



Application & Selection Catalogue

Wind Turbines Oil Maintenance



Wind turbines - the application

Wind Turbines are used for power generation from a renewable resource – the wind. Wind turbine manufacturers consider themselves as power plant producers. The Wind Turbine consists of the Nacelle, the Rotor and the Tower. The rotor includes the Blades.

Traditionally all turbines were of the Gear driven type. That means that the relatively low revolutions of the Rotor are converted to higher revolutions through a gear (step up 100x). And it is the output shaft of the gear that drives the generator.

Today, the direct drive turbines are increasing in numbers, but primarily on large MW turbines. Small to medium MW turbines are still dominated by the Gear drive types. Direct drive means that the generator is an integral part of the rotor. Components wear are reduced significantly and so are the risks of mechanical failure.

Turbines today are using pitch control on the blades, meaning the output and revolutions of the rotor is controlled by adjusting the pitch. The control of the pitch can be either hydraulic or electric.

The two largest bearings are the rotor and generator bearings which can either be grease or oil lubricated.

We will in the following focus on what's inside the standard Gear driven type Nacelle. Here we will find the generator, the gear, the Hydraulic Power Unit (HPU) and all of the other control equipment enabling a safe and steady power production. CJC Filters can be used on the Gear, on the bearings of the Generator and Rotor and on the HPU. The entire nacelle can be turned up in the wind to maximize power output by means of Yaw gear. These can be electric or hydraulic operated and contains small gears.



The stakeholders

The stakeholders we in C.C.JENSEN operate with are:

- The OEM's, the turbine manufacturers
- The IPP's, Independent Power Providers, the owners of wind turbines, either one, a few or very large wind turbine parks
- The ISP's, Independent Service Providers, Companies not associated to the OEM or IPP, but providing turbine maintenance and service solutions

Some OEM's also provide Service solutions, either as a part of the original contract for a number of years after delivery, or in direct competition with the established ISP's as a separate Business Unit of the OEM.

The Market

The entire business is based on the intention to reduce the emissions coming from the fossil fuel / hydrocarbons. Traditionally the cost of electricity has been higher than the cost of electricity from traditional fossil fuel dependent power generation. Thus in many parts of the world, the switch to renewable wind power is relying on some sort of subsidy from the local government.

The recent initiatives within this area on an international scale (COP21) should provide for further growth of renewable energies.

However, the pressure is on the OEM's to reduce the leveled cost of electricity in order to match the traditional market prices. This means that today, whenever a project is being developed by the local governments and IPP's, auctions are held and the OEM with the lowest cost wins the project.

The future market conditions will be an open commercial market.

This structure of the stakeholders and markets means that we have a differentiated structure of how we do business with them.

It is thus of outmost importance that we navigate the market with respect to the stakeholders and that we adhere strictly to our own internal strategy. Otherwise we risk confusing our customers and allowing for our competitors to take market shares.

The Gearbox

The problem:

- Very expensive repairs, down time and possible fines for not delivering power to the grid
- Highly loaded, complex gear design (planetary gear) is sensitive to particles in the oil
- Long oil life is required, so water, wear metals and oxidation has to be removed from the oil

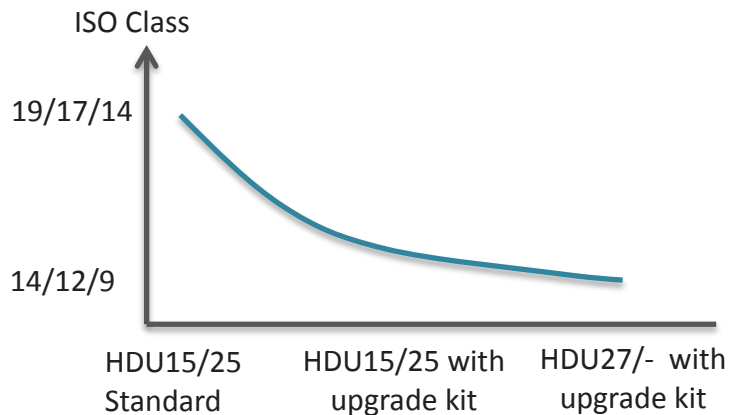
Parameters:

- High viscosity lubricants (ISO VG 320) and low temperatures in some environments

The solution

C.C.JENSEN has supplied more than 80,000 offline filters to wind turbines world wide - mainly installed on the gear box (WTG). Many OEM's has supplied HDU 15/25 as standard, but new studies have shown improved oil cleanliness can be achieved by this upgrade:

- Upgrade to a larger HDU 27/- series on the gear. Optional with Online Condition Monitor (OCM)
- Existing HDU 15/25 can be moved from gear to the pitch hydraulic
- Both HDU filters can be upgraded with CJC™ Upgrade Kit for improved performance



CJC Filter Upgrade Kit

- Increases filtration efficiency (on the 4-6 micron particles up to 3-5 ISO classes)
- Filter housing is pressurized so the existing insert is utilized more efficient

Benefits:

- Improved wind turbine availability
- Increased oil change intervals
- Increased life time of mechanical components

Standard selection for gears

Turbine size	Oil volume	CJC Wind Gear Filter	Description	Pump flow (60 Hz)	CJC article no.
< 1,500 kW	<200 L	WG1500	HDU 15/25 PV-B2PV	90 (108 L/h)	FA 76 171 78
< 2,000 kW	<250 L	WG2000	HDU 27/27 PV-B2PV	120 (145) L/h	FA 76 171 79-1
< 2,000 kW	<250 L	WG2000-OCM	HDU 27/27 PV-B2E20PV	120 (145) L/h	FA 76 171 77-174
2,0 - 4,0 MW	500 L	WG3000	HDU 27/54 PV-B2PV	250 (300) L/h	FA 76 171 79-2
2,0 - 4,0 MW	500 L	WG3000-OCM	HDU 27/54 PV-B2E20PV	250 (300) L/h	FA 76 171 77-277

CJC WG filters with OCM includes control box with motor protection, 24V power supply and Modbus

All wind filters uses Viton seals, mini mess sample valve and 3x400V

Pitch Hydraulic:

The Problem:

- Very sensitive hydraulic control valves can seize to operate due to particles or varnish
- The oil is stressed due to many cycles per minute
- The stroke of the cylinders are small so the oil is not exchanged - old dirty oil stays there

The Solution:

The hydraulic pitch system typically contains up to a few hundred liters, so a HDU 15/25 with B-insert is sufficient to keep the oil free from particles, water and varnish.

Standard selection for pitch hydraulic

Turbine size	Oil volume	CJC Wind Pitch Filter	Description	Pump flow (60 Hz)	CJC article no.
< 4,0 MW	<500 L	WP4000	HDU 15/25 PV-V	120 (145) L/h	FA 76 171 80

All wind filters uses Viton seals, mini mess sample valve and 3x400V

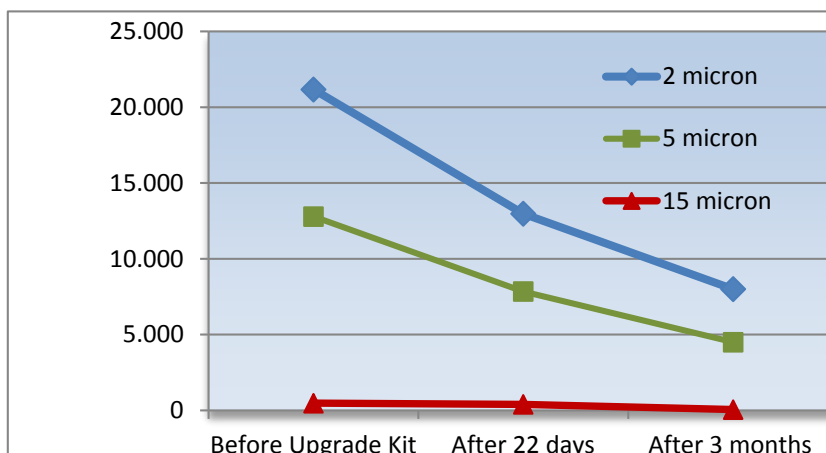
Cases

Upgrading the gear box from a HDU 15/25 to a HDU 27/27

SVEF, Börstad, Sverige

Wind Turbine Gearbox, Vestas V52-850 kW

155 L, Texaco Meropa 320



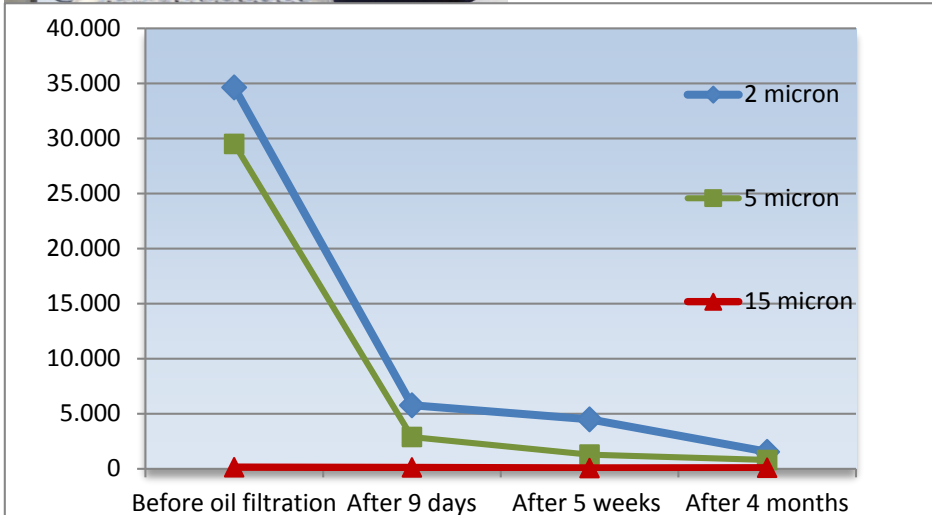
Installing a HDU 15/25 on the hydraulic pitch system

Oxhult Wind Farm, Sweden

Pitch Hydraulic System, Arise, Turbine #7

Texaco Rando HDZ 32

Achieved: ISO 11/10/7 and below 100 ppm water in oil



<i>pr. 100 ml</i>	Before Oil Filtration	After 9 days	After 5 weeks	After 4 months
Pitch Hydraulic System #7				
> 2 micron	34,631	5,773	4,489	1,539
> 5 micron	29,503	2,887	1,285	797
> 15 micron	149	123	75	98
ISO Code	16/15/8	13/12/7	13/11/7	11/10/7
Water, ppm	1,859	977	89	86

Questions

Introduction examples of investigating questions to use for wind turbine owners:

- What is your current oil maintenance scheme?
- What is the current condition of the oil?
- How do you monitor the oil today?
- How often do you have issues?
- How does the gearbox look inside today?
- Do you ever experience control issues?
Including downtime, manpower etc

