KOHLER POWER SYSTEMS

Sound Enclosures
KD/KM/KV Models

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

General Information

Measuring Sound Level

The unit of measurement for sound level is the decibel (dB) that is calculated using the sound pressure (LpA) relative to a reference pressure.

$$Lp\ (dB) = 10 \log (P1^2/P0^2)$$

P1 = sound pressure of the sound wave (expressed in Pascals).

P0 = reference pressure (p_o = 20 x 10^{-6} *Pa)*

Figure 1 provides a comparison of sound pressure (LpA) levels and typical sources.

Sound Pressure (LpA) Level, dB(A)	Examples
140	Pain threshold
120	Boiler room Engine test stand Pneumatic drill/hammer
100	Diesel engine on test stand at full load at a distance of 1 m (3.3 ft.)
80	Inside a small car at 80 kph (50 mph)
70	Road noise
60	Landscaped office
50	Normal conversation
40	Quiet countryside
30	Whisper
20	Recording studio
10	Dead room
0	Audibility threshold in young adults for frequencies of 1000–4000 Hz

Figure 1 Sound Pressure (LpA) Level Examples

Sound Pressure (LpA) and Sound Power (LwA)

Directive 2000/14/EC was drawn up to limit the sound power of equipment used outdoors. This directive can be used as a gauge for limiting sound power in many applications and is of particular relevance to generator sets. Sound power is determined using a measurement of the sound level of the set operating at 3/4 of its rated power. The sound power limit authorized by the directive depends on the equipment's power and is classified as shown in Figure 2.

Generator Set at Rated Power, kW (kVA) *	January, 2002 (Step 1), LwA	January, 2006 (Step 2), LwA
0.5–2 (0.6–2.5)	97	95
2.5–3 (3.1–3.8)	98	96
3.2–10 (4–12.5)	99	97
11–31 (14–39)	98	96
32–316 (40–395)	99	97
317–399 (396–499)	100	98
>400 (>500)	No limit	No limit
* Rated Power		

Figure 2 Authorized Sound Power (LwA) Limit

Role of Sound Power

By limiting the sound power and not the pressure, it is possible to establish noise pollution comparisons between, for example, a portable generator set and a soundproofed unit.

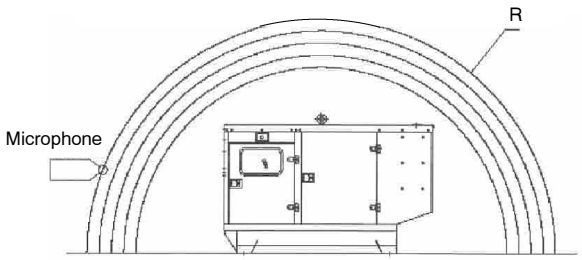
At equal sound power, irrespective of the generator set's size, the sound energy produced remains the same, and two generator sets of different sizes will produce exactly the same level of environmental noise pollution for an identical LwA value.

However, the larger the generator set, the larger its sound-emitting surface and, consequently, the higher the 10 log(S) value. In this case, to keep the LwA value within the permitted limits, the LpA (sound level) must be reduced, requiring improved soundproofing.

Sound power is calculated using the sound pressure measured by a sound level meter. The latter value is also known as sound level.

The sound power (LwA) and sound pressure (LpA) values are expressed in dB(A) or decibel (A weighted). See Figure 3. These two variations are exactly proportional and the sound power (LwA) value is, therefore, constant irrespective of the distance and the shape of the area used for measuring.

LwA = LpA + 1 - log(S)



LwA = sound power

LpA = sound pressure

S = area of the measurement hemisphere (area S relative to a reference area of length m^2)

The greater the distance R, the smaller the LpA value

The greater the distance R, the greater the S value

Figure 3 Sound Power and Sound Pressure Calculations

The effect is similar to that of a light bulb where its power is always the same irrespective of the distance, but the light bulb's illuminating capacity diminishes, like the sound pressure, as the distance increases. See Figure 4.

Model	Enclosure	LwA	LpA	
		dB	dB(A) @ 1 m (3.3 ft.)	dB(A) @ 7 m (23 ft.)
KD130	Yes	96	77.6	67.6

Figure 4 Sound Pressure vs. Distance

The standard allows a measurement to be taken using six microphones in a hemisphere whose radius depends upon the size of the generator set (4 , 10 , or 16 m [13, 33, or 52 ft.]) or in an equal distance of 1 m (3.3 ft.) from the generator set using a number of microphones, which depends on the size of the generator set. We use both methods, depending on the context (size of generator set, time saved in measuring, or need to multiply measuring points, etc.).

Aim of Directive 2000/14 EC

This directive was adopted by the European Parliament and Council on May 8, 2000, in order to harmonize the legislation of member states. It relates to noise emissions from equipment used outdoors; generator sets were listed among more than fifty types of product.

The aim of the directive is to encourage a healthy home environment and to improve the well-being of the population by reducing noise emissions. The directive has four central aims:

- Harmonization of noise emission standards
- Harmonization of conformity assessment procedures
- Harmonization of labeling relating to sound levels
- Collection of data relating to noise emission

The directive also aims to ensure that manufacturers respect imposed and declared sound levels. The manufacturer is committed to reducing outdoor noise levels and, in accordance with this directive, carries out regular sound checks on standard product ranges. The manufacturer has invested in the necessary resources:

- Approved sound level measuring area
- Data acquisition for measurement

As stated in Figure 2, the regulations were supplemented on January 1, 2006, when the limit for all generator sets was reduced to 2 dB(A). The full range of enclosures for the new generation now conform to the new requirement.

Noise Reduction Research

Noise reduction has always been a priority for the manufacturer. Consequently, the manufacturer has for some time possessed the measuring tools needed for checking the soundproofing of our generator sets. Nevertheless, in the interest of improvement and enhanced performance, the manufacturer has recently invested in cutting-edge techniques.

Traditional Methods

Traditional methods of measuring sound pressure using a sound level meter or several microphones connected to a data acquisition unit are sufficient for measuring the sound level of machines and relaying data on global sound pressure and sound spectra at the various measuring points.

The manufacturer still uses these traditional methods to check the sound power of all models covered by directive 2000/14/EC. To perform these checks, the manufacturer has portable sound level meters and a data acquisition connection to six microphones.

However, these measurements give only a general picture. They are not capable of determining the precise position or intensity of sound sources. The free field method of sound measurement can detect a sound level but cannot be used to determine the sound sources.

Sound Intensity Measurement

The manufacturer has been using the new technique of sound intensity measurement. This highly advanced method has a distinct advantage over traditional methods in that it is able to precisely identify sources of noise. It can be used to create a map of the sound emitted from the various components or surfaces of machines.

This precision analysis enables exact identification of all sound emissions in dB(A) and also on a frequency band. Consequently, noise sources can be more effectively identified and generator set soundproofing optimized.

The results of sound intensity measurement can also be corroborated using vibration measurements at various points on the generator set or by model analysis that we are now able to do using 3D CAD technology.

Enclosure Features

Accessory	KM Models, All KD Models up to KD110/KD100U	KD120U/KD130 and Larger
Aluminum hinges lined with epoxy powder paint	●	●
Plastic (polyamide) hinges (qty. 6)	●	●
Locks with seal	●	●
Bichromate galvanized bolting	●	●
Stainless steel rivets	●	●
Polyurethane sound insulating foam lined with protective film	●	X
Polyurethane sound insulating foam lined with hydrocarbon sealing film	X	●
Foam fire classification type automotive (self-extinguishing foam)	●	●
Rock wool with glass film	X	X
Emergency stop button on outside of enclosure	●	●
Operator access via side access panel with true keyed lock, number of access panels	3 qty.	4 qty.
Command/control unit porthole	●	●
Control unit door	●	●
Exhaust silencer integrated in enclosure	●	●
● Standard X Not Available		

Figure 5 Enclosure Accessories

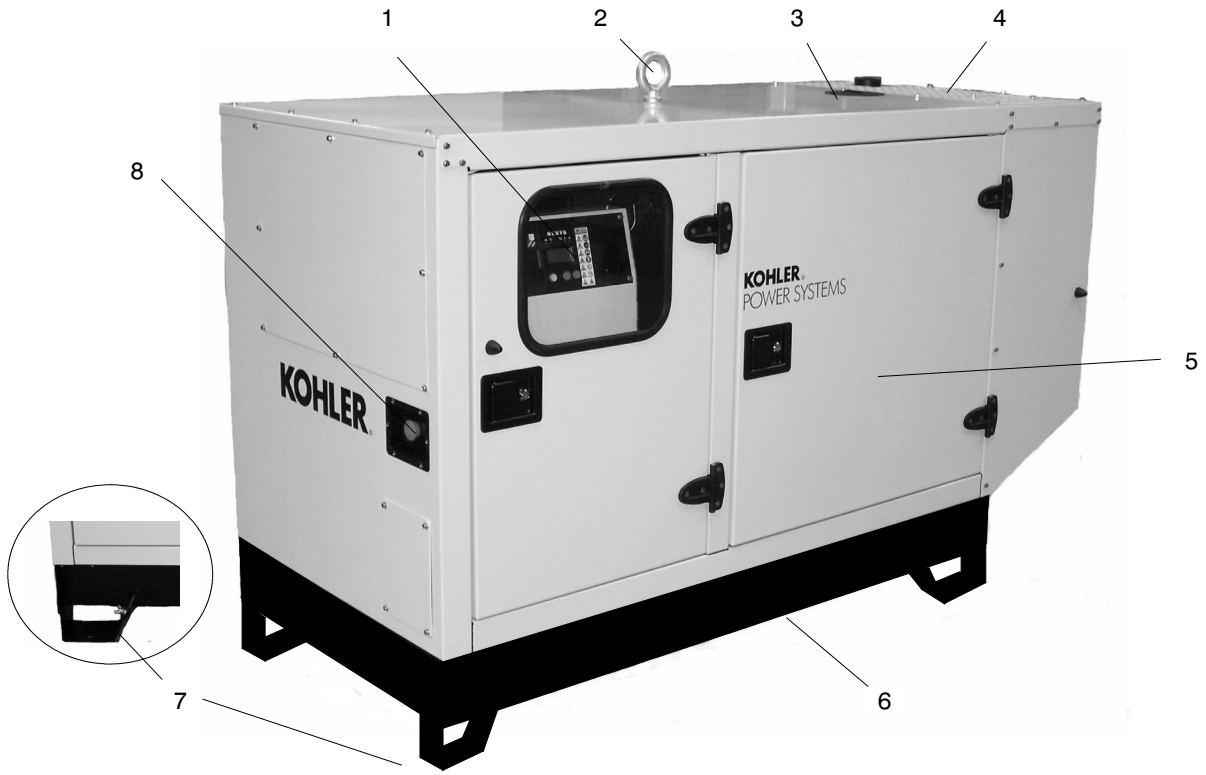
Enclosure Handling

One of the factors determining the quality of an enclosure is the ease with which it can be fitted. The standard enclosures in the manufacturer range have been designed to incorporate all the necessary lifting and handling points to respond to this requirement. See Figure 6 and Figure 7.

Accessory	1 KM Models All KD Models up to KD110/KD100U	2 KD120U-KD200U KD130-KD220	3 KD250U-KD300 KV Models
Integral brackets for forklifts	●	X	●
Removable brackets or pads for forklifts	X	●	X
Handling the generator set using a forklift either lengthwise or sideways	●	●	●
Eye for pulling and/or mounting	●	●	●
Single central lifting eye	●	●	X
Side lifting eyes	X	X	●
Base panel for fluid recovery	●	○	X

● Standard X Not Available ○ Optional

Figure 6 Lift and Handling Points



1. Control unit viewing porthole
2. Central lifting ring
3. Radiator filler access
4. Air outlet via top only; facilitates installation inside buildings through addition of a shroud
5. Engine access door
6. Base panel for fluid recovery
7. Brackets for fork lifts
8. Remote emergency stop button

Figure 7 Enclosure Features

Enclosure Specifications

Generator Set Model	Enclosure	Length, mm (in.)	Width, mm (in.)	Height, mm (in.)	Area, m^2 (ft^2)	LpA dB(A) @ 7 m (23 ft.), 60 Hz	LpA dB(A) @ 7 m (23 ft.), 50 Hz	Enclosure Wt., kg (lb.)
KM5.5M	M126	1750 (69)	715 (28)	1230 (48)	1.25 (13.4)	—	60.1	148 (326)
KM7.5								
KM9M							60.4	
KM11U						62.5	—	
KM11UM								
KM11.5						—	60.4	
KM11.5HM							70.8	
KM12M							60.7	
KM15H							70.8	
KM16							60.7	
KM16U						64	—	
KM16UM								
KM17M	M127	2080 (82)	904 (36)	1415 (56)	1.88 (20.5)	—	61	230 (507)
KM20H	M126	1750 (69)	715 (28)	1230 (48)	1.25 (13.4)		68.4	148 (326)
KM20U	M127	2080 (82)	904 (36)	1415 (56)	1.88 (20.5)	67	—	230 (507)
KM20UM								
KM22						—	61	
KM27H							62	
KM30U						67.4	—	
KM30UM						—	67.4	
KM33							73	
KD24M	M127	2080 (82)	904 (36)	1415 (56)	1.88 (20.5)	—	68	220 (485)
KD30U						73	—	230 (507)
KD30UM								220 (485)
KD33						—	68	230 (507)
KD40U						72	—	220 (485)
KD40UM								230 (507)
KD44						—	65	220 (485)
KD60U	M128	2300 (91)	1080 (43)	1680 (66)	2.48 (27.2)	66	—	400 (881)
KD60UM	M129	2554 (101)	1170 (46)	1680 (66)	2.99 (32.3)			530 (1168)
KD66	M128	2300 (91)	1080 (43)	1680 (66)	2.48 (27.2)	—	66	400 (881)
KD70U						67	—	430 (948)
KD70UM	M129	2554 (101)	1170 (46)		2.99 (32.3)			530 (1168)
KD77	M128	2300 (91)	1080 (43)	1680 (66)	2.48 (27.2)	—	66	420 (926)
KD80U						73.1	—	430 (948)
KD88						—	70	420 (926)
KD100U	M129	2554 (101)	1170 (46)		2.99 (32.3)	70	—	530 (1168)
KD110						—	67	

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Enclosure Specifications, continued

Generator Set Model	Enclosure	Length, mm (in.)	Width, mm (in.)	Height, mm (in.)	Area, m^2 (ft^2)	LpA dB(A) @ 7 m (23 ft.), 60 Hz	LpA dB(A) @ 7 m (23 ft.), 50 Hz	Enclosure Wt., kg (lb.)
KD120U	M226	3508 (138)	1200 (47)	1830 (72)	4.21 (45.0)	70.1	—	550 (1212)
KD130						—	67.6	500 (1102)
KD150U						70.1	—	480 (1058)
KD165						—	68.6	
KD175U						70.1	—	530 (1168)
KD200						—	69	
KD200U						70.1	—	646 (1424)
KD220						—	68.6	596 (1313)
KD250U	M227	4004 (158)	1380 (54)	2125 (84)	5.53 (59.3)	72.5	—	990 (2182)
KD275U						—	69.5	980 (2160)
KD300								990 (2182)
KD350U	M228	4475 (176)	1410 (56)	2430 (96)	6.31 (68.4)	NA	—	1130 (2491)
KD400						—	66.5	
KD400U						NA	—	
KD440						—	66.6	
KV200U	M227	4004 (158)	1380 (54)	2125 (84)	5.53 (59.3)	71.7	—	960 (2116)
KV220						—	68.5	
KV300U	M228	4475 (176)	1410 (56)	2430 (96)	6.31 (68.4)	69.9	—	1130 (2491)
KV330						—	67	
KV350U						73	—	
KV375						—	67	
KV400U						73	—	
KV410						—	70	
KV440						—	70	
KV450U	M229	5031 (198)	1560 (61)		7.85 (83.9)	73.8	—	1250 (2755)
KV500						—	68	
KV500U						75	—	
KV550						—	68	
KV550U	M230		1690 (67)	2662 (105)	8.50 (92.1)	75.4	—	3372 (7430)
KV630						—	71.5	

NA Not available at this time.

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