REGIONE CAMPANIA

Provincia di Avellino

COMUNI DI Lacedonia (AV) – Monteverde (AV)

PROGETTO

PROGETTO DI REBLADING DEL PARCO EOLICO LACEDONIA-MONTEVERDE (39,60 MW)

PROGETTO DEFINITIVO

COMMITTENTE:

ERG Wind 4

ERG EVOLVING ENERGIES

PROGETTISTA:

GOLDER
Via Sante Bargellini, 4
00157 - Roma (RM)

Dott. Ing. VITO BRETTI ORDINE INGEGNERI ROMA A 23403 settori a-b-c

OGGETTO DELL'ELABORATO:

ALLEGATO 6

SCHEDE TECNICHE DEL MODELLO DI AEROGENERATORE E DEI CAVI ELETTRICI DI COLLEGAMENTO

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Storia delle revisioni del documento

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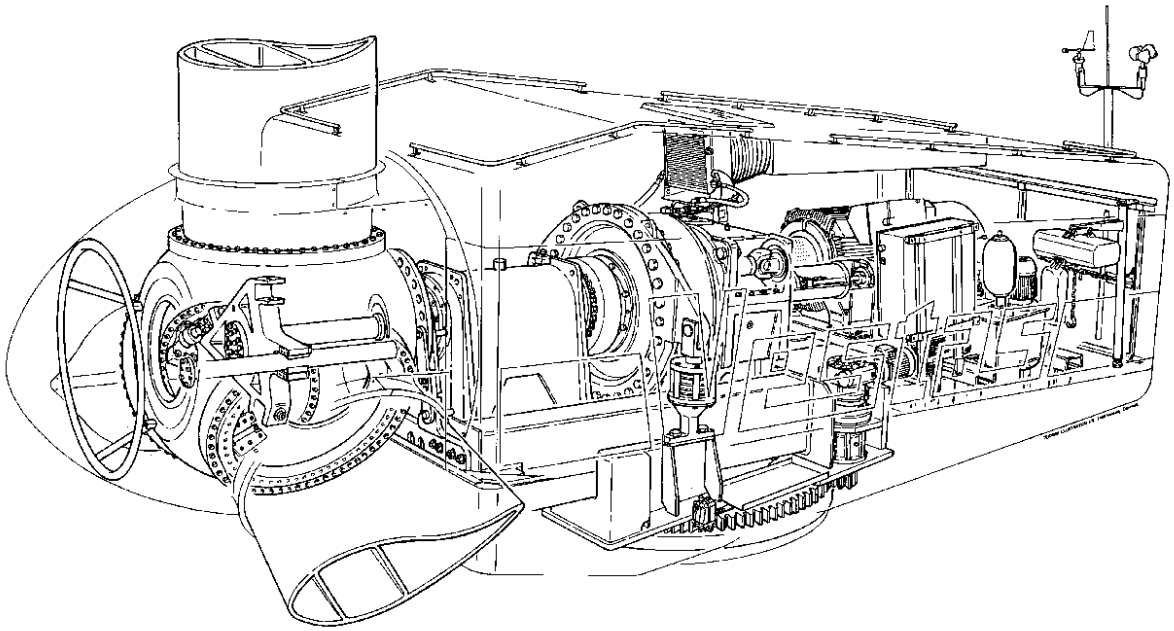
00	**03/2020**	PRIMA EMISSIONE	MGL	LSP	VBR

SCHEDA TECNICA DEL MODELLO DI AEROGENERATORE INSTALLATO – VESTAS V47

General Specification

660 kW Variable Slip Wind Turbines



V47 - 660 kW

V47 - 660/200 kW

Item no.: 943111.R4

(11)

Vestas 660 kW, Variable Slip Wind Turbines

Contents **Page**

1. Introduction

The Vestas 660 kW wind turbines are based on the experience gained from the V39-500 kW and V39/42/44-600 kW wind turbines.

The Vestas 660 kW wind turbines are available in two versions with the same swept areas and the same climatic conditions. The difference between the two versions consists in the V47-660 kW having a synchronous rotor speed of 28.5 rpm and one generator. The V47-660/200 kW has two seperate generators running at two different synchronous speeds (26 and 20 rpm).

The V47 turbines uses the superior variable slip concept, which was introduced in the Vestas 600 kW turbines (V39/42/44). This feature ensures a smooth power output and at the same time reduces the loads significantly.

The special Vestas Optitip® feature is standard on both Vestas 660 kW turbines. This feature provides the optimum tip angle at all times with respect to power performance and noise emission.

2. Type Approvals

The wind turbines are designed in accordance with IEC 1400-1 , DS472 (“Teknisk Grundlag”), Germanisher Lloyd IV part 1 and NEN 6096/2.

3. Climatic Conditions

The wind climate for a given site is normally specified by a Weibull distribution. The Weibull distribution is described by an A and a C factor. The A factor is proportional to the mean wind speed and the C factor defines the shape of the Weibull distribution or in other words long term variations of hours at different wind speeds. Turbulence is the factor which describes short term wind variation/fluctuations. In the table below the design wind conditions for the Vestas 660 kW wind turbine are listed.

Version	Mean wind speed	Turbulence	Hub height [a)]
V47 - 660 kW	Max. 10 m/s	Max. 17%	40 - 55 m.
V47 - 660/200 kW	Max. 10 m/s	Max. 17%	40 - 65 m.

[a)] Vestas modular tower.

Table 1 Wind speed and turbulence according to IEC/GL at hub height.

The stop wind speeds are a design parameter. The maximum wind speeds are also important for the loads on the wind turbine. The maximum allowable extreme wind speeds are listed in table 2 next page.

Version	Max. 10 min. mean	Max. 3 sec. mean	Gust max. acc.	Stop wind speed/ Restart wind speed
V47 – 660 kW	50 m/s	70 m/s	10 m/s^2	25 m/s 20 m/s
V47 – 660/200 kW	50 m/s	70 m/s	10 m/s^2	25 m/s 20 m/s

Table 2. Wind speed according to IEC/GL.

The above tables can be used to determine if a Vestas V47 turbine is appropriate for a given site in other countries than Denmark, Germany and the Netherlands. For these countries table 3 below must be consulted.

Country	Turbine	Conditions		Hub height a)
		Class	Stop/start	meter
Denmark	V47-660	all classes	25 / 20 m/s	40 - 55
Denmark	V47-660/200	all classes	25 / 20 m/s	40 - 65
Germany	V47-660/200	DIBt III	20 / 18 m/s	55 - 65
Netherland	V47-660	Den Helder	25 / 20 m/s	40 - 55
Netherland	V47-660/200	Den Helder	25 / 20 m/s	40 - 65

[a)] Vestas modular towers

Table 3. Country specific conditions and approvals.

Concerning park installations the conditions of section 9 are to be observed, and for other conditions Vestas must be consulted.

3.1 Stop wind speed / restart wind speed

The turbine stops for high wind speed when the exponential mean wind speed averaged during 100 seconds is above the stop wind speed level.

The turbine restarts when the exponential mean wind speed averaged during 100 seconds, is below the reset wind speed, and stays below the stop wind speed for 1 minute.

3.2 Site specific loads

The turbines can be placed under various climatic conditions: where the air density, turbulence intensity and the mean wind speed are the parameters to be considered. If the turbulence intensity is high the turbine loading increases and the turbine lifetime decreases, on the contrary the loading will be reduced and the lifetime extended if the mean wind speed or/and turbulence is low. Therefore, the turbines can be placed on sites with high turbulence intensity if the mean wind speed is suitable low.

Vestas has to examine the climatic conditions if the prescribed is exceeded.

3.3 Low Temperature version

The VestasV47-660 kW turbine is also available as a Low Temperature version.

This version is equipped with special heat treated steel components when necessary, and the nacelle has built in heaters. Also the wind vane and anemometer are heated. Other modifications have also been necessary to enable this version to operate down to -30°C. This version is designed for a temperature range from -30°C to +40°C. (Standard -20°C to +40°C). For non-operational conditions a temperature range of -40°C to +40°C is allowed. Please note that because of the higher density of the air at low temperatures, the LT version has lower extreme wind speed limits.

Version	Max. 10 min. mean	Max. 3 sec. mean	Gust max. acc.	Stop wind speed/ Restart wind speed
V47 – 660 kW, LT	42.5 m/sec.	59.5 m/s	10 m/s^2	25 m/s / 20 m/s

Table 4. V47-660 kW LT wind speed according IEC 1400-1.

4. Power curve and annual production (calculated)

See enclosure 1 for the measured power curve.

4.1 V47 - 660 kW

Power curves calculated on basis of NACA63.600 and FFA-W3 airfoil data.

Wind speed: 10 minutes average value, at hub height and orthogonal to the rotor plane.

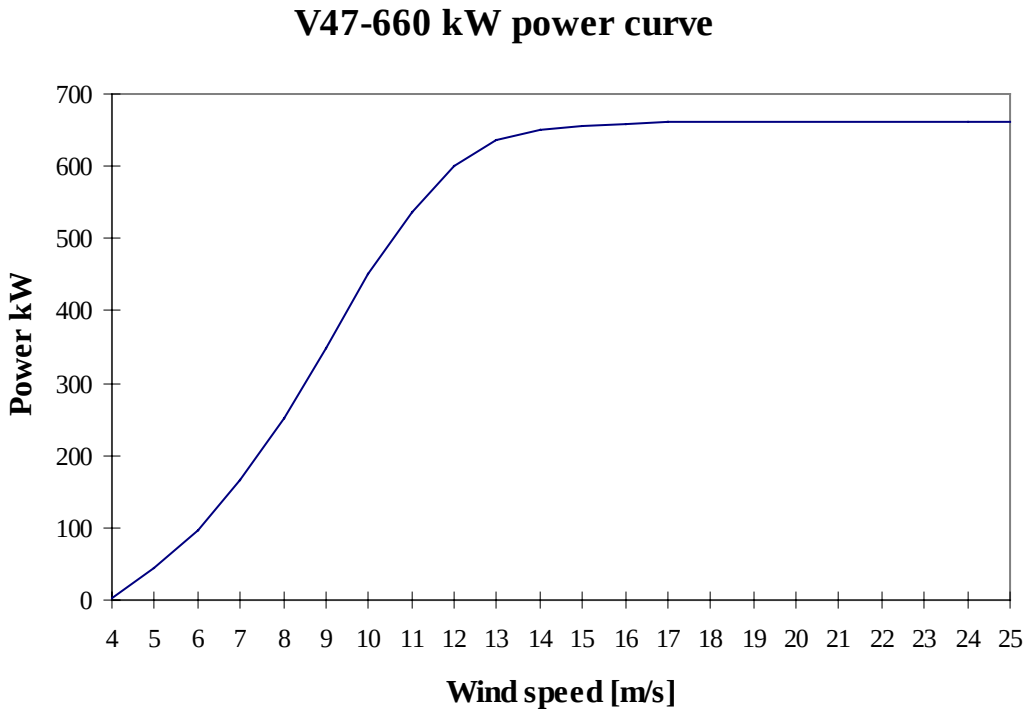
Parameters for calculated curves:

	50 Hz/60 Hz
Tip angle:	Pitch regulated.
Turbulence:	10 %.
Rotor speed (Synchr.):	28.5 rpm.

EL-power [kW] as a function of wind speed [m/s] and air density [kg/m^3]:

V10	**1.225**	1.06	1.09	1.12	1.15	1.18	1.21	1.24	1.27
4.0	**2.9**	0.6	1.1	1.5	1.9	2.3	2.7	3.1	3.5
5	**43.8**	36.2	37.5	38.9	40.3	41.7	43.1	44.5	45.8
6	**96.7**	81.8	84.5	87.2	89.9	92.6	95.4	98.1	101
7	**166**	141	146	150	155	159	164	168	173
8	**252**	215	222	228	235	242	248	255	262
9	**350**	300	309	318	327	337	346	354	363
10	**450**	392	402	413	424	435	446	455	464
11	**538**	480	491	502	512	523	534	542	549
12	**600**	554	563	572	580	589	598	602	607
13	**635**	607	612	618	623	629	634	636	639
14	**651**	637	640	643	646	648	651	652	653
15	**657**	652	653	654	655	656	657	658	658
16	**659**	657	658	658	659	659	659	659	659
17	**660**	659	659	660	660	660	660	660	660
18	**660**	660	660	660	660	660	660	660	660
19-25	**660**	660	660	660	660	660	660	660	660

4.1.1 V47-660 kW power curve



The curve will vary at other turbulence and air density values.

The V47-660 kW is especially developed for sites where noise concerns are less critical.

4.2 V47 - 660/200 kW

Power curves calculated on basis of NACA63.600 and FFA-W3 airfoil data.

Wind speed: 10 minutes average value, at hub height and orthogonal to the rotor plane.

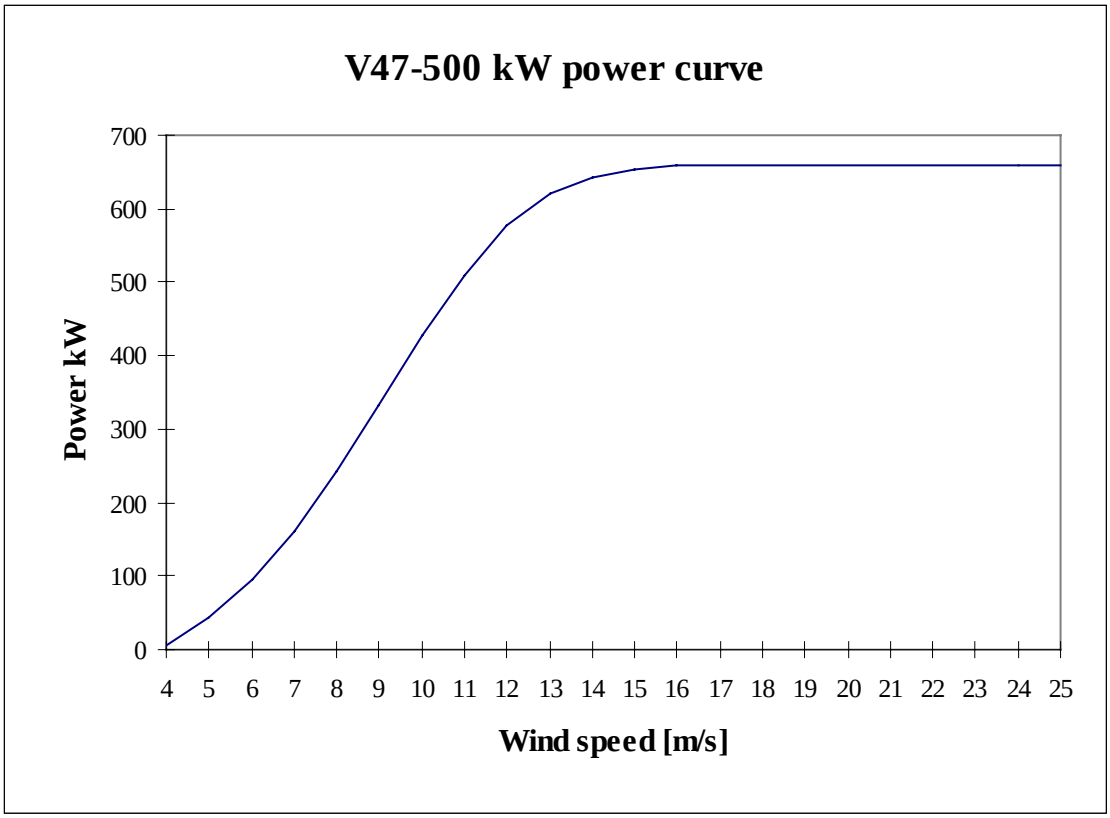
Parameters for calculated curves:

	50 Hz/60 Hz
Tip angle:	Pitch regulated.
Turbulence:	10 %.
Rotor speed (Synchr.):	26 and 20 rpm.

EL-power [kW] as a function of wind speed [m/s] and air density [kg/m^3]:

V_{10}	**1.225**	1.06	1.09	1.12	1.15	1.18	1.21	1.24	1.27
4	**5.3**	0.8	1.6	2.4	3.2	4.1	4.9	5.7	6.5
5	**44.9**	35.2	37.0	38.8	40.5	42.3	44.1	45.8	47.6
6	**95.4**	79.0	82.0	85.0	88.0	91.0	93.9	96.8	99.7
7	**161**	136	141	145	150	155	159	163	168
8	**242**	206	213	219	226	233	239	246	252
9	**334**	285	293	302	311	320	329	338	347
10	**426**	366	377	389	400	410	421	432	442
11	**511**	446	459	471	484	495	505	516	526
12	**577**	519	531	543	556	564	573	581	589
13	**620**	578	587	597	607	612	618	623	628
14	**644**	619	625	631	637	640	643	645	648
15	**654**	642	645	648	652	653	654	655	656
16	**658**	653	655	656	657	658	658	658	659
17	**660**	658	658	659	659	659	660	660	660
18	**660**	659	660	660	660	660	660	660	660
19-25	**660**	660	660	660	660	660	660	660	660

4.2.1 V47-660/200 kW power curve



The curve will vary at other turbulence and air density values.

The V47-660/200 kW is especially designed for sites, where noise requires special attention.

4.3 Production/year

Production/year for different mean wind speeds and different Weibull distributions.

Mean wind speed m/sec. Production in MWh (C=2.0)					
	6	7	8	9	10
V47 - 660 kW	1366	1890	2377	2803	3155
V47 – 660/200 kW	1321	1825	2307	2729	3081

Mean wind speed m/sec. Production in MWh (C=1.5)					
	6	7	8	9	10
V47 - 660 kW	1476	1894	2254	2544	2766
V47 – 660/200 kW	1434	1844	2199	2488	2709

Mean wind speed m/sec. Production in MWh (C=2.5)					
	6	7	8	9	10
V47 - 660 kW	1259	1843	2411	2924	3363
V47 – 660/200 kW	1216	1777	2329	2835	3273

Danish roughness class at hub height 45 meter - Beldringe correction. Production in MWh				
Turbine	Class 0	Class 1	Class 2	Class 3
V47 - 660 kW	2513	1756	1454	1023
V47 - 660/200 kW	2465	1702	1406	991

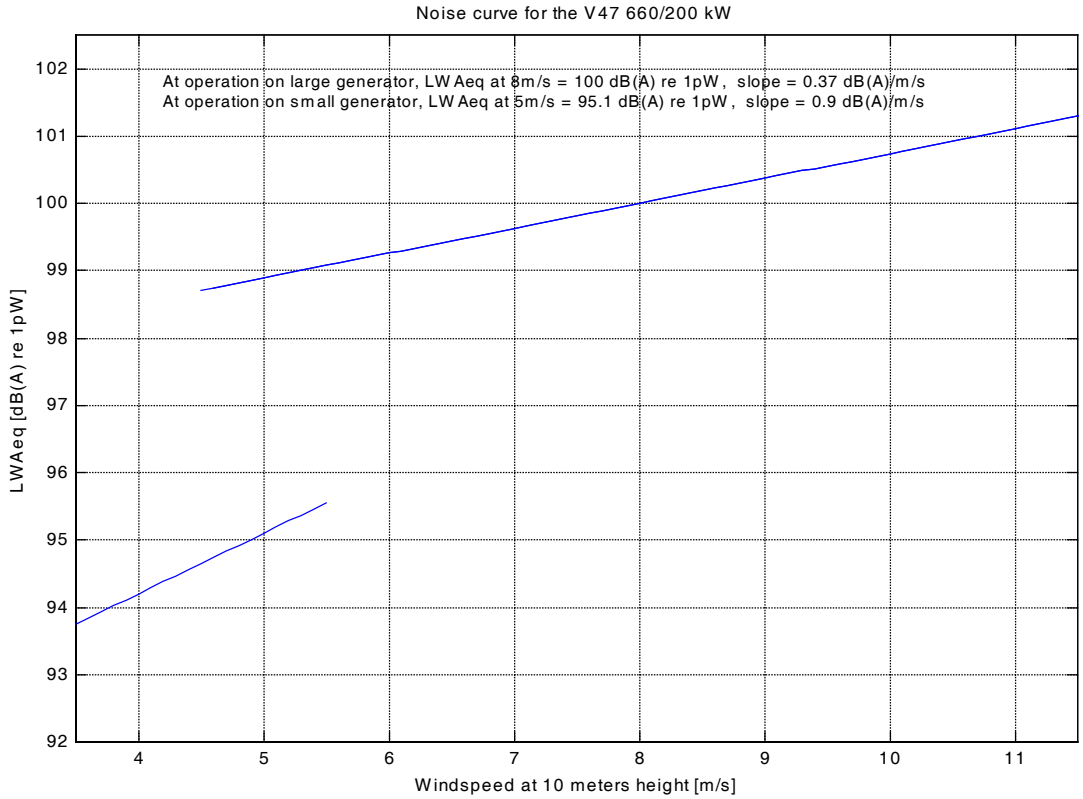
5 Noise emission

See enclosure 2, Noise resume.

5.1.1 Noise level: (sound power level)

According to DK 304	V47-660 kW	V47-660/200 kW
In dB (A) re 1 PW	102	100

The noise emission for the V47-660/200 kW is given for the large generator in operation at a synchronous rotor speed of 26 rpm, as the generator shift is approximately at 7 m/sec and the reference wind speed for the noise measurements is 8 m/sec. The noise emission of this turbine will be significantly lower at low wind speeds, when the turbine is operating at the lower synchronous rotor speed (20 rpm) with the small generator connected.



Wind speed measured in 10 meters height. Roughness length = 0,05 m and hub height = 45,7 m (45 m tower).
The wind speed from 10 meters height can be calculated to a wind speed in 45,7 m height, by using the multiplying factor 1,2868 (valid only for a roughness length and 0,05 m). Example,

$V_{10\ meter}$ = 5 m/s ==> $V_{45,7\ meter}$ = 6,43 m/s
$V_{10\ meter}$ = 8 m/s ==> $V_{45,7\ meter}$ = 10,29 m/s

6. Variable slip, Optislip®

So far the normal way of operating asynchronous wind turbine generators has been that of constant speed. An induction generator operates with almost constant speed normally within 100% to 101% of nominal speed. For a four pole generator this means operation from 1500 rpm (no load) to 1515 rpm (full load) at 50 Hz frequency. This small variation is considered insignificant, and this is why operation mode is called constant speed.

When the wind speed changes it will result in corresponding power output changes. When nominal power is reached power fluctuations are undesirable. Vestas introduced pitch regulation because this feature enables maximum power to be limited to nominal as an average at high wind speeds. However, with a fixed speed generator, power fluctuations are so fast that it is only possible to keep the average power constant, and therefore rapid fluctuations will occur. These rapid fluctuations contribute to the loading of the turbine. In order to minimise the loads Vestas introduced the variable slip concept together with the V39/42/44-600 kW wind turbine and reused this concept for the Vestas V47 turbine. This feature means that it is possible electronically to vary the slip within 10% (1500 - 1650 rpm).

The variable slip feature is used when a wind gust hits the rotor. The controller then allows the speed of the generator to increase slightly in response to the gust. At the same time the pitch system turns the blades to a less aggressive angle and thereby decreases the rotor rpm. The result is a 100% constant and smooth power output with a minimum of loads on; blades, main shaft and gearbox.

The variable slip is a very simple, reliable and cost effective way of achieving load reductions compared to more complex solutions such as full variable speed using full scale converters.

7. General specification

7.1 Structure of machinery

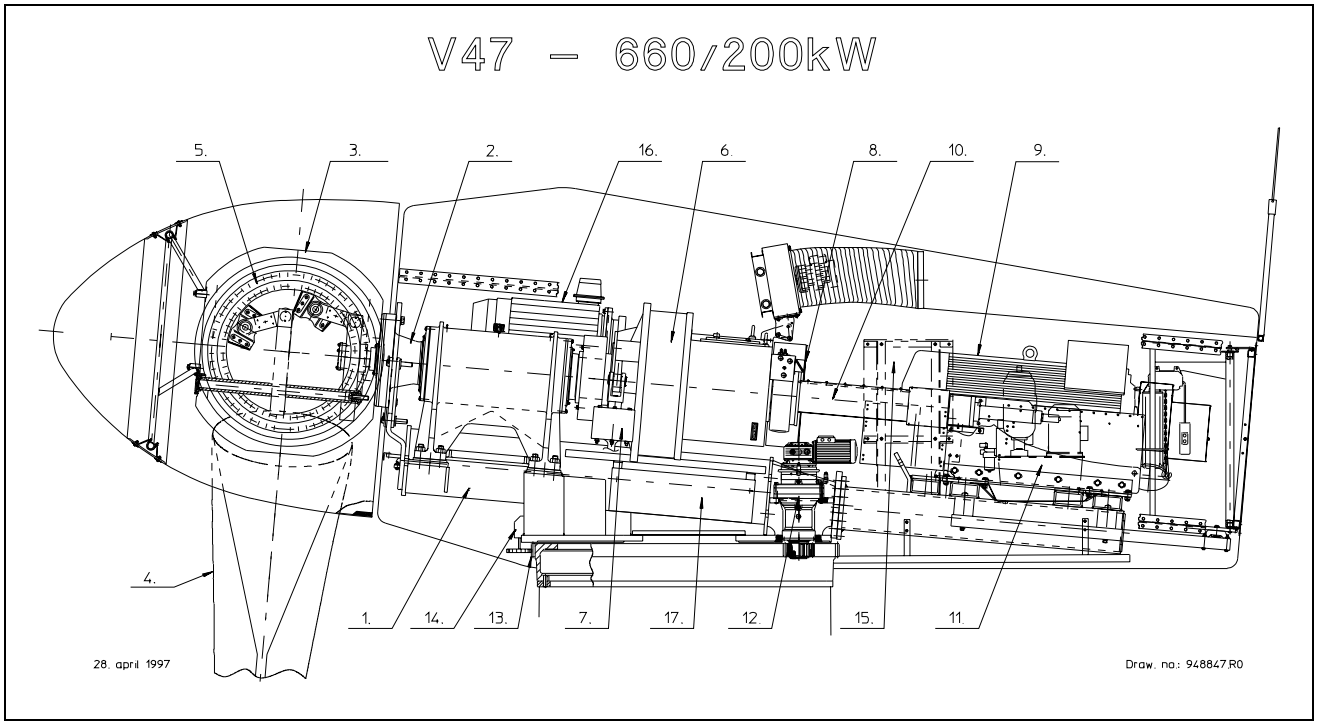


Figure 1 Structure of V39/V42/V44-600 kW and V47-660 kW wind turbine.

1. Base frame
2. Main shaft
3. Blade hub
4. Blade
5. Blade bearing
6. Gearbox
7. Gear tie rod
8. Disc brake
9. Generator
10. Cardan shaft
11. Hydraulic unit
12. Yaw gear motor
13. Yaw ring
14. Yaw control
15. VMP top control unit
16. Small generator
17. Generator shift box

8.Technical specifications

8.1.1 Rotor

	V47-660 kW	V47-660/200 kW
Diameter:	47 m	47 m
Swept area:	1735 m^2	1735 m^2
Rotational speed, rotor:	28.5 rpm	26/20 rpm
Rotational direction:	Clockwise (front view)	

8.1.2 Tubular tower

Top diameter (for all towers): 2.0 m

Type	Exact Hub Height	Bottom diameter	Weight
2-parted, modular tower (40 m)	40.7 m	3.0 m	approx. 28900 kg
2- parted, modular tower (45 m)	45.7 m	3.0 m	approx. 33000 kg
2- parted, modular tower (50 m)	50.1 m	3.3 m	approx. 38000 kg
2&3- parted, modular tower (55 m)	55.1 m	3.3 m	approx. 50700 kg
3- parted, modular tower (60 m)	59.7 m	3.6 m	approx. 58500 kg
3- parted, modular tower (65 m)	64.6 m	3.6 m	approx. 66400 kg

The exact hub height includes 0.4 m (distance from foundation section to earth).

Paint system, outside:	
Surface treatment:	Metallizing + painting
Sand blasting:	SA 3 ISO 8501-1
Metallizing:	DSI/ISO 2063, 60 µm Zn
Sealing with twocomponent epozyprimer:	Approx. 20 µm
Primer:	Min. 90 µm
Top coat:	UV resistant, min. 50 µm
Corrosion class (DS/R 454):	3
Paint system, inside:	
Surface treatment:	Paint
Sand blasting:	SA 2.5 ISO 8501-1
Zinciferous primer:	Min. 40 µm
Top coat:	Min. 100 µm
Corrosion class (DS/R 454):	2

8.1.3 Foundation sections

Type	Height	Max. diameter	Weight
For 35,40,45 m modular tower	2.1 m	3.2 m	approx. 3100 kg
For 50,55 m modular tower	2.1 m	3.5 m	approx. 3400 kg
For 60,65 m modular tower	2.1 m	3.75 m	approx. 4500 kg

8.1.4 Gear, V47-660 kW

Type:	Planetary/helical gear
Ratio:	52.6514

8.1.5 Gear, V47-660/200 kW

Type:	Planetary/helical gear
Ratio:	58 & 75

8.1.6 Large generator

Type:	Asynchronous, variable slip
Rated power:	660 kW
Voltage:	690 VAC
Frequency:	50 Hz
Class of protection:	IP54
Number of poles:	4
Rotational speed:	1515-1650 rpm
Rated current:	628 A
Power factor:	0.88
Resultant power factor:	0.98
Resultant current:	564 A

8.1.7 Small generator

Type:	Asynchronous, cons. slip (1.1%)
Rated power:	200 kW
Voltage:	690 VAC
Frequency:	50 Hz
Class of protection:	IP54
Number of poles:	4
Rotational speed:	1500-1516 rpm
Rated current:	190 A
Power factor:	0.89
Resultant power factor:	0.99
Resultant current:	171 A

8.1.8 Controller:

Electrical data:

Voltage:	3x690 V, 50 Hz
Lockable circuit breaker:	630 A
Power supply for light:	1x10 A/230 V
Generator cut in:	By thyristors
Power factor correction:	250 kVAr

Top processor:

Supervision/Control:	Yawing
	Hydraulic
	Surroundings (Wind, temperature)
	Rotation
	Generator
	Pitch system

Bottom processor:

Supervision/Control:	Grid
	Power factor correction
	Thyristors
	Remote monitoring

Operator panel:

Information:	Operating data
	Production
	Operation log
	Alarm log
Commands:	Run/Pause
	Manual yaw start/stop
	Maintenance routine

8.1.9 Remote monitoring:

Possibility of connection of serial communication e.g. Vestas Remote Panel.

8.1.10 Weight:

The listed masses is maximum values

Complete nacelle:	Approx. 20400 kg
Rotor V47, (incl. hub):	Approx. 7200 kg

9. Installation

Terrain:

If the terrain within a 100 m radius of the turbine has a slope of more than 10°, certain considerations may be necessary.

Climatic conditions:

The turbine is designed for an ambient temperature range from -20°C up to +40°C, (10 min. average). The temperature range for the LT-version is –30°C up to +40°C (10 minutes average). Outside these temperatures the turbine will stop and certain considerations may be necessary.

The turbine can be placed in wind farms with a distance of min. 5 rotor diameters (235 m) between turbines. If the turbines are placed in only one row (perpendicular to the predominant wind direction) the distance between the turbines must as a min. be 4 rotor diameters (188 m).

For operation under different conditions contact Vestas.

The humidity can be 100%, (max. 10% of the time). Corrosion protection according to corrosion class 3 outside, and 1 to 2 inside, (DS/R 454).

Grid connection:

Intermittent or rapid power fluctuations of utility grid frequencies may cause serious damage to the wind turbine. Steady variations within +1/-3 Hz are acceptable. The voltage operational range shall be within +10/-6 of nominal.

Grid drop-outs should only take place once per week as an average over the lifetime of the turbine.

A ground connection of max. 10 Ω must be present. Furthermore, it is recommended that the turbine is connected to a TN-grid.

In case of small independent grids, it will be necessary to check the actual conditions.

The 5th and 7th. harmonics are sinusoidal voltage with frequencies at 250Hz and 350Hz respectively. Harmonics are caused by different equipment (e.g. welding machines), which via a transformer is connected to same power supply systems as the wind turbine. Harmonics in the power supply systems reduce the lifetime of the capacitor.

The impedance voltage of the transformer and the size of the power factor correction are very important for the acceptable level of harmonics.

- If a 800kVA transformer with 4.5% impedance voltage is used together with the 250 kVAr power factor correction, the 5th and 7th harmonics have to be below 3% and 2% respectively.
- If a 800kVA transformer with 6% impedance voltage is used together with the 250 kVAr power factor correction, the 5th and 7th harmonics have to be below 3% and 1% respectively.

It is recommended to use a 800kVA transformer with 4.5% impedance voltage for a V47-660kW wind turbine.

10. General reservations

Derating of nominal power may occur with a combination of e.g. high wind, low voltage or frequency and high temperature.

In general it is recommended that the grid voltage is as close to nominal as possible. A stationary frequency below nominal will influence the power curve.

In connection with a grid drop-out and very low temperatures, a certain time of heating-up must be expected before the turbine restarts after re-establishing of the grid.

If the wind turbine is placed in more than 1000 m above sea level, a higher temperature rise than usual might occur in generator, transformer and other electrical components. In this case a periodic reduction of rated power might occur, even if the ambient temperature is within the specified limits.

Furthermore, also at sites in more than 1000 m above sea level there will be an increased risc of icing up.

Due to continuous development and updating of VESTAS products, VESTAS reserves the right to change the specifications.

11. Enclosure 1, power curve measurement

Power Curve measurement V47 660 kW wind turbine

11.1 Power curve measurement on the V47-660kW Wind turbine

1. The measurement is carried out by:

   Tripod Wind Energy Aps
   Gladsaxe møllevej 21
   2860 Søborg
   Phone 39666622
   Fax 39666699

   Tripod Wind Energy is authorized by the Danish Ministry of Energy to carry out power curve measurements and type testing in accordance with the Danish system for approval of wind turbines.

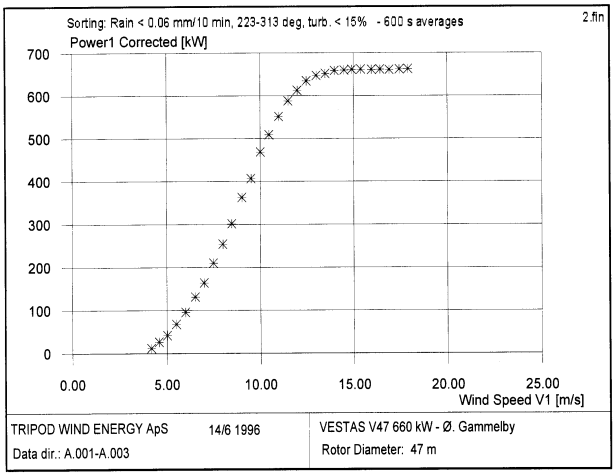
2. This resumé is made the 24. November 1997 by Vestas Wind Systems A/S

3. The measurements are reported in “TWE-report 970615-2”, which is dated June 1997. The measurements are carried out in the period 8/4-1997 to 6/5 1997.

4. The Windturbine type is: VESTAS V47-660kW

5. The measurement was performed according to the “Recommandation for wind turbine power curve measurements [Risø-I-745(EN), November 1993]”.

6. Results.



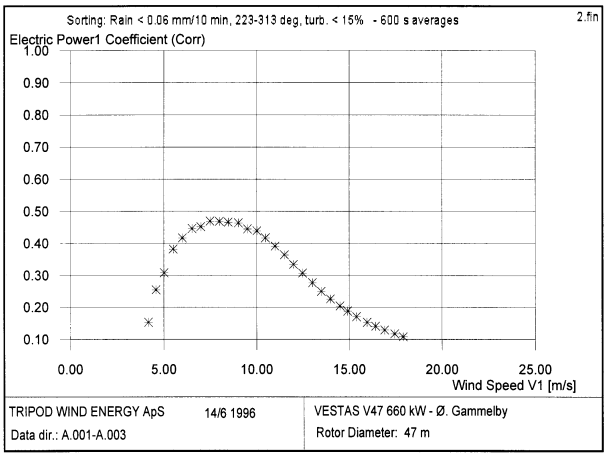
TRIPOD WIND ENERGY : 14/6-1997 14:59 (2.fin)

Object of bin-analysis : Sorting: Rain < 0.06 mm/10 min, 223-313 deg turb. < 15%
: VESTAS V47 660 kW - Ø. Gammelby
: Rotor diameter: 47 m
Data directories : \A.001 - \A.003
Basic averaging time : 60.00 secs
Final averaging time : 600.00 secs

X-axis (bins) : Wind speed V1 [m/s]
Y-axis (binned) : Power1 Corrected [kW]

X-bin	# data	mean(Y)	rms(Y)	min(Y)	max(Y)
4.17	4	11.75	1.58	9.41	13.31
4.58	36	26.46	7.22	11.77	42.61
5.02	90	41.79	8.35	25.42	57.86
5.50	97	67.86	12.85	43.90	121.74
6.00	119	95.69	14.21	65.51	165.56
6.51	133	131.45	18.04	95.44	230.63
6.99	142	164.31	17.77	119.24	205.93
7.49	128	209.85	20.23	174.14	268.28
7.99	83	253.80	22.68	193.43	318.20
8.47	69	301.19	22.79	262.51	360.79
9.02	68	362.48	27.29	308.11	423.27
9.51	60	406.70	31.41	322.22	482.98
10.01	67	468.74	38.10	378.42	548.99
10.47	70	508.55	36.66	393.63	614.14
10.99	86	551.26	26.27	476.08	602.81
11.50	59	587.82	27.41	498.62	649.74
11.99	48	612.36	16.74	577.32	647.15
12.48	41	634.38	15.86	592.10	657.99
13.01	33	646.79	12.15	609.59	661.80
13.49	25	651.40	10.01	626.58	660.70
13.99	24	658.40	4.63	645.43	662.67
14.50	32	659.46	3.61	645.79	662.79
14.91	13	661.11	1.85	656.63	662.91
15.39	11	661.16	1.54	658.73	662.91
15.96	7	660.87	1.04	659.71	662.91
16.42	8	661.22	1.27	659.83	662.79
16.91	6	660.49	0.99	659.71	662.67
17.45	4	661.47	1.16	660.08	662.79
17.91	1	662.42	0.00	662.42	662.42
Total	1564				

The measured power curve is corrected to the standard air density of 1.225kg/m^3.



TRIPOD WIND ENERGY : 14/6-1997 14:59 (3.fin)

Object of bin-analysis : Sorting: Rain < 0.06 mm/10 min, 223-313 deg turb. < 15%
: VESTAS V47 660 kW - Ø. Gammelby
: Rotor diameter: 47 m
Data directories : \A.001 - \A.003
Basic averaging time : 60.00 secs
Final averaging time : 600.00 secs

X-axis (bins) : Wind speed V1 [m/s]
Y-axis (binned) : Electric power1 (corr.) coefficient Cp [-]

X-bin	# data	mean(Y)	rms(Y)	min(Y)	max(Y)
4.17	4	0.153	0.021	0.123	0.177
4.58	36	0.255	0.057	0.142	0.379
5.02	90	0.308	0.046	0.208	0.411
5.50	97	0.382	0.061	0.271	0.695
6.00	119	0.417	0.051	0.305	0.709
6.51	133	0.446	0.047	0.344	0.735
6.99	142	0.452	0.037	0.334	0.538
7.49	128	0.469	0.036	0.375	0.561
7.99	83	0.468	0.040	0.341	0.557
8.47	69	0.466	0.030	0.396	0.553
9.02	68	0.464	0.028	0.390	0.515
9.51	60	0.445	0.028	0.380	0.528
10.01	67	0.439	0.030	0.361	0.515
10.47	70	0.417	0.028	0.326	0.480
10.99	86	0.391	0.020	0.332	0.454
11.50	59	0.364	0.016	0.319	0.401
11.99	48	0.334	0.013	0.302	0.361
12.48	41	0.307	0.009	0.290	0.329
13.01	33	0.277	0.011	0.255	0.298
13.49	25	0.250	0.007	0.237	0.263
13.99	24	0.226	0.006	0.215	0.235
14.50	32	0.204	0.006	0.194	0.214
14.91	13	0.188	0.003	0.182	0.193
15.39	11	0.171	0.003	0.163	0.175
15.96	7	0.153	0.003	0.149	0.157
16.42	8	0.141	0.003	0.137	0.145
16.91	6	0.129	0.003	0.124	0.131
17.45	4	0.117	0.003	0.112	0.120
17.91	1	0.108	0.000	0.108	0.108
Total	1564				

The annual energy output is calculated on the assumption that the availibility is 100% and that the stop wind speed is 25m/s. The annual energy output is calculated using a Rayleigh distribution with an annual mean wind speed of 5 - 10 m/s.

Annual mean Wind speed	Annual Energy Output	Uncertainties	
[m/s]	[MWh]	[MWh]	[%]
5	862	50,6	5,9
6	1386	57,2	4,1
7	1918	60,0	3,1
8	2410	60,1	2,5
9	2838	58,5	2,1
10	3187	55,9	1,8

The Annual Energy Output in the 4 Danish roughness classes is calculated, using a Weibull distribution, by Vestas Wind Systems A/S. The annual energy output is calculated on the assumption that the availibility is 100%, 45 m hub height and 25m/s stop wind speed. The uncertainties are estimated from the above mentioned uncertanties, which is calculated by Tripod Wind Energy Aps.

Roughness class	Annual Energy Output	Uncertainties	
[-]	[MWh]	[MWh]	[%]
0	2584	59,4	2,3
1	1791	59,3	3,3
2	1480	57,7	3,9
3	1039	52,8	5,1

11.2 Power curve measurement on the V47-660/200kW Wind turbine

1. The measurement is carried out by:

   Windtest
   Kaiser-Wilhelm-Koog GmbH
   Sommerdeich 14b
   D-25709 Kaiser-Wilhelm-Koog
   Phone +49 48569010
   Fax +49 485690149

   Windtest Kaiser-Wilhelm-Koog GmbH is authorised by the German accreditation council DAR to carry out power curve measurements.

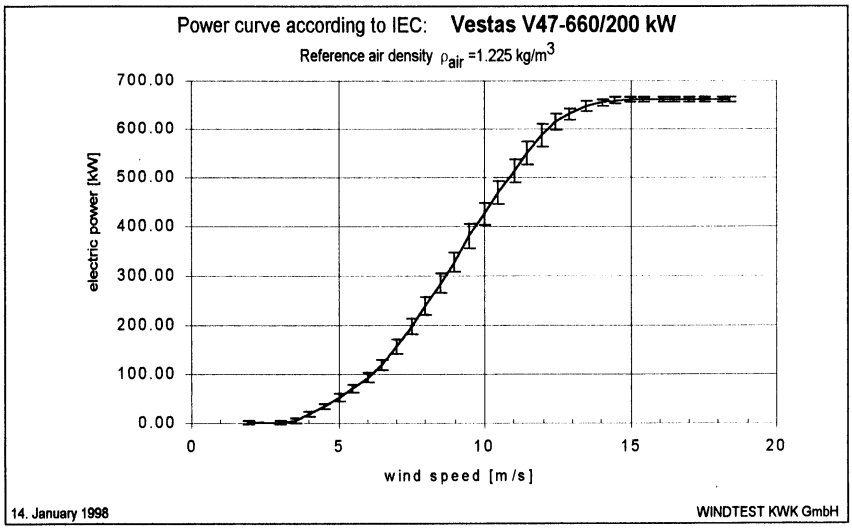
2. This resumé is made the 19. January 1998 by Vestas Wind Systems A/S

3. The measurements are reported in "WT 761/97". The measurements are carried out in the period 24/10-1997 to 25/12 1997.

4. The Windturbine type is: VESTAS V47-660/200kW

5. The measurement was performed according to IEC/TC88 "Wind Turbine Generator Systems, Part 12:Power Performance Techniques" .

6. Results.



The measured power curve is corrected to the standard air density of 1.225kg/m^3.

MEASURED POWER CURVE: V47

reference air density: 1.225 kg/m³
cut-out windspeed: 25 m/s

bin no.	hub height wind speed [m/s]	power output [kW]	no. of data sets (10 min. avg.)	category A standard uncertainty [kW]	category B standard uncertainty [kW]	combined uncertainty standard uncertainty [kW]
1	1.90	1.34	123	0.03	4.22	4.2
2	3.03	1.18	95	0.12	4.21	4.2
3	3.51	5.28	104	0.43	4.39	4.4
4	4.01	19.13	156	0.50	5.78	5.8
5	4.51	33.92	215	0.53	6.02	6.0
6	5.02	52.56	218	0.59	6.84	6.9
7	5.50	72.07	222	0.58	7.63	7.7
8	6.00	93.28	227	0.66	8.09	8.1
9	6.50	118.30	239	1.01	9.60	9.6
10	7.01	156.90	259	1.14	14.34	14.4
11	7.51	196.50	312	1.05	15.76	15.8
12	7.99	239.10	329	1.27	18.28	18.3
13	8.51	284.70	264	1.40	19.29	19.3
14	8.99	327.50	212	1.81	20.29	20.4
15	9.49	380.30	156	2.16	24.87	25.0
16	10.00	425.40	125	2.48	22.29	22.4
17	10.49	468.20	123	2.19	22.57	22.7
18	11.02	514.00	97	2.40	23.58	23.7
19	11.46	549.70	95	2.12	23.02	23.1
20	11.95	587.60	41	4.43	22.85	23.3
21	12.44	614.70	26	2.81	17.34	17.6
22	12.92	630.90	25	3.12	11.70	12.1
23	13.46	647.30	17	1.21	11.12	11.2
24	14.02	654.20	27	0.96	6.71	6.8
25	14.48	658.40	20	0.50	6.17	6.2
26	14.97	659.70	16	0.21	5.38	5.4
27	15.43	660.30	12	0.38	5.15	5.2
28	16.09	661.30	8	0.15	5.17	5.2
29	16.48	661.4	14	0.14	5.14	5.1
30	17.01	661.4	17	0.12	5.13	5.1
31	17.52	661.3	11	0.17	5.14	5.1
32	18.11	661.4	10	0.20	5.14	5.1
33	18.37	661.1	5	0.20	5.16	5.2

The annual energy output is calculated on the assumption that the availibility is 100% and that the stop wind speed is 25m/s. The annual energy output is calculated using a Rayleigh distribution with an annual mean wind speed of 4- 11 m/s.

ESTIMATED ANNUAL ENERGY PRODUKTION (AEP)

extrapolation of the power curve between the highest measured wind speed and the cut-out wind speed considering the same as the measured at highest measured wind speed

type of WTGS: V47
cut-out wind speed: 25 m/s
reference air density: 1.225 kg/m³

hub height annual average wind speed (Rayleigh) [m/s]	AEP-measured (measured power curve) [MWh]	uncertainty of measured power in terms of standard deviation of AEP [MWh]	[%]	AEP-extrapolated (extrapolated power curve) [MWh]
4.0	433.8	58.8	13.5	433.8
5.0	845.7	78.7	9.3	845.8
6.0	1333.3	94.9	7.1	1336.9
7.0	1818.9	104.7	5.8	1844.6
8.0	2233.8	108.4	4.9	2323.2
9.0	2538.9 *	107.7	4.2	2745.0
10.0	2727.3 *	104.0	3.8	3093.5
11.0	2813.2 *	98.7	3.5	3360.9

values marked with *: power curve incomplete acc. IEC criteria for data base

The Annual Energy Output in the 4 Danish roughness classes is calculated, using a Weibull distribution, by Vestas Wind Systems A/S. The annual energy output is calculated on the assumption that the availibility is 100%, 45 m hub height and 25m/s stop wind speed. The uncertainties are estimated from the above mentioned uncertanties, which is calculated by Windtest.

Roughness class	Annual Energy Output	Uncertainties	
[-]	[MWh]	[MWh]	[%]
0	2487	107,8	4,3
1	1721	102,7	5,9
2	1426	96,7	6,7
3	1012	84,2	8,3

11.3 Enclosure 2, noise measurement

11.4 Noise resume of VESTAS V47-660 kW Wind Turbine

1. The measurement has been done by:

   Acoustica as
   Fælledvej 3
   8800 Viborg

   under the accreditation, registration no. 134, from DANAK.

2. This resume has been worked out on September 3, 1996 by Vestas Wind Systems A/S.

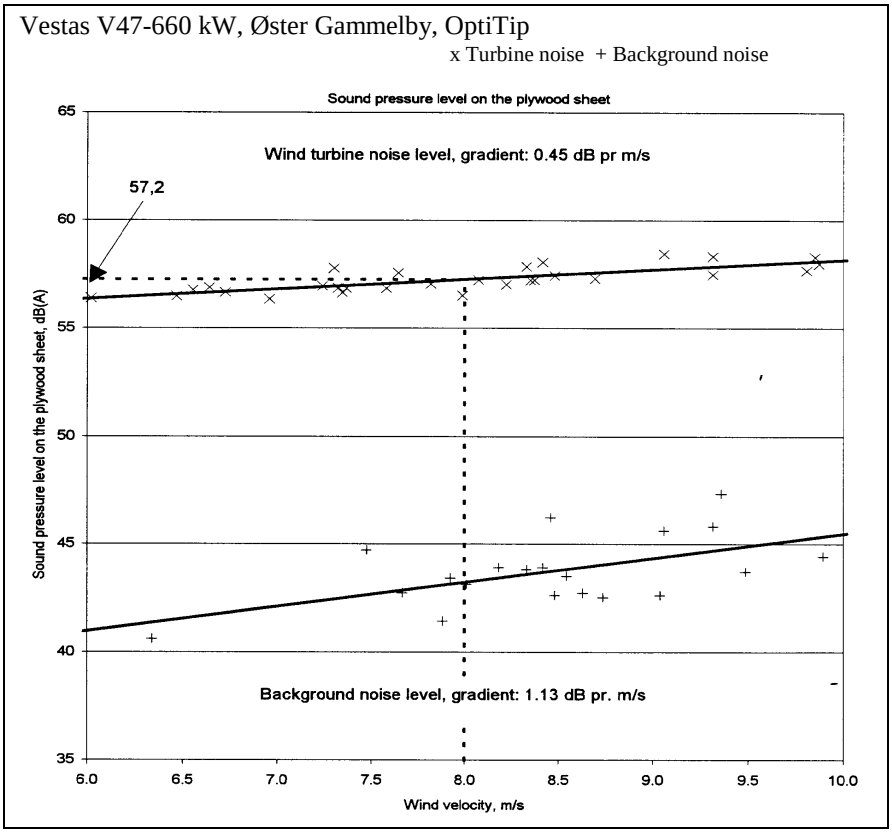
3. The noise measurements have been reported in Acoustica report no. P4.010.97 dated August 6, 1997. The noise measurements has been carried out July 28, 1997.

4. The measurements were carried out to determine the noise emission from a VESTAS V47-660 kW.

5. The noise emission has been determined according to statutorial order no. 304 of may, 14, 1991, and relevant parts of Guideline no. 6/1984, "Noise from Industrial Plants", from the Danish Ministry of the Environment.

6. Results of Measurements:

6a.



The apparent A-

weighted sound power level can be calculated from the equivalent continuous A-weighted sound pressure level, using the following expression:

$$L_{WA} = L_{Aeq} + 10 \cdot \log(4 \cdot \pi \cdot (d^2 + h^2)) - 6 \text{ dB}$$

Where, d = distance from the base of the wind turbine to the measurement position (d= 75m).
h = hub height (h = 40,5m + 0,5m).

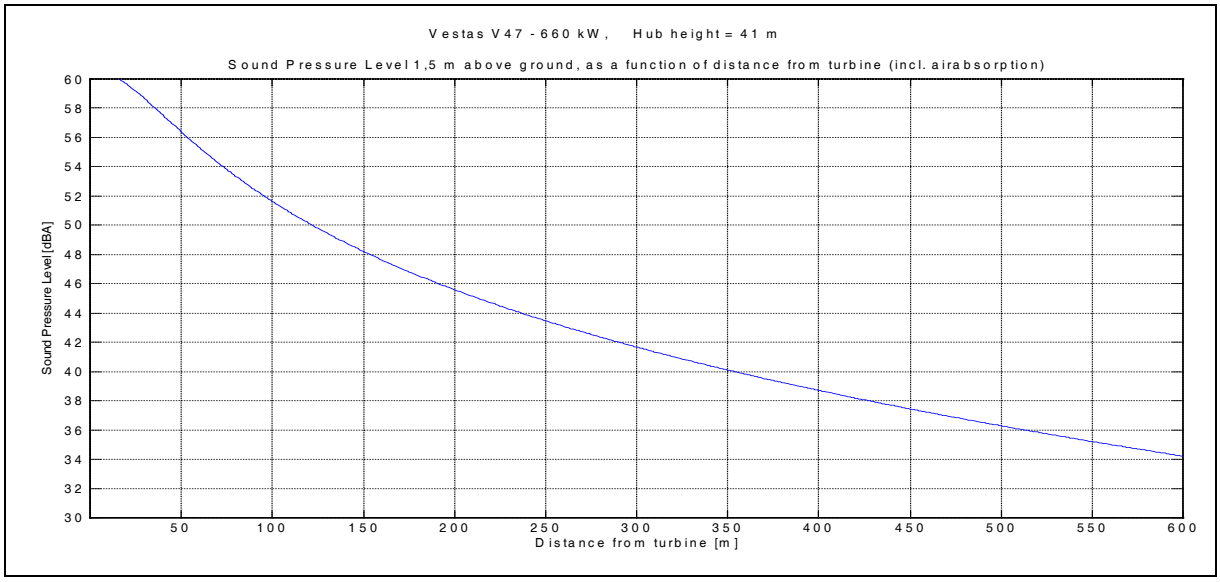
6b. The measurement show the following results at a wind speed of 8 m/s. The measurements is given respectively, as the A-weighted sound pressure level $L_{Aeq,ref}$ and the A-weighted sound power level $L_{WA,ref}$.

Frequency	$L_{Aeq,ref}$ [dB(A)]	$L_{WA,ref}$ [dB(A)]
1/1 octave 63 Hz	34,6	78,2
1/1 octave 125 Hz	42,5	86,1
1/1 octave 250 Hz	46,2	89,8
1/1 octave 500 Hz	51,6	95,2
1/1 octave 1 kHz	53,4	97,0
1/1 octave 2 kHz	49,2	92,9
1/1 octave 4 kHz	44,2	87,9
1/1 octave 8 kHz	25,6	69,2
A-weighted, total	57,2	100,8

According to statoturial order no. 304 of May 14, 1991, from the Danish Ministry of the Environment, the degree of accuracy on the results is ±2 dB.

6c. An analysis of the noise in a distance of 75 meter show, that the noise from the turbine contains no clearly audible tones or impulses. The analysis has been performed according to guideline no. 6/1984, “Noise from Industrial Plants”, from the Danish Ministry of the Environment.

6d.



11.5 Noise resume of VESTAS V47-660/200 kW Wind Turbine

1. The measurement has been done by:

   Acoustica as
   Fælledvej 3
   8800 Viborg

   under the accreditation, registration no. 134, from DANAK.

2. This resume has been worked out on September 3, 1996 by Vestas Wind Systems A/S.

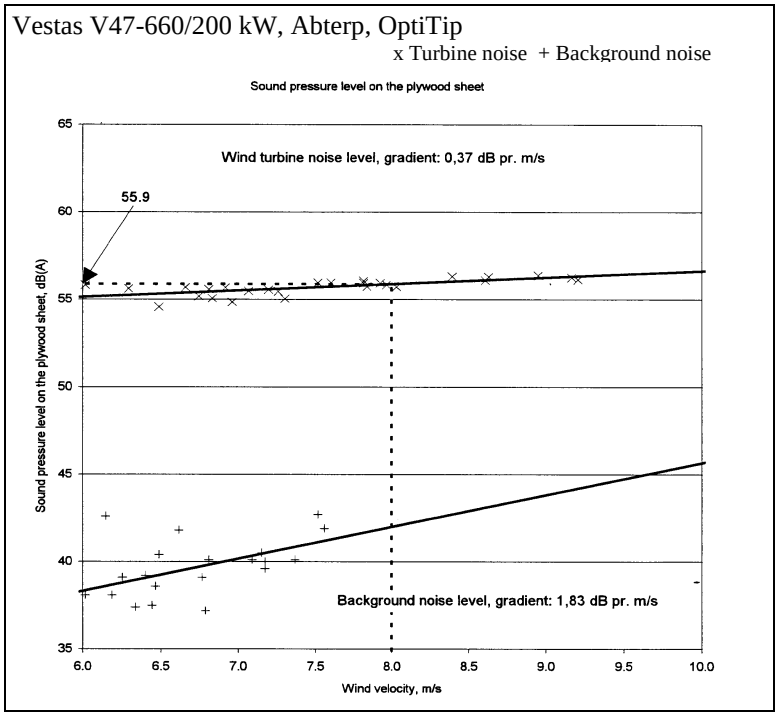
3. The noise measurements have been reported in Acoustica report no. P4.011.97 dated August 6, 1997. The noise measurements has been carried out July 30, 1997.

4. The measurements were carried out to determine the noise emission from a VESTAS V47-660/200 kW.

5. The noise emission has been determined according to statutorial order no. 304 of may, 14, 1991, and relevant parts of Guideline no. 6/1984, "Noise from Industrial Plants", from the Danish Ministry of the Environment.

6. Results of Measurements:

6a.



The apparent A-weighted sound power level can be calculated from the equivalent continuous A-weighted sound pressure level, using the following expression:

$$L_{WA} = L_{Aeq} + 10 \cdot \log(4 \cdot \pi \cdot (d^2 + h^2)) - 6 \text{ dB}$$

Where, d = distance from base of wind turbine to measurement position (d= 75m).
h = hub height (h = 45,0m + 1,0m).

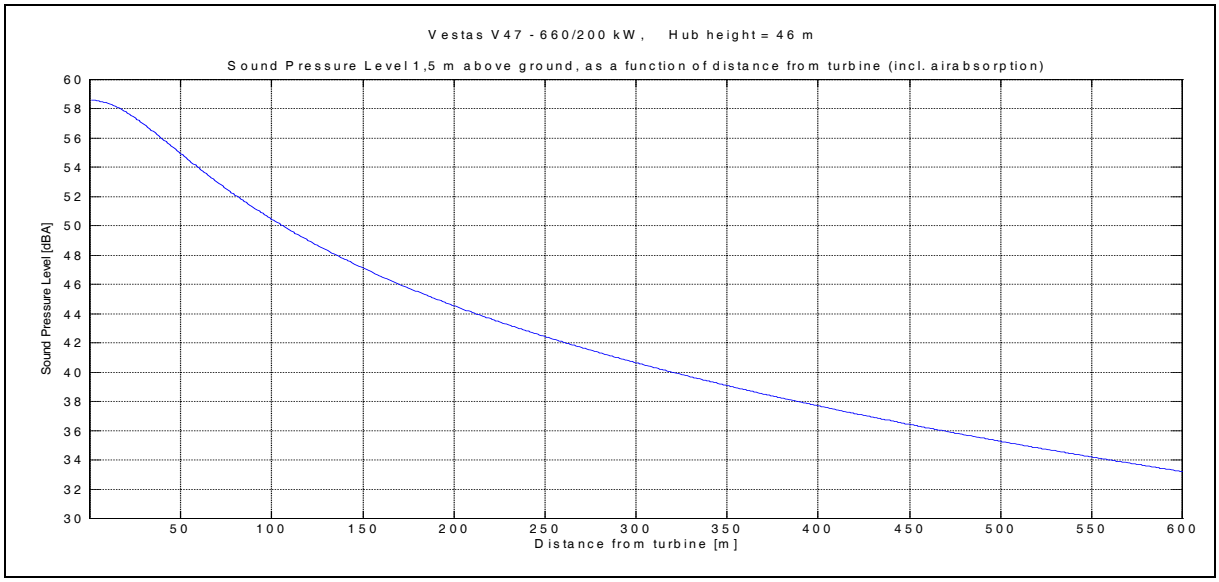
6b. The measurement show the following results at a wind speed of 8 m/s. The measurements is given respectively, as the A-weighted sound pressure level $L_{Aeq,ref}$ and the A-weighted sound power level $L_{WA,ref}$.

Frequency	$L_{Aeq,ref}$ [dB(A)]	$L_{WA,ref}$ [dB(A)]
1/1 octave 63 Hz	32,6	76,5
1/1 octave 125 Hz	40,2	84,1
1/1 octave 250 Hz	46,7	90,6
1/1 octave 500 Hz	52,1	95,9
1/1 octave 1 kHz	50,8	94,7
1/1 octave 2 kHz	45,8	89,7
1/1 octave 4 kHz	39,8	83,7
1/1 octave 8 kHz	24,8	68,7
A-weighted, total	55,9	99,8

According to statoturial order no. 304 of May 14, 1991, from the Danish Ministry of the Environment, the degree of accuracy on the results is ±2 dB.

6c. An analysis of the noise in a distance of 75 meter show, that the noise from the turbine contains no clearly audible tones or impulses. The analysis has been performed according to guideline no. 6/1984, “Noise from Industrial Plants”, from the Danish Ministry of the Environment.

6d.



SCHEDE TECNICHE DEI CAVI ELETTRICI DI COLLEGAMENTO POSTI IN OPERA

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 95 mm²

CAVI 20 kV UNIPOLARI E TRIPOLARI A SPIRALE VISIBILE CON ISOLAMENTO HEPR (G7) E GUAINA DI PVC.

Descrizione

APPLICAZIONI

In reti di distribuzione energia MT per sistemi a 20 kV. Per installazioni fisse interne o esterne con posa in aria o direttamente o indirettamente interrata, anche in ambienti bagnati.

Standards

Internazionale EN 60228;
EN 60332-1-2

Nazionale CEI 20-13

MARCATURA (a getto d'inchiostro)

Unipolari ARG7H1R

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1R 12/20kV 1x"S" "marcatura metrica"

Tripolari a spirale visibile ARG7H1RX

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1RX 12/20kV 3x"S" FASE 1 "marcatura metrica"

FASE 2 su fase 2

FASE 3 su fase 3

S = sezione del conduttore in mm²; ANNO anno di fabbricazione

NOTE

Portate dei cavi calcolate considerando:

- schermi metallici connessi tra loro e a terra ad entrambe le estremità;
- resistività del terreno 1,0 °C m/W;
- profondità di posa of 1,0 m;
- cavi unipolari in posa a trifoglio

Cavi tripolari a spirale visibile

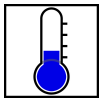
- diametro circoscritto: moltiplicare il diametro esterno in tabelle per 2.16
- peso del cavo: multiplicare il peso in tabella per 3
- raggio minimo di piegatura: 21(xD)

Massima resistenza elettrica dello schermo in c.c. a 20°C: 3,0 ohm/km equivalente a circa 6 mm²; possibilità di sezioni maggiori di 6 mm²

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 95 mm²

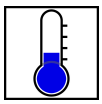
Caratteristiche

Caratteristiche di costruzione	
Materiale del conduttore	Alluminio
Tipo di conduttore	Corda rotonda compatta classe 2
Materiale del semi-conduttore interno	Mescola semiconduttrice
Isolamento	HEPR (mescola elastomerica reticolata)
Materiale del semi-conduttore esterno	Pelabile a freddo
Schermo	Fili di rame + nastro di rame
Guaina esterna	Mescola di PVC
Colore guaina esterna	Rosso
Caratteristiche dimensionali	
Diametro del conduttore	11,5 mm
Diametro sull'isolante	24,3 mm
Diametro esterno	30,5 mm
Peso approssimativo	1090 kg/km
Caratteristiche elettriche	
Massima resistenza el. del cond. a 20°C in c.c.	0,32 Ohm/km
Resistenza el. del cond. a 90°C in c.a. - trifoglio	0,411 Ohm/km
Reattanza di fase a 50 Hz a trifoglio	0,121 Ohm/km
Capacità nominale	0,232 µF / km
Portata di corrente in aria a 30°C	268 A
Portata di corrente direttamente interrato a 20°C	246 A
Corrente di corto circuito nel conduttore 1s	9 kA
Tensione nominale Uo/U (Um)	12 / 20 (24) kV
Caratteristiche d'utilizzo	
Massima forza di tiro durante la posa	50.0 N/mm2
Fattore di curvatura durante l'installazione	14 (xD)
Temperatura massima di servizio del conduttore	90 °C
Max temperatura di sovraccarico	130 °C
Temperatura massima di cortocircuito del conduttore	250 °C
Minima temperatura d'installazione	0 °C
Ritardante la fiamma	EN 60332-1-2

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 150 mm²

CAVI 20 kV UNIPOLARI E TRIPOLARI A SPIRALE VISIBILE CON ISOLAMENTO HEPR (G7) E GUAINA DI PVC.

Descrizione

APPLICAZIONI

In reti di distribuzione energia MT per sistemi a 20 kV. Per installazioni fisse interne o esterne con posa in aria o direttamente o indirettamente interrata, anche in ambienti bagnati.

Standards

Internazionale EN 60228;
EN 60332-1-2

Nazionale CEI 20-13

MARCATURA (a getto d'inchiostro)

Unipolari ARG7H1R

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1R 12/20kV 1x"S" "marcatura metrica"

Tripolari a spirale visibile ARG7H1RX

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1RX 12/20kV 3x"S" FASE 1 "marcatura metrica"

FASE 2 su fase 2

FASE 3 su fase 3

S = sezione del conduttore in mm²; ANNO anno di fabbricazione

NOTE

Portate dei cavi calcolate considerando:

- schermi metallici connessi tra loro e a terra ad entrambe le estremità;
- resistività del terreno 1,0 °C m/W;
- profondità di posa of 1,0 m;
- cavi unipolari in posa a trifoglio

Cavi tripolari a spirale visibile

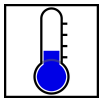
- diametro circoscritto: moltiplicare il diametro esterno in tabelle per 2.16
- peso del cavo: multiplicare il peso in tabella per 3
- raggio minimo di piegatura: 21(xD)

Massima resistenza elettrica dello schermo in c.c. a 20°C: 3,0 ohm/km equivalente a circa 6 mm²; possibilità di sezioni maggiori di 6 mm²

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 150 mm²

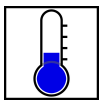
Caratteristiche

Caratteristiche di costruzione	
Materiale del conduttore	Alluminio
Tipo di conduttore	Corda rotonda compatta classe 2
Materiale del semi-conduttore interno	Mescola semiconduttrice
Isolamento	HEPR (mescola elastomerica reticolata)
Materiale del semi-conduttore esterno	Pelabile a freddo
Schermo	Fili di rame + nastro di rame
Guaina esterna	Mescola di PVC
Colore guaina esterna	Rosso
Caratteristiche dimensionali	
Diametro del conduttore	14,3 mm
Diametro sull'isolante	27,1 mm
Diametro esterno	33,5 mm
Peso approssimativo	1330 kg/km
Caratteristiche elettriche	
Massima resistenza el. del cond. a 20°C in c.c.	0,206 Ohm/km
Resistenza el. del cond. a 90°C in c.a. - trifoglio	0,265 Ohm/km
Reattanza di fase a 50 Hz a trifoglio	0,113 Ohm/km
Capacità nominale	0,27 µF / km
Portata di corrente in aria a 30°C	351 A
Portata di corrente direttamente interrato a 20°C	313 A
Corrente di corto circuito nel conduttore 1s	14,2 kA
Tensione nominale Uo/U (Um)	12 / 20 (24) kV
Caratteristiche d'utilizzo	
Massima forza di tiro durante la posa	50.0 N/mm2
Fattore di curvatura durante l'installazione	14 (xD)
Temperatura massima di servizio del conduttore	90 °C
Max temperatura di sovraccarico	130 °C
Temperatura massima di cortocircuito del conduttore	250 °C
Minima temperatura d'installazione	0 °C
Ritardante la fiamma	EN 60332-1-2

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 240 mm²

CAVI 20 kV UNIPOLARI E TRIPOLARI A SPIRALE VISIBILE CON ISOLAMENTO HEPR (G7) E GUAINA DI PVC.

Descrizione

APPLICAZIONI

In reti di distribuzione energia MT per sistemi a 20 kV. Per installazioni fisse interne o esterne con posa in aria o direttamente o indirettamente interrata, anche in ambienti bagnati.

Standards

Internazionale EN 60228;
EN 60332-1-2

Nazionale CEI 20-13

MARCATURA (a getto d'inchiostro)

Unipolari ARG7H1R

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1R 12/20kV 1x"S" "marcatura metrica"

Tripolari a spirale visibile ARG7H1RX

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1RX 12/20kV 3x"S" FASE 1 "marcatura metrica"

FASE 2 su fase 2

FASE 3 su fase 3

S = sezione del conduttore in mm²; ANNO anno di fabbricazione

NOTE

Portate dei cavi calcolate considerando:

- schermi metallici connessi tra loro e a terra ad entrambe le estremità;
- resistività del terreno 1,0 °C m/W;
- profondità di posa of 1,0 m;
- cavi unipolari in posa a trifoglio

Cavi tripolari a spirale visibile

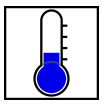
- diametro circoscritto: moltiplicare il diametro esterno in tabelle per 2.16
- peso del cavo: multiplicare il peso in tabella per 3
- raggio minimo di piegatura: 21(xD)

Massima resistenza elettrica dello schermo in c.c. a 20°C: 3,0 ohm/km equivalente a circa 6 mm²; possibilità di sezioni maggiori di 6 mm²

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 240 mm²

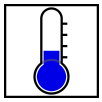
Caratteristiche

Caratteristiche di costruzione	
Materiale del conduttore	Alluminio
Tipo di conduttore	Corda rotonda compatta classe 2
Materiale del semi-conduttore interno	Mescola semiconduttrice
Isolamento	HEPR (mescola elastomerica reticolata)
Materiale del semi-conduttore esterno	Pelabile a freddo
Schermo	Fili di rame + nastro di rame
Guaina esterna	Mescola di PVC
Colore guaina esterna	Rosso
Caratteristiche dimensionali	
Diametro del conduttore	18,5 mm
Diametro sull'isolante	31,3 mm
Diametro esterno	38,1 mm
Peso approssimativo	1780 kg/km
Caratteristiche elettriche	
Massima resistenza el. del cond. a 20°C in c.c.	0,125 Ohm/km
Resistenza el. del cond. a 90°C in c.a. - trifoglio	0,161 Ohm/km
Reattanza di fase a 50 Hz a trifoglio	0,105 Ohm/km
Capacità nominale	0,325 µF / km
Portata di corrente in aria a 30°C	480 A
Portata di corrente direttamente interrato a 20°C	413 A
Corrente di corto circuito nel conduttore 1s	22,7 kA
Tensione nominale Uo/U (Um)	12 / 20 (24) kV
Caratteristiche d'utilizzo	
Massima forza di tiro durante la posa	50.0 N/mm2
Fattore di curvatura durante l'installazione	14 (xD)
Temperatura massima di servizio del conduttore	90 °C
Max temperatura di sovraccarico	130 °C
Temperatura massima di cortocircuito del conduttore	250 °C
Minima temperatura d'installazione	0 °C
Ritardante la fiamma	EN 60332-1-2

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 300 mm²

CAVI 20 kV UNIPOLARI E TRIPOLARI A SPIRALE VISIBILE CON ISOLAMENTO HEPR (G7) E GUAINA DI PVC.

Descrizione

APPLICAZIONI

In reti di distribuzione energia MT per sistemi a 20 kV. Per installazioni fisse interne o esterne con posa in aria o direttamente o indirettamente interrata, anche in ambienti bagnati.

Standards

Internazionale EN 60228;
EN 60332-1-2

Nazionale CEI 20-13

MARCATURA (a getto d'inchiostro)

Unipolari ARG7H1R

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1R 12/20kV 1x"S" "marcatura metrica"

Tripolari a spirale visibile ARG7H1RX

NEXANS B "ANNO" MEDIASTRIP G7 CEI 20-13 ARG7H1RX 12/20kV 3x"S" FASE 1 "marcatura metrica"

FASE 2 su fase 2

FASE 3 su fase 3

S = sezione del conduttore in mm²; ANNO anno di fabbricazione

NOTE

Portate dei cavi calcolate considerando:

- schermi metallici connessi tra loro e a terra ad entrambe le estremità;
- resistività del terreno 1,0 °C m/W;
- profondità di posa of 1,0 m;
- cavi unipolari in posa a trifoglio

Cavi tripolari a spirale visibile

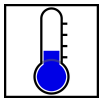
- diametro circoscritto: moltiplicare il diametro esterno in tabelle per 2.16
- peso del cavo: multiplicare il peso in tabella per 3
- raggio minimo di piegatura: 21(xD)

Massima resistenza elettrica dello schermo in c.c. a 20°C: 3,0 ohm/km equivalente a circa 6 mm²; possibilità di sezioni maggiori di 6 mm²

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2

Contatto
Vendita Cavi Mercato
nexans.cavi@nexans.com

ARG7H1R / ARG7H1RX 12/20 kV MEDIASTRIP G7

ARG7H1R(X) 12/20 kV 300 mm²

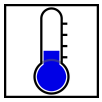
Caratteristiche

Caratteristiche di costruzione	
Materiale del conduttore	Alluminio
Tipo di conduttore	Corda rotonda compatta classe 2
Materiale del semi-conduttore interno	Mescola semiconduttrice
Isolamento	HEPR (mescola elastomerica reticolata)
Materiale del semi-conduttore esterno	Pelabile a freddo
Schermo	Fili di rame + nastro di rame
Guaina esterna	Mescola di PVC
Colore guaina esterna	Rosso
Caratteristiche dimensionali	
Diametro del conduttore	20,7 mm
Diametro sull'isolante	33,5 mm
Diametro esterno	40,3 mm
Peso approssimativo	2035 kg/km
Caratteristiche elettriche	
Massima resistenza el. del cond. a 20°C in c.c.	0,1 Ohm/km
Resistenza el. del cond. a 90°C in c.a. - trifoglio	0,13 Ohm/km
Reattanza di fase a 50 Hz a trifoglio	0,101 Ohm/km
Capacità nominale	0,354 µF / km
Portata di corrente in aria a 30°C	552 A
Portata di corrente direttamente interrato a 20°C	466 A
Corrente di corto circuito nel conduttore 1s	28,3 kA
Tensione nominale Uo/U (Um)	12 / 20 (24) kV
Caratteristiche d'utilizzo	
Massima forza di tiro durante la posa	50.0 N/mm2
Fattore di curvatura durante l'installazione	14 (xD)
Temperatura massima di servizio del conduttore	90 °C
Max temperatura di sovraccarico	130 °C
Temperatura massima di cortocircuito del conduttore	250 °C
Minima temperatura d'installazione	0 °C
Ritardante la fiamma	EN 60332-1-2

Tensione nominale Uo/U (Um)
12 / 20 (24) kV

Fattore di curvatura durante l'installazione
14 (xD)

Temp. max di servizio del conduttore
90 °C



Minima temperatura d'installazione
0 °C

Ritardante la fiamma
EN 60332-1-2