

CASE STUDY

HOW OPTIMAL LOAD BANKS HELPS TO MAINTAIN EFFICIENCY AND PERFORMANCE OF DIESEL ENGINES

A Case Study on the Role of Load Banks in Enhancing Efficiency, Preventing Low Load Issues and Improving the Overall Performance of Diesel Generators



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Figure 1:

Resistive Load Bank
Core Components

HEATING
ELEMENTS

COOLING
FANS

CONTROL
PANEL

SAFETY
PROTECTIONS

IMPROVES
EFFICIENCY

Ensures optimal engine
operation and better
fuel efficiency.

PREVENTS
LOW LOAD ISSUES

Eliminates wet stacking,
carbon buildup & other
low load problems.

ENHANCES
PERFORMANCE

Maintains engine health,
stable power output &
consistent performance.

REDUCES
EMISSIONS

Helps in cleaner
combustion and lower
carbon emissions.

EXTENDS
ENGINE LIFE

Minimizes wear & tear
and increases overall
engine lifespan.

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How Optimal Load Banks helps to Maintain Efficiency and Performance of Diesel Engines

Gensets preferably known as diesel generating sets offer reliable backup and power across industries such as commercial buildings, healthcare, manufacturing and data centres. If the machines are operated properly, they result in good efficiency, performance and durability.

One of the most critical factors in diesel generator operation is load level. If a diesel generator is operated under low load conditions mostly below 30% of its rated capacity, then it might result in operational, mechanical and environmental issues. This reduces the efficiency and lifespan of the generators.

In this blog, we will highlight on how load banks eradicate these issues and increase the performance of the engines.

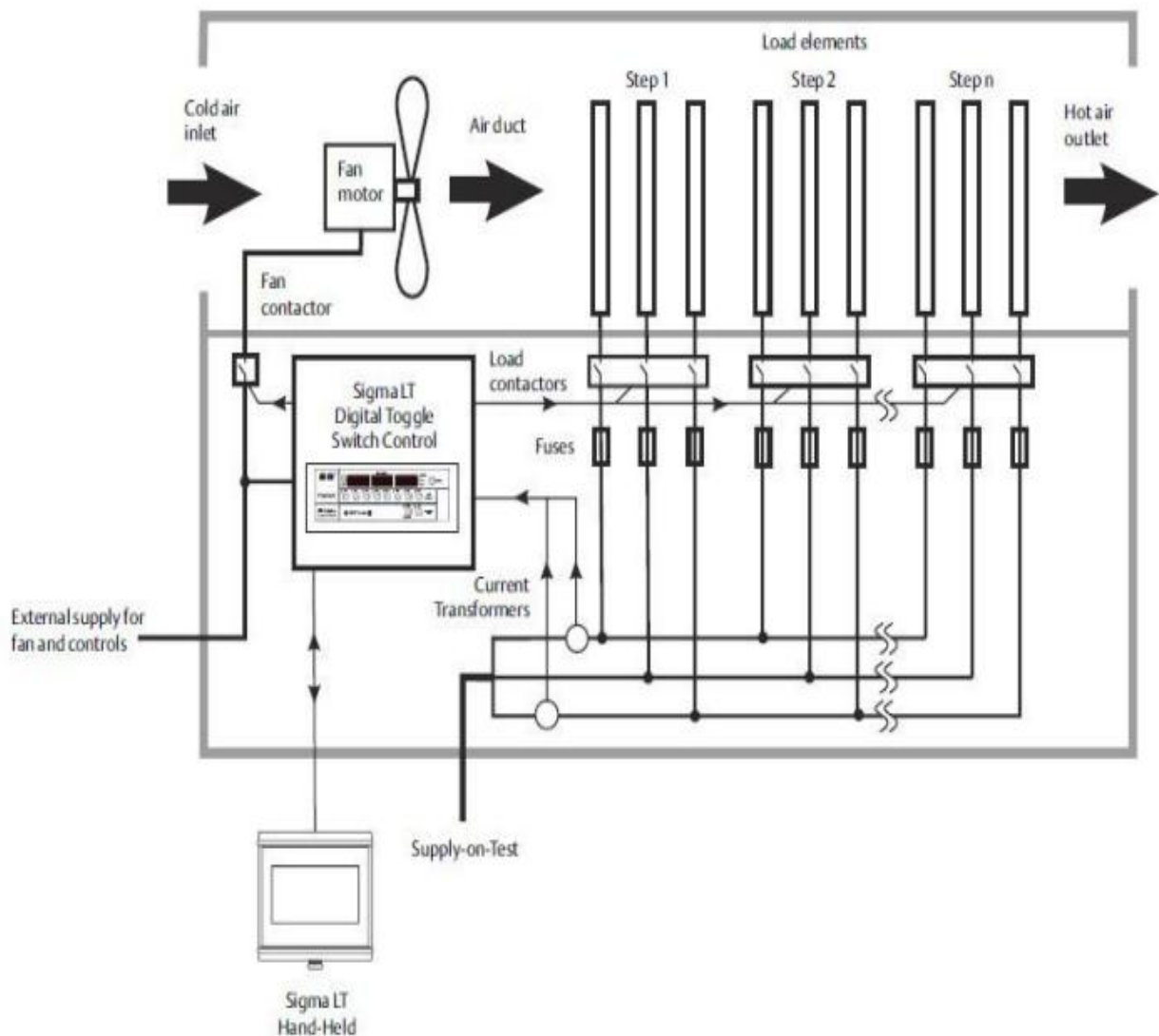


Figure 1: Resistive Load bank core components

Well, what exactly is the load bank

A load bank is a crucial device designed to simulate electrical load on diesel generators. This device absorbs electrical energy and transforms it into heat which helps operators to operate generators under safe and controlled conditions.

It helps to test the performance of the system and ensures that it is functioning properly. For instance, a load bank when connected to diesel generators, it can analyse the actual power demand and run accordingly.

Variations in Load Banks



Figure 2: Variations in Load Banks

Below are the variations that are applicable for the load banks

1. Simple resistive load banks

This is a device that makes use of resistors to convert electrical energy into heat.

- These load banks use resistors to create load.
- These are not suitable for complex and heavy generators.

2. Advanced load banks

This is a device that uses real world scenarios to test power systems

- These systems make use of digital controls and reactive components.
- This is done so that the systems can operate in a precise manner.

What Load Banks do

These are devices used to test power systems by applying various electrical loads under different conditions

- Give a load that is stable and easy to control
- Allow for performance testing and improve efficiency
- Help keep the engine at the right temperature
- Stop problems that happen when you don't load enough

If load banks are used correctly within their designed load range, they help keep the system healthy and make the engines last longer.

Issues Due to Low Load Operation

Diesel engines are designed in such a way so that they can operate efficiently under moderate to high loads.

However, if they are run under low loads for extended periods then several issues arise due to insufficient temperature and pressure within the engine. Some of them are as follows:

1. Wet Stacking - A slow threat to performance

Wet stacking is one of the most common problems associated with low load operations.

What actually is Wet Stacking?

This problem occurs when the fuel remains unburnt in the exhaust system as the engine is unable to reach the temperature that is required for complete combustion. Wet stacking is one of the most common problems associated with low load operations.

Causes	Effects
Running below these load levels	Affects engine performance and efficiency
Insufficient temperature range for fuel combustion	Increased carbon emissions
Incomplete fuel burning	Wastage of fuel
Collection of unburnt fuel in exhaust	Can block engine parts

Some of the severe cases of wet stacking can also lead to liquid fuel dripping from the exhaust system which damages the engines at very early stage and affect the performance.

2. Improper Fuel Combustion and Carbon Emissions- Improper Fuel Combustion and Carbon Emissions

If the temperature is not maintained at a certain limit, then diesel engines will not get high pressure for proper combustion. This might result in:

- Decrease in cylinder pressure
- Improper fuel combustion
- Carbon emissions that are harmful for environment

Which could lead to:

- Forming a layer of hydrocarbon inside cylinders
- Carbon deposits on injectors and turbochargers
- Disturbing the environment through increased smoke and pollution

If not treated at early stage, these deposits might demolish engine performance and efficiency.

What is meant by the Diesel Particulate Filter (DPF)

DPF are an important component in the load banks as it helps engines to run efficiently without clogging. These filters absorb the carbon emissions by trapping a particular matter known as soot.

Working of DPF:

- The filter absorbs soot particles from exhaust gases emitted during fuel combustion
- Automatically cleans itself periodically through a process called regeneration

Regeneration process is of two types:

1. Passive Regeneration

This process automatically cleans the engine with carbon exhausts when operated at high temperatures.

2. Active Regeneration

In this process extra fuel is injected to raise the temperature for proper functioning.

Pro Tip: So, for low load operations it is very important that the exhaust temperature should be high. Otherwise, passive regeneration will not take place and there will be accumulation of unburnt fuel in the engines.

Outcomes:

- Harmful gas emissions
- Reduced engine performance and efficiency
- More fuel usage
- Engine break down

For better performance diesel engines should be operated within a specific load range.

Recommended Load Range

with a minimum capacity of 30% and optimal capacity of 30% or higher.

- Ensures complete fuel combustion
- Maintains proper engine temperature
- Prevents carbon buildup
- Supports effective DPF operation

Even if a generator occasionally runs at low load, it should be periodically operated at higher loads to “clean” the system.

Different Methods to maintain Load in Load Banks

Supplemental Loading

This is primarily used in load banks to increase the load during low demand situations to maintain minimum engine load in power systems.

In many real-world scenarios, generators are oversized to accommodate future demand. As a result, they often run at low loads during normal operation.

What do you mean by Supplemental Loading?

Supplemental loading is a process wherein artificial load is added to the generator using a load bank.

Benefits:

- It ensures proper combustion
- Can extend equipment life
- Can prevent wet stacking; and
- Maintains required load levels

Types of Load Banks that you must know

These are different categories of load banks that are used to test the generators.

Types	Description
Portable Load Banks	It is ideal for temporary testing and is easy to move around
Permanent Load Banks	Primarily used for continuous operation
Radiator Mounted Load Banks	These are not portable and are integrated with the cooling system of the generator

Building Load Method

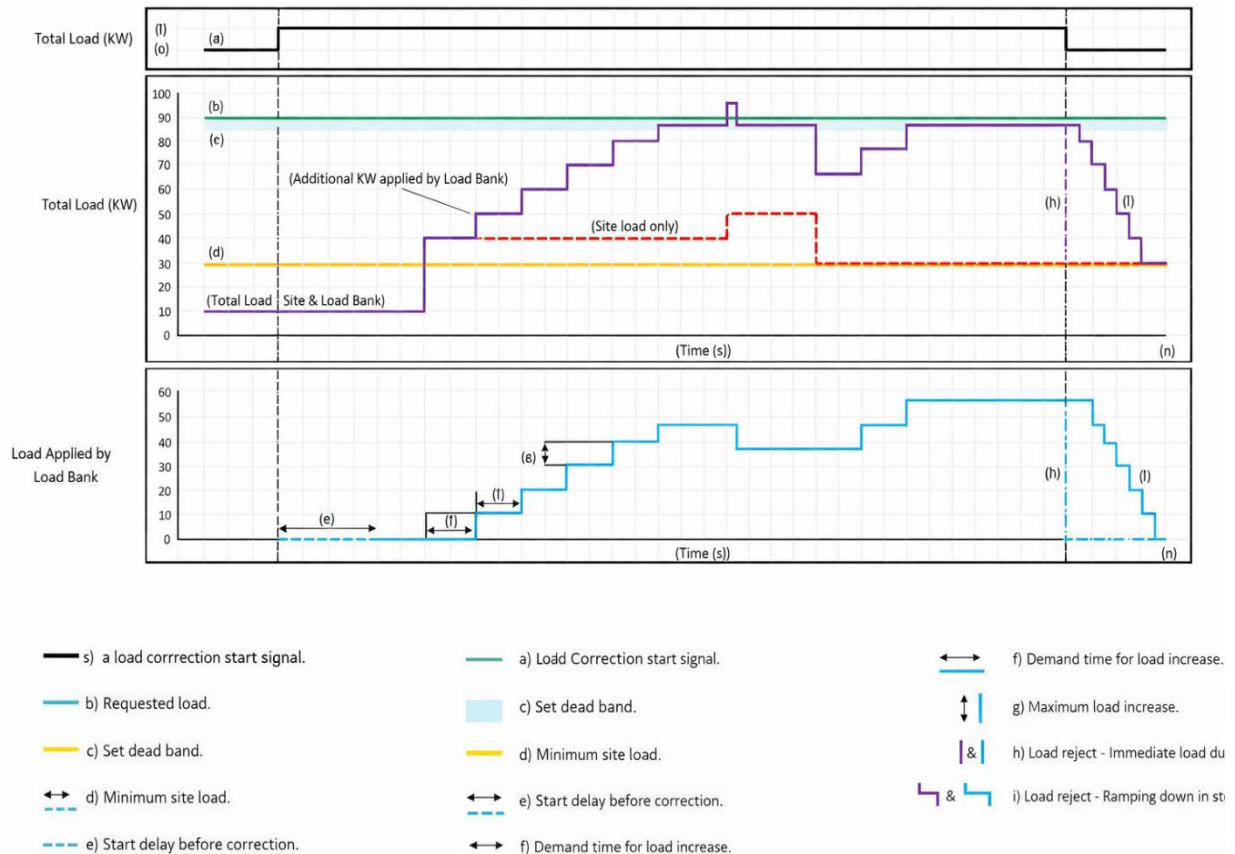


Figure 3: Load Correction Timing Diagram

Is a method in which load is increased gradually to test the generator. It involves using actual building load to test generator. While it's a practical approach, it has several challenges associated with it, such as:

While Building Load method is a practical approach to test generators it has multiple risks and challenges associated with it, such as:

Risks and Challenges:

- It can lead to incomplete testing
- It can lead to data loss in certain cases
- It can lead to load fluctuation
- It can lead to interruption in power during testing

For these reasons, load banks are widely considered a safer and more reliable alternative.

Advanced Load Bank

This device is used to simulate multiple electrical conditions for detailed testing of power systems.

Smart control systems make testing new load banks more useful. Automatic load management, programmable steps, and real-time monitoring are some of its most important features.

Site Load Correction

SLC helps to monitor actual site load and automatically change the output of load bank. This helps to maintain a consistent load on generator.

It helps in reducing manual activities and also avoids under or overloading of generators.

These new and advance controls have made load banks become an important part of power systems.

Industry Standards and Guidelines

Similar to other industries, power generation business also had safety and reliability standards that businesses need to follow.

Some of these are:

- **NFPA 110 (Emergency Power Systems):** As part of this standard, monthly testing is required minimum for 30 minutes and with load greater than 30%
- **ISO 8528:** This standard primarily defines performance ratings for generators basis various factors such as standby power, prime power and continuous operation.

Impact of Low Load Operation

Low load operation can lead to mechanical, financial and environmental impact in the long run. Examples include low engine life, low efficiency, poor performance, higher carbon emissions and many more. Therefore, ignoring load management can lead to a very high costs compared to investments in preventive measures.

Key takeaways

Diesel generators are strong and dependable machines, but they won't last as long or work as well if you don't use them correctly.

Key takeaway 1: If you run a generator at a low load for a long time, it can cause big problems like wet stacking, bad combustion, and clogged particulate filters. To make generator engine run at optimal level, it needs to run at a minimum capacity of 30%. This will improve the efficiency and performance of the generator and also increase life span.

Key takeaway 2: Load banks not only make generators work better, but they also lower maintenance costs and the impact on the environment by using advanced control systems and following industry standards. Advance and modern load banks systems will lower running costs and also help the environment.

By understanding and addressing the challenges of low load operation, organizations can significantly enhance the performance, reliability, and lifespan of their diesel generating systems.

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