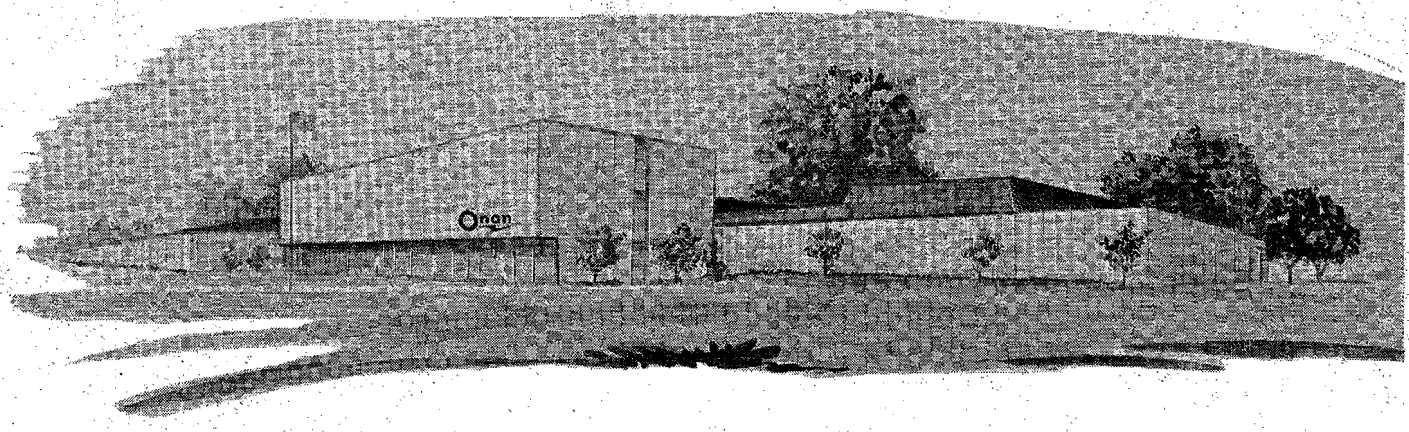
T-017

technical bulletin

RATING FACTORS FOR ELECTRIC GENERATING SETS



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INTRODUCTION

Ratings of electric generating sets and operating conditions must be studied and considered before a unit is selected for a particular installation. Under some conditions, many considered normal, a generating set could fall short of the requirements if certain operating factors are overlooked. Read through the bulletin and follow the examples on selecting a generating set.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. Onan reserves the right to make changes at any time without notice.

FACTORS AFFECTING GENERATING SET OUTPUT

Engine power and generator capabilities determine output of a generating set. A main factor affecting output is the ratio of engine power to power required by the generator. Engines with considerable reserve horsepower are only slightly affected by a small loss of engine efficiency. If the engine must operate near its maximum rated power output, any engine power loss will also result with a generator output loss.

Among the variable factors affecting generating set output is —

- Fuel
- High Altitude
- High Ambient Temperature

If any one condition affects engine power enough, the rating of the generating set has to be lowered or "derated." Each of these conditions is discussed separately.

Fuel

All Onan generating sets are normally rated on their standard fuel capability. However, most Onan gasoline-fueled generating sets are adaptable for use with gaseous fuel. Gas fuel, LP, natural or manufactured, can be specified and greatly affects engine power developed. An engine will develop nearly the same horsepower using LP gas as when using gasoline. But for natural or manufactured gas, derating is usually larger. See Table 1.

Ratings for the different fuels in Table 1 are based on regular-grade gasoline, 2500 BTU/cu. ft. propane, 1000 BTU/cu. ft. natural gas, and number 2 diesel fuel. Note some engines have higher maximum KW potentials as high compression engines. Generally, propane and natural gas allow higher compression ratios.

High Altitude

From a practical viewpoint, altitude derating of any Onan generating set is unnecessary at altitudes below 1000 feet. Onan units are rated for conditions at the factory where the altitude is approximately 900 feet. However, lower density air at higher altitudes can cause lower engine power and lower generator cooling capabilities. The degree of power loss varies from engine to engine, but as a general rule, derate about 4 percent for each 1000 feet increase in altitude.

High Ambient Temperature

When an engine is operating in hot air ambients, the engine suffers a proportionate power loss because hot air is less dense than cool air (similar to higher altitude). An average derating value of 1 percent loss for each 10 F above 60 F is used, disregarding the fact summer ambient temperature for the factory test run is frequently well above 80 F. Derating for higher temperature only is seldom required . . . usually done in combination with other derating factors or in borderline cases.

Because life of some engines is shortened when run continuously at rated load for long periods of time, some are derated for prime power installations. This is especially true when the engine does not have a large horsepower reserve for a given generator size. Contact your Onan distributor.

DETERMINING GENERATING SET RATING

Engine

1. Find the maximum KW potential of the engine for the appropriate fuel in Table 1.

   For city-water cooling, add KW shown in the first column to the engine KW potential (based on deduction of fan horsepower).

2. Use the altitude derating percentage from Table 2 or 3 (if over 1000 feet) and add to the following temperature derating, if any.
3. Derate the engine 1 percent for each 10 F above 60 F ambient temperature.
4. Total the derating percentages for altitude and temperature. Subtract this total from 100 percent and multiply this percentage times the maximum KW from Step 1.

Generator

Find the altitude deration in Table 4. Multiply the percentage shown in "% of Standard Rating (KW)" column times the generating set rating. This figure is the maximum generator KW.

Actual Generating Set Capacity

Find the lower KW capability from "Engine" and "Generator." This figure is the actual unit rating for that particular application. See the following examples.

EXAMPLE 1

A city-water cooled 450.0DFW (diesel) is selected for a standby application with a 9000-foot altitude and a 70° F ambient temperature.

Engine

1. Maximum engine KW potential from Table 1 under "Diesel" is 460.0 KW. Add 14.0 KW for deducting fan horsepower on city-water cooling.

   460.0 + 14.0 = 474.0 KW

2. Altitude derating from Table 2 is 30.5 percent for 9000 feet. Because no derating is necessary for the DFW under 5000 feet (see exceptions below table), subtract the 5000-foot derating from the 9000-foot derating.

   30.5% - 16.0% = 14.5%

3. The temperature derating is 1 percent.

4. Total the deratings.

Altitude	14.5%
Temperature	+ 1.0%
	15.5%

   Subtract the total derating percent from 100 percent to determine the percentage of engine KW potential.

100.0%
- 15.5%
84.5%

   Multiply the maximum KW potential of the engine, from Step 1, by the percentage just determined.

   474.0 KW x 0.845 = 400.5 KW

Generator

Derating at 9000 feet is 18 percent. This means the maximum generator output is 82 percent of the unit rating.

450.0 KW x 0.82 = 369 KW

Actual Unit Capacity

In this example, the generator is the major derating factor and determines unit capacity, 369 KW.

EXAMPLE 2

A radiator-cooled, propane-fueled 85.0 KR is selected for a standby application with a 3000-foot altitude and an 80 F ambient temperature.

Engine

1. Maximum engine KW potential of a propane-fueled 85.0 KR is 85 KW (Table 1).
2. Altitude derating from Table 2 is 9 percent at 3000 feet.
3. The temperature derating is 2 percent.
4. Total the deratings.

Altitude	9.0%
Temperature	+ 2.0%
	11.0%

Subtract the total derating percent from 100 percent to determine the percentage of the engine KW potential.

100.0%
- 11.0%
89.0%

Multiply the maximum KW potential of the engine, from Step 1, by the percentage just determined.

85.0 KW x 0.89 = 75.6 KW

Generator

Because there is no generator derating at 3000 feet (Table 4), the generator rating is the same as the unit rating . . . 85.0 KW.

Actual Unit Capacity

The engine is the limiting factor in this example for determining unit capacity, 75.6 KW.

TABLE 1. MAXIMUM kW POTENTIAL OF GENERATOR SET (ENGINE LIMITED) [1]

SPARK IGNITION				
Air-Cooled Series		**Gasoline**	**Propane**	**Natural Gas**
2.5LK		2.5	2.5	2.0
2.5AJ		2.5	2.5	2.3
4.0CCK		5.0	5.0	4.5
5.0CCK		5.0	5.0	4.5
6.5NH		6.5	6.0	5.0
7.5JB		8.0	7.8	6.7[4]
10.0CCKB		10.2	9.5	8.0
12.5JC		17.0	16.0	13.5
15.0JC		17.0	16.0	13.5[2]
Liquid Cooled Series	**Add this kW for City Water Cooling**	**Gasoline**	**Propane**	**Natural Gas**
12.5RJC	—	17.0	16.5	16.0
15.0RJC	—	17.0	16.5	16.0
30.0EK	2.0	33.0	31.0	28.0
30.0SK	—	37.0	33.5	26.0
45.0EM	2.0	48.0	45.0	39.0
55.0EN	3.0	—	—	57.0
55.0KB	3.0	65.0	58.0	52.0
65.0KB	3.0	65.0	—	—
70.0EN	3.0	79.0	75.0	—
70.0KR	3.0	—	—	77.0
85.0KR	4.0	93.0	85.0	77.0[3]

DIESEL		
Air Cooled Series	**—**	**Diesel**
3.0DJA		3.2
6.0DJB		6.7
6.0DJE		6.7
12.0DJC		13.4
Liquid Cooled Series	**Add this kW for City Water Cooling**	**Diesel**
15.0RDJC	—	15.7
17.5RDJF	—	17.5
30.0DDA	2.0	33.0
30.0DEH	2.0	33.0
45.0DEF	2.0	53.0
45.0DYJ	2.0	45.0
50.0DDB	2.0	52.0
50.0DEG	2.0	55.0
60.0DYA	1.1	66.0
75.0DYC	3.5	106.0
90.0DYC	3.5	106.0
100.0DYC	2.0	106.0
125.0DYD	4.0	141.0
150.0DYG	5.0	207.0
155.0DFE	6.0	240.0
175.0DYG	6.0	207.0
180.0DFE	5.0	240.0
200.0DYG	5.0	202.0
200.0DFP	5.0	240.0
230.0DFP	5.0	240.0
250.0DYH	10.0	257.0
250.0DFM	8.0	267.0
300.0DFS	11.0	310.0
350.0DFN	8.0	376.0
400.0DFV	14.0	460.0
450.0DFW	14.0	460.0
500.0DFY	13.0	520.0
600.0DFX	15.0	625.0
750.0DFZ	27.0	785.0

1. Maximum engine kW capability with no deratings for altitude or temperature. Ratings shown are for 60 hertz. Use 83% of these ratings for 50 hertz.
2. 15.0 kW with high compression engine (do not use propane).
3. 80.0 kW with high compression engine.
4. 7.5 kW with high compression engine.

For prime power ratings or application problems, contact your Onan distributor.

TABLE 2. GASOLINE, PROPANE AND DIESEL ENGINE ALTITUDE DERATINGS

Altitude Above Sea Level	% of Standard Rating (KW)	% Deration per 1000 ft	Total % Deration
1000	100 %	0	0
2000	95.5	4.5	4.5
3000	91	4.5	9.0
4000	87.5	4.1	12.5
5000	84	4.0	16.0
6000	80	4.0	20.0
7000	76	4.0	24.0
8000	72	4.0	28.0
9000	69.5	3.8	30.5
10000	67	3.7	33.0

EXCEPTION: Derating is unnecessary through 5000 feet for series DYJ, DYA, DYB, DYC, DYD, DYG, DYH, DFV, DFW and DFY. Use only additional altitude when calculating.

TABLE 3. NATURAL GAS ENGINE ALTITUDE DERATINGS

Altitude Above Sea Level	% of Standard Rating (KW)	% Deration per 1000 ft	Total % Deration
1000	100 %	0	0
2000	93.6	6.4	6.4
3000	87.9	6.0	12.1
4000	82.7	5.7	17.3
5000	77.9	5.5	22.1
6000	72.5	5.5	27.5
7000	67.2	5.4	32.8
8000	62.2	5.4	37.8
9000	58.6	5.2	41.4
10000	55.9	4.9	44.1

TABLE 4. GENERATOR ALTITUDE DERATINGS

Altitude Above Sea Level	% of Standard Rating (KW)	% Deration per 1000 ft	Total % Deration
1000	100 %	0	0
2000	100	0	0
3000	100	0	0
4000	97	3	3
5000	94	3	6
6000	91	3	9
7000	88	3	12
8000	85	3	15
9000	82	3	18
10000	79	3	21

NOTE: Derate from standby ratings as shown on charts, specification sheets or unit's nameplate.

Onan manufactures a complete line of electric power systems from 1 to 750 kW (generator sets • automatic transfer switches • industrial engines), gas-, gasoline- or diesel-driven. For standby power in homes, industrial plants, commercial buildings and institutions. For auxiliary or portable power in boats, recreational vehicles, service trucks and construction equipment.

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