



Information Sheet #73

Defining Ratings for Generator Systems

Your Reliable Guide for Generator Maintenance

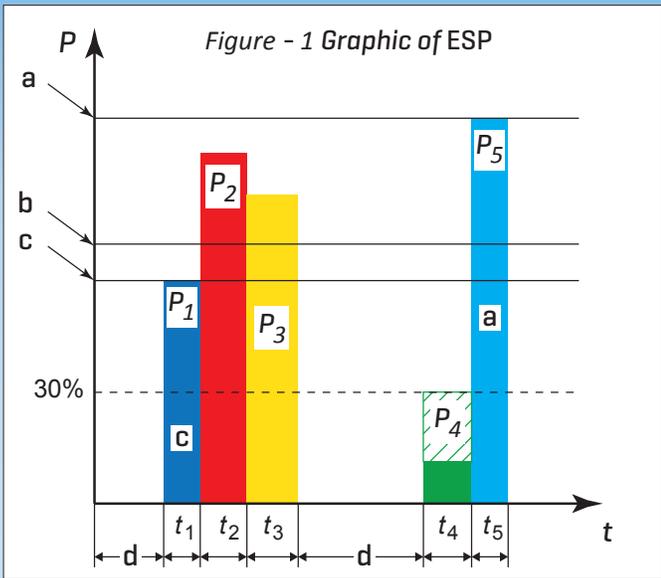
1.0 Introduction:

The rating system applicable to generator set systems has evolved as the application of generator systems has evolved. The particular rating assigned is important in the selection of the correct generator set required for any given application. Over time, various ratings have been determined for a variety of applications. The final kW assigned to a particular generator set must take account of the Reciprocating Internal Combustion (RIC) engine's ability to manage the applied load, as regards load factor, duration of load, expected life cycle, mean time between overhauls (MTBO), ambient conditions, fuel, and the appropriate maintenance program.

This Information Sheet discusses the factors for determining the assigned electrical rating for industrial generator sets applied to various applications found in the North American marketplace.

2.0 International Standards Organization (ISO):

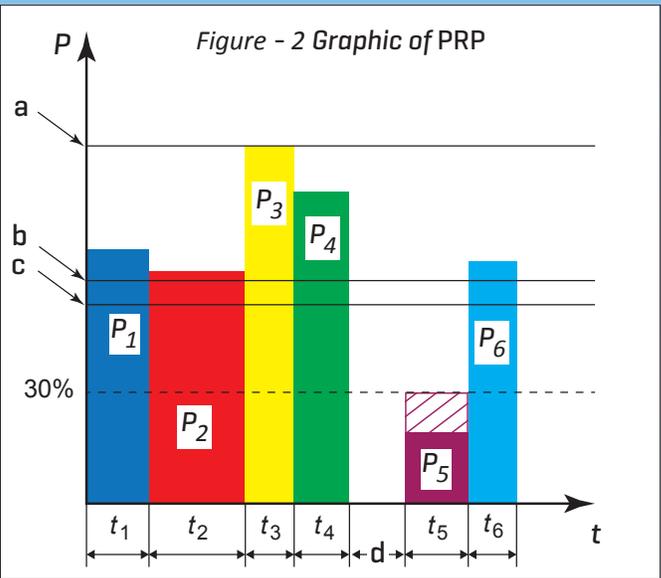
ISO is an independent, non-governmental international organization with a membership of 164 national standards bodies. Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges. Generator set manufacturers, specifying engineers, and others involved in the manufacture and application of generator systems have adopted ISO recommended ratings for generator sets. It applies to AC generating sets driven by RIC engines for land and marine use, excluding generating sets used on aircraft or to propel land vehicles and locomotives. *(Continued over)*



Emergency Standby Power (ESP) - Key

- t Time
- P Power
- a Emergency standby power (100%)
- b Permissible average power during a 24-hour period (Ppp)
- c Actual average power over a 24-hour period (Ppa)
- d Stop

NOTE: $t_1 + t_2 + t_3 + \dots + t_n = 24 \text{ h}$



Prime Power (PRP) - Key

- t Time
- P Power
- a Prime power (100%)
- b Permissible average power during a 24-hour period (Ppp)
- c Actual average power over a 24-hour period (Ppa)
- d Stop

NOTE: $t_1 + t_2 + t_3 + \dots + t_n = 24 \text{ h}$

To fulfill our commitment to be the leading supplier in the power generation industry, the Kelly Generator & Equipment, Inc. teams ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our **Information Sheets** are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.

The installation information provided in this information sheet is informational in nature only and should not be considered the advice of a properly licensed and qualified electrician or used in place of a detailed review of the applicable National Electric Codes, NFPA 99/110 and local codes. Specific questions about how this information may affect any particular situation should be addressed to a licensed and qualified engineer and/or electrician.

3.0 ISO Standard ISO-8528-1:

ISO-8528-1 is an industry standard of performance parameters used for on-site generator set applications. The ratings, as defined in ISO-8528-1, define the basic rating categories based on four segments:

- Emergency standby
- Prime power
- Limited-time running time
- Continuous power
- Data center continuous power

In each category, the set's rating is determined by its maximum power output relative to running time and load profile. Any misapplication will likely jeopardize the longevity (life) of the generator set, possibly void the manufacturer's warranty, and put it at risk for premature failure.

4.0 Emergency Standby Power (ESP) Rating - ISO Standard ISO-8528-1:

This rating covers standby generator sets supplying emergency power to installations that are normally connected to a reliable utility power source. The standby nameplate rating is available for the duration of any utility outage, with varying electrical loads. There is no overload capability for this standby rating, and any use of the generator set above the standby rating is strongly discouraged. (See figure 1)

The standby rating is applicable with an average load factor of X%, with 'X' been determined by the manufacturer (normally 70% but determined by the manufacturer). Typically, emergency duty generator sets at such ratings are limited to 200 hours a year, in order to comply with the Environmental Protection Agency (EPA) exhaust emissions regulations. There is an exception for the use of a lower Tier engine, when the generator is destined for emergency duty only, when it backs up the power supply in the case of a power outage or a supply that falls outside the frequency and/or voltage parameters. For all other duties, it is necessary to incorporate the latest Tier power unit.

5.0 Prime Power (PRP) Rating - ISO Standard ISO-8528-1:

This rating applies to any application where utility power is unavailable or too unreliable. The ratings are in accordance with ISO 8528-1 and overload power in accordance with ISO 3046-1. It is applicable for variable electrical loads (such as 70%) having an unlimited number of operating hours per year. A 10% overload output is available for short durations, but not to exceed a period of more than one hour in every 12 hours, and is limited to 400 hours a year. The latest Tier 4 Final engine is required so as to meet current EPA emission regulations for diesel engine power. (See figure 2)

Typical prime power applications include load management, peak shaving, sole source power, such as remote mines, quarries, oil field operations, any off-grid locations, and include mobile rental units.

6.0 Limited-time Running Prime Power (LTP) Rating - ISO Standard ISO-8528-1:

This rating applies to generators that are operating under non-variable load factors and/or constant loads for a limited number of hours. Power is therefore continuously supplied up to 100% for a limited number of hours per year with this limit set by the manufacturer. For any operation that exceeds this LTP, the continuous rating should be used.

Typical limited-time applications can include load management, such as supplying electrical power to a utility as part of a financial arrangement, peak shaving, interruptible rate duty, load curtailment, and cogeneration. This rating is rarely specified in generator literature and should be obtained from the manufacturer.

7.0 Continuous Power (COP) Rating - ISO Standard ISO-8528-1:

This rating can also be referred to as the Base Load rating. It applies to generators that operate as a utility-type power source, which has non-variable loads and/or constant loads up to 100% for an unlimited number of hours annually. Note! No overload capability is available in this rating.

Typical continuous applications can include, utility base-load generation, a main power source at a remote site, and cogeneration.

8.0 Data Center Continuous (DCP) Rating - ISO Standard ISO-8528-1:

A number of generator manufacturers have begun to offer a new classification of DCP ratings for their generators when utilized at data centers. The Uptime Institute determined that a data center needs to have uninterruptible, independent, dedicated power source availability (uptime) for their Tier 3 and 4 classified data centers. Such diesel generators therefore must be available for unlimited hours of operation, without restrictions of the average variable or non-variable load factor. Such generator ratings have to be reviewed and approved by the Uptime Institute.

By including such rated generators in the data center installation, site certification can be achieved with the certification issued by the Uptime Institute. The rating has the ability to achieve 100% load acceptance in one step yet provide the necessary reliability and dependability.

9.0 Manufacturer's Ratings/Additional Derates:

Most generator manufacturers follow the ratings detailed in ISO 8528/1. However, some have slight exceptions in order to help them meet customer requirements, performance needs, or maintenance schedules. Before applying a generator system the manufacturer's authorized distributor should be consulted.

A manufacturer's plate rating, usually found on the side of the generator, applies to the rated power available at Normal Temperatures and Pressures (NTP). NTP can be reduced by increased ambient temperature, altitude and humidity. For the purpose of determining the rated power output of the generating set, the following standard reference conditions shall be used:

- Total barometric pressure: $p_r = 100 \text{ kPa}$
- Air ambient temperature: $T_r = 298 \text{ K}$ ($t_r = 25 \text{ }^\circ\text{C}$)
- Relative humidity: $\phi_r = 30 \%$



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