Licence for manufacture and sale of windmills

VIRYA-1.25, VIRYA-1.825 and VIRYA-2.68

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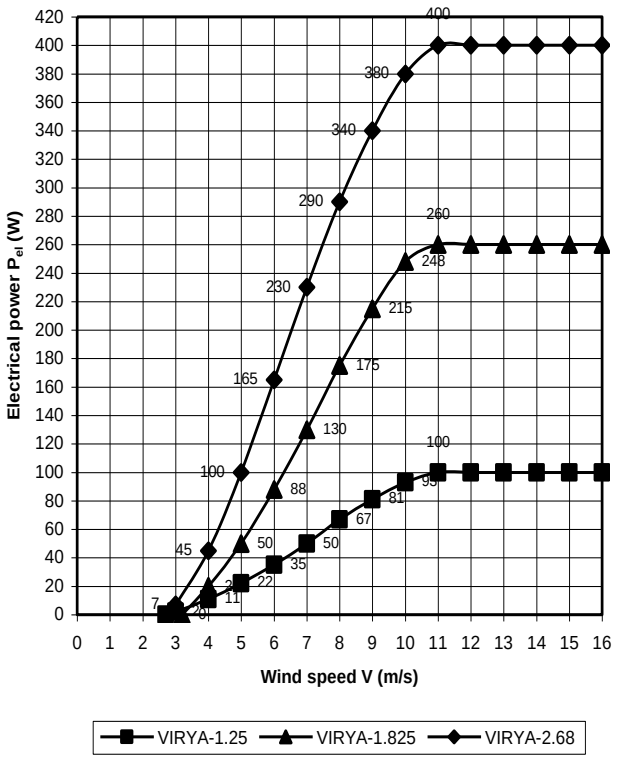
VIRYA-1.25

P_{el}-V curves VIRYA-1.25, VIRYA-1.825 and VIRYA-2.68 windmills



Kragten Design

Kragten Design (KD) is a one man engineering office founded in 1989 and specialises in designing windmills and wind energy consultancy (see separate folder). Up to now eighteen windmills with rotor diameters from 1 to 4.6 metre haven been developed and more than 570 KD-reports haven been written. Adriaan Kragten, B.Sc., worked for fifteen years in the Wind Energy Group, Faculty Physics of the University of Technology Eindhoven, one of the parties in the former CWD (Consultancy services Wind energy Developing countries). The address of KD is:

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Description of the windmills

The rotors of the VIRYA-1.25, the VIRYA-1.825 and the VIRYA-2.68 windmills have two blades which are made from cambered stainless steel sheet with a constant chord. The VIRYA-1.25 has a very simple rotor, made of one stainless steel strip with cambered and twisted blades. The VIRYA-1.825 and the VIRYA-2.68 have two separate non twisted blades which are bolted to a central strip. These rotors are relatively lighter. Special tools are developed for cambering, so these rotors are very suited to serial manufacture. The blades of the VIRYA-1.25 and the VIRYA-1.825 have the same chord and can be made with the same blade press. The blades of the VIRYA-2.68 have a larger chord. The blades can be cut from standard sheet without waste material. The rotor hub, the head, the and the tower pipe are also made of stainless steel. The VIRYA-1.25 and 1.825 have a stainless steel vane blade. The VIRYA-2.68 has an aluminium vane blade. The INA Permaglide head bearings are waterproof and the mills are entirely maintenance free.

These windmills have generators based on standard rotary current motors. These motors are modified with a permanent magnet armature with neodymium magnets and a stainless steel shaft. This procedure is explained in public report KD 341. The windmill rotor is mounted directly to the tapered shaft of the generator. The VIRYA-1.25 is primarily designed to be coupled to a 11 W fluorescent lamp (without battery) and for this use the standard 230/400 V winding has to be rectified in star. The VIRYA-1.25 can also be used for 24 V battery charging but then the winding has to be modified into a 115/200 V winding and delta rectification is required. The VIRYA-1.825 is primarily designed for 24 V battery charging and this requires a modified 115/200 V winding and delta rectification. The VIRYA-2.68 uses a standard 230/400 V winding and can be used for 24 battery charging if rectified in delta and for 48 V battery charging if rectified in star. 3-phase rectification is explained in public report KD 340. A standard 230/400 V winding can be modified into a 115/200 V winding by connecting the first and the second layer of the winding in parallel. The generator can be used as a brake by short-circuiting the generator winding. The generators have been tested on a test-rig at the University of Technology Eindhoven (see reports KD 18, KD 54 and KD 78). The batteries are protected against over-charging by a 27.6 V battery charge controller with dump load.

The mills are provided with a “hinged side vane safety system” to limit rotor speed and thrust at high wind speeds. The rotor axis is offset from the tower axis. The vane juts out along the rotor and the vane blade is connected to the vane arm using hinges. At low wind speeds, the vane blade hangs in almost vertical position and the rotor is perpendicular to the wind. At wind speeds higher than about 6 m/s, the rotor starts to turn gradually out of the wind. At very high wind speeds the rotor turns out of the wind by about 70° and the vane blade is in almost horizontal position. The behaviour of this system is very stable and the rotor speed is well controlled.

The towers consists of a 2 metre tubular upper section which can be connected to a supporting structure such as a wall of a house. If a supporting structure is not available, a 6 metre long steel tubular lower section can be used for the VIRYA-1.825. A 6 m long steel rectangular lattice tower can be used for the VIRYA-2.68. The generator, the head and the tower of the VIRYA-1.825 are identical to those of the 3-bladed VIRYA-1.8 and VIRYA-1.75. The head of the VIRYA-2.68 is derived from the head of the former VIRYA-2.5. The VIRYA-1.25 has been tested for about 7 year and has survived rotating, a maximum wind speed of 26 m/s. The VIRYA-1.825 and the VIRYA-2.68 have not yet been manufactured and tested by Kragten Design.

Although these mills are designed primarily for manufacture in industrialised countries, they can also be manufactured by a good workshop in developing countries. However, a prerequisite is that stainless steel is available and that one should be able to import some of the materials and standard parts. Kragten Design cannot supply materials and parts such as bearings, generators, magnets, electronics etcetera. The required workshop skills are sawing, drilling, turning, milling and welding.

Specification

	VIRYA-1.25	**VIRYA-1.825**	**VIRYA-2.68**
Diameter	D = 1.25 m	D = 1.825 m	D = 2.68 m
Number of blades	B = 2	B = 2	B = 2
Design tip speed ratio	$\lambda_d = 4.5$	$\lambda_d = 5.25$	$\lambda_d = 5.25$
Gear ratio	i = 1	i = 1	i = 1
Rotor eccentricity	e = 0.11 m	e = 0.15 m	e = 0.23 m
Height tower pipe	H = 2 m	H = 2 m	H = 2 m
Total tower height		H_{tot} = 7.8 m	H_{tot} = 7.5 m
Mass with tower pipe only	m = 15 kg	m = 25.2 kg	m = 55.8 kg
Mass with lower tower part		m_{tot} = 105 kg	m_{tot} = 111.9 kg
Starting wind speed	V_{start} = 2.9 m/s	V_{start} = 4.4 m/s	V_{start} = 3.1 m/s
Cut in wind speed (if started)	$V_{cut\ in}$ = 2.7 m/s	$V_{cut\ in}$ = 3.2 m/s	$V_{cut\ in}$ = 2.7 m/s
Rated wind speed	V_{rated} = 11 m/s	V_{rated} = 11 m/s	V_{rated} = 11 m/s
Survival wind speed	V_{surv} = 35 m/s	V_{surv} = 35 m/s	V_{surv} = 35 m/s
Nominal battery voltage	U = 24 V DC	U = 24 V DC	U = 24 V (or 48V) DC
Power at rated wind speed	P_{rated} = 100 W	P_{rated} = 260 W	P_{rated} = 400 W (or 480 W)

Drawings and manuals

A set of drawings consists of a main assembly drawing of the whole mill, sub-assembly drawings of rotor, generator, head, tower, and battery charge controller and dump load and detailed drawings of all parts. Drawings of a blade press to camber the blades are also included. Lists of parts to be manufactured and of standard parts are included too. In the manual several aspects are explained in detail including the safety system, manufacture of parts, mounting and installation. The battery charge controller is described in a separate manual.

Licence conditions

A world licence for manufacture of the VIRYA-1.25, the VIRYA-1.825 or the VIRYA-2.68 windmill is available only for professional manufacturers or trading companies. For licence conditions ask Kragten Design. Although the mills have been designed and tested carefully, no responsibility is accepted for the operation of a mill neither as a whole, nor for any of its separate parts.