OPTIMIZATION OF SILENT GENSET FOR THE AIR FLOW AND NOISE LEVELS

YUGANDHAR 1*, Mr. SURESH 2*

1. II.M.Tech , Dept of ME, SPHOORTHY ENGINEERING COLLEGE.
2. Asst .Prof, Dept of ME, SPHOORTHY ENGINEERING COLLEGE.

ABSTRACT:

Silent Genset is a reciprocating diesel engine equipped power generating machine with reduced noise levels.

So the main focus of the customer is on the performance of generator and noise levels. Optimizing the parameters that effects the noise levels and airflow by studying and validating the relevant factors that effects the performance

To improve the performance (by optimizing the air flow)

The raw power from engine should be utilized at fullest.

As the rating increases the engine should be equipped with water cooled arrangement(radiator) as air cooled engine has limitation of producing power up to some extent.

Radiator size is dependent on the cooling rate of engine by air. If proper air flow is provided with proper arrangement of louver positons It is possible to reduce the radiator size and fan capacity.

In this project, few genset with various arrangement of louvers and accessories are to examined and validated for better airflow so that radiator size can be reduced

To improve the damping (noise reduction) levels:

There are various methods to reduce the noise in genset.

Using proper foam (damping material used inside the enclosure of the genset) with appropriate density and thickness according to rating.

Placing the exhaust silencers in appropriate position by studying and validating few gensets

Above two points to be validated in this project by testing and improving the noise levels

Though there are many companies are meeting the market requirements as well as standards in India, most of them not able to grab the export market share as they demand more reduced noise levels and improved performance. By this project proper guidelines for these drawbacks can be done so that companies meet the improved standards as per export market
INTRODUCTION

Diesel Genset is the main source of power to fulfil the power requirements rated between 5 kVA to 2000kVA. It has found its own limitations based on the location of its operation. Significant variants areas.

Industrial (1500 to 2000 kVA)
Commercial (1000 to 2000 kVA)
Domestic (up to 750 kVA)

Area of study in this project purely deals with Domestic Purposes.

Difference among limitations imposed among These variants are only in noise levels and heat-balance to be maintained.

- Objective
- To Maintain heat balance and noise at optimised levels as per CPCB II standards by providing proper arrangements and additional auxiliaries such as baffles, louvers and foam in enclosure.

COMPONENTS

1. Base Frame
2. Lifting Eye
3. Canopy
4. Fuel Tank
5. Fuel Filling Spout
6. Diesel Engine (Should consider
7. Alternator (can vary with child rating of engine)
8. Anti-Vibration Mount
9. Control Panel
10. Air Cleaner (accessibility)
11. Air Intake
12. Exhaust Silencer
13. Exhaust Bellows

GENSET COMPONENTS

Fig: Genest components

VIEW FROM CONTROL PANEL SIDE

Fig: VIEW FROM CONTROL PANEL SIDE
PRINCIPLE AND WORKING

➢ Principle of AC generator

A.C GENERATOR. A Generator is a device which converts mechanical energy into electrical energy. A.C Generator works on the principle of electromagnetic induction (motional emf). In generator an induced EMF produced by rotating a coil in a magnetic field.

➢ Electrical generator work

In electricity generation, a generator is a device that converts mechanical energy to electrical energy for use in an external circuit. The source of mechanical energy may vary widely from a hand crank to an internal combustion engine. Generators provide nearly all of the power for electric power grids.

➢ Methodology- Noise Reduction

The main noise producing components are

1. Radiator fan
2. IC ENGINE Reciprocating components

When engine and radiator before assembly looks like below

Noise Reduction of an Enclosed Diesel Generator Set. The aim is to understand the mechanism of noise reduction in canopies, particularly the influence of the ducts for air inlet and exhaust.

Study goes with the experimental method by considering existing arrangements and standards that could be reached. Finding improvements in openings containing louvres or grilles, and ducts with acoustic treatment By measuring noise levels as per CPCB standards i.e. 75dbA at 1 meter distance

➢ Methodology – Heat Balance

At maximum, 35% efficiency can be obtained in diesel engine

Remaining power goes waste at different levels of conversion

Out of incapable power, 40% is spent on cooling the engine.

As a part of the project, To get the 35% efficiency, auxiliaries must be placed in proper positions and angles. Taking the existing
This can be maintained at different locations based on the space availability of the genset.

But to get the better air flow it should be placed at the back side and it should be detachable louvers.

- Punched louvers can be less efficient than they are cost effective than detachable louvers.

### DETACHABLE LOUVERS

![Detachable Louvers](image)

#### LOUVER AREA CALCULATIONS

- **RADIATOR CORE AREA = 30% OF THE ENGINE OUTPUT RATING**
- **LOUVER AREA SHOULD BE 2.3 TIMES THE RADIATOR CORE AREA**
- **LOUVER AREA OF THE 100KVA ENGINE IS DECIDED AS 0.4 Sq. m**

- **RADIATOR FAN**
- **ALTERNATOR**
- **IC ENGINE PISTON AND CYLINDER**
- **EXHAUST GAS**
- **AIR FLOW**

Noise levels when air flow is allowed through mesh type louvers

- Air flow calculations through detachable louvers
- **PERFORMANCE TEST**

**NOISE CONTROL**

**TESTING AND CPCB CERTIFICATION**

- Requirement of certification: Every manufacturer of engine or product, as the case may be, shall have valid certificate(s) of Type Approval and Conformity Of Product(COP) for each COP year, for all engine models being manufactured or, for all engine or product models being imported, after the effective date for the emission limits, as specified Following
- **CPCB-II NOISE STANDARDS**

The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity up to 1000 KVA, manufactured on or after the 1st January, 2005 shall be 75 dB(A) at 1 meter from the enclosure surface.

The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).

The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards

- **VENTILATION REQUIREMENTS**

**EXPERIMENTAL RESULTS**

**AIR FLOW CALCULATIONS:**

- Typical Air Temperature Surrounding an Operating Genset
The required air flow rate to maintain a specific temperature rise in the generator room is described by the formula:

\[ m = \frac{Q}{c_p \Delta T} \]

Where: \( m \) = Mass flow rate of air into the room, ft\(^3\)/min (m\(^3\)/min)
\( Q \) = Heat rejection into the room from the genset and other heat sources; BTU/min (MJ/min).
\( c_p \) = Specific heat at constant pressure; 0.241 BTU/lb\( ^\circ \)F (1.01x10\(^{-3}\) MJ/kg\( ^\circ \)C).
\( \Delta T \) = Temperature rise in the generator set room over outdoor ambient; \(^\circ\) F (\(^\circ\) C).
\( d \) = Density of air; 0.0754 lb/ft\(^3\) (1.21 kg/m\(^3\)).

**APPARATUS - MEASUREMENT**

- Use a clamp-on Amp meter or power analyzer to measure facility load levels.

Clamp each leg separately and take the measurement during peak usage levels.

240V 1ø Applications: To determine peak usage in kW, add the highest Amp readings from the two legs, multiply by 120 and divide by 1,000.

- \((L1 + L2)120 / 1000\)
- Heat transfer process in engines

**Areas where heat transfer is important**

- Intake system: manifold, port, valves
- Exhaust system: valves, port, manifold, exhaust pipe
- Coolant system: head, block, radiator
- Oil system: head, piston, crank, oil cooler, sump

**Information of interest**

- Heat transfer per unit time (rate)
- Heat transfer per cycle
  - (often normalized by fuel heating value)
- Variation with time and location of heat flux
  - (heat transfer rate per unit area)

These above mentioned can be illustrated from following figure

**How does a Load Bank Test Work?**

When a load bank test is implemented, an artificial load is placed on the generator. The test is timed and gradually increases the kW load in specific increments. Each time the kW load is increased, the test measures and records critical
engine parameters equipment needed to complete the test includes a load bank (machine with kW rated sizes and battery like cables)

Our typical load bank reports include the following:
- KW Load
- AC Voltage
- Oil Pressure
- Amperage Rating
- Voltage Tested

LOAD BANK TEST

What is Generator Load Bank Testing?

A generator load bank test involves an examination and assessment of a Generator Set each year. It verifies that all primary components of the generator set are in proper working condition. The equipment used to conduct a load bank test produces artificial loads on the generator by bringing the engine to an appropriate operating temperature and pressure level.

PERFORMANCE /LOAD TEST

NOISE LEVELS FOR 7.5KVA GENSET

The energy in a sound wave can be measured using Decibels. The Decibel Meter shows examples of things that make noise and measurements in decibels. Amplitude measures how forceful the wave is. It is measured in decibels or dBA of sound pressure.

CONCLUSION

- Optimization of genset enables the companies to look into the standards that are not met so far. So that Indian companies can meet the demands of the companies from the developed countries by being able to get certified for fine tuned standards imposed by their pollution control boards.
- NOISE RESULTS, HEAT BALANCE EFFECTIVENESS ARE TAKEN FOR WATER COOLED ENGINE OPERATED SILENT GETNST BY PLACING THE LOUVERS AND EXHAUST IN APPROPRIATE POSITIONS.
- THOSE RESULTS ARE PROVEN TO BE BETTER ACROSS LOWER RATING FROM 5kVA TO 125kVA WHEN BENCHMARKED WITH CURRENT SERIES OF EXISTING MODELS AVALABLE AT GREVES COTTON LTD.
- BENCHMARKING WITH OTHER RIVALS IN MARKET DONE AND IT IS COMPARED WITH THOSE MODELS AND TO BE OPTIMIZED FURTHER IF NEEDED.