to the generator frame as supplied from the factory. An earth terminal is provided inside the terminal box adjacent to the main terminals. If the set is required to operate with the neutral earthed, a substantial earth conductor (normally equivalent to one half of the section of the line conductors) must be connected between the neutral and the earth terminal inside the terminal box. Additional earth terminals are provided on the generator feet.

Earthing strip data

DG Set Rating	Recommended Earth Strips / Wire
30 kVA	8 SWG Copper
40 kVA	8 SWG Copper
50 kVA	8 SWG Copper
62.5 kVA	8 SWG Copper
75 kVA	8 SWG Copper
82.5 kVA	25 x 3mm CU / 25 x 6 mm GI
100 kVA	25 x 3mm CU / 25 x 6 mm GI
125 kVA	25 x 3mm CU / 25 x 6 mm GI
140 kVA	25 x 3mm CU / 25 x 6 mm GI
160 kVA	25 x 3mm CU / 25 x 6 mm GI
180 kVA	25 x 3mm CU / 25 x 6 mm GI
200 kVA	25 x 3mm CU / 25 x 6 mm GI
250 kVA	32 x 3mm CU 1 Run / 25 x 6 mm GI 2 Runs
320 kVA	32 x 3mm CU 1 Run / 25 x 6 mm GI 2 Runs
380 kVA	32 x 3mm CU 1 Run / 25 x 6 mm GI 2 Runs
437.5 kVA	25 x 6mm CU 2 Runs / 25 x 6 mm GI 2 Runs
500 kVA	25 x 6mm CU 2 Runs / 25 x 6 mm GI 2 Runs
625 kVA	50 x 6mm CU 1 Run / 50 x 6 mm GI 2 Runs
750 kVA	50 x 6mm CU 1 Run / 50 x 6 mm GI 2 Runs
1000 kVA	50 x 6mm CU 1 Run / 50 x 6 mm GI 2 Runs
1250 kVA	50 x 6mm CU 1 Run / 50 x 6 mm GI 2 Runs
1500 kVA	50 x 6mm CU 2 Runs / 50 x 6 mm GI 3 Runs
2000 kVA	50 x 6mm CU 2 Runs / 50 x 6 mm GI 3 Runs







Suggested Log Book Format

LOG SHEET

CUSTOMER NAME : _____

ENGINE SR. NO. : _____

ALTERNATOR MAKE : _____

ALTERNATOR FRAME : _____

ALTERNATOR Sr. No. : _____

DATE: _____

Hr / CLOCK	LUB PRESS kg / cm ²	LUB OIL TEMP. Deg C	COOLANT TEMP. Deg C	CURRENT (amps)		VOLTAGE (V)		POWER FACTOR (L/NO / F/NO)	POWER KW	FUEL CONSUMPTION (lit/hr)	ELECTRIC METER READING
				II	V	II	V				
0700											
0800											
0900											
1000											
1100											
1200											
1300											
1400											
1500											
1600											
1700											
1800											
1900											
2000											
2100											
2200											
2300											
2400											
0100											
0200											
0300											
0400											
0500											
0600											

Room Temp (Deg C): _____

Leakage's / Condition (If Not OK, give details)

Fuel System	Exhaust / Empty (Deg C)
Lubrication System	Exhaust / Humid
Cooling System	Exhaust / Humid
Air Intake / Exhaust System	Exhaust / Humid

Supervisor Name / Sign / Date

Remarks: _____

Operator Name / Sign / Date

Installation Checklist



Installation Recommendations

Generator set – Installation checklist (Enclosed or Containerized Generating Sets)

This checklist should be used to validate the completion of a generator set installation, prior to commissioning. A checklist should be completed for each generator of a multiple installation.

Project Details

Project name
.....
.....
Customer (End User)
.....
.....
Address of Site
.....
.....
Tel.No.
Mobile
Email.

Generator Set Details

Generator Set Model.
Generator Set Serial No.
Set No.....
Controller Type
Engine Sr. No.
A C Generator Sr. No.
Controller Sr. No.

Site Information – Yes or No

Site clean & clear from obstruction & secure.....
Site services complete & commissioned.....
(lighting, auxiliary supply, water etc)
Installation - open air or closed room.....
Installation on level & firm ground.....
No loose material near generating set
Pipes & cables secured
Air intake & exit paths clear & clean
Electrical bonding complete
Comments / Any other irregularity

Cooling System – Yes or No

Radiator air outlet clean, free from obstruction
Coolant overflow well routed for spillage
Possibility of hot air recirculation

Fuel System – Yes or No

Bulk storage tank installation complete
Transfer pump installed & connected
Piping correct material, cleaned & leak-free
Spillage containment complete
Vent installed, piped to safe area and open

Day tank fill point clean & clear
Electrical bonding completed
Storage facility secured

Exhaust System – Yes or No

Installation prevents exhaust recirculation
Installation allows for pipework expansion
Welded joints & flanges secured with gaskets
Piping correctly supported
Stack prevents rain ingress
Condensate drain provided
Exit directed away from building
System lagged & cladded properly
Flammable material properly protected

Ventilation – Yes or No

Installation prevents hot air recirculation
Installation accounts for prevailing wind
Air exit directed away from building
Forced ventilation if in place wired
Moving Louvers if any connected to system
Inlet, outlet & enclosure bird protected

Electrical System – Yes or No

Control system

Field wiring to set mounted control complete
Customer wiring to control complete
Interconnection to remote control complete
Remote emergency stop controls wired

Generator / Switchgear / Changeover / transfer

Means of disconnection / isolation provided
Switchgear installation & pre-testing complete
Cables installed correctly, marked & flexible
Power connections complete
Enclosure penetration properly sealed

Enclosure

All electrical boxes clean & covers replaced
Auxiliary electrical supply complete
Grounding system complete & tested
Utility supply available as required

Any other comment / observation if any
.....
.....

Checklist completed by
.....
.....

Date
Company.....

Note : Completion of this checklist does not relieve
The Installer of contractual obligation.

Our authorised GOEMs



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