



Eaton's Offering for Wind Energy Solutions - Husum Wind Energy September 2012

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Eaton Corporation



Eaton has been Powering businesses worldwide for >100 years



- Founded in 1911 by J.O. Eaton
- World Headquarters in Cleveland, Ohio USA
- Regional Headquarters in Shanghai, China; Morges, Switzerland; Sao Paulo, Brazil
- Innovation Centers in the USA, Czech Republic, China and India
- Customers in more than 150 countries
- 2011 sales of \$16 billion, 55% of sales outside the U.S.
- More than 70,000 employees
- Chairman & CEO – Alexander M. Cutler

The power of One Eaton

Over the years, Eaton has expanded its expertise and portfolio of products and services by integrating the competencies and equities of some of the world's most respected names into Eaton to build a brand you can trust to meet every power management need.



Eaton provides energy efficient solutions for electrical, mechanical, and fluid applications

Our products & services deliver reliability, efficiency, and safety for:



Cities & Buildings



Industrial & Machinery



Energy & Utilities



Transportation



Information Technology



Infrastructure

...helping to bridge the gap between rapidly rising demand for energy and naturally constrained sources of supply with sustainable solutions

Eaton's strength is global reach with local responsiveness and support



- Customers served in more than 150 countries
- Products that meet the varied local specifications
- Diverse channels ensure reliable availability and support
 - Field sales teams support large, direct relationships
- Design and engineering teams provide support for standard products and custom solutions
- Eaton experts offer efficient product and application training



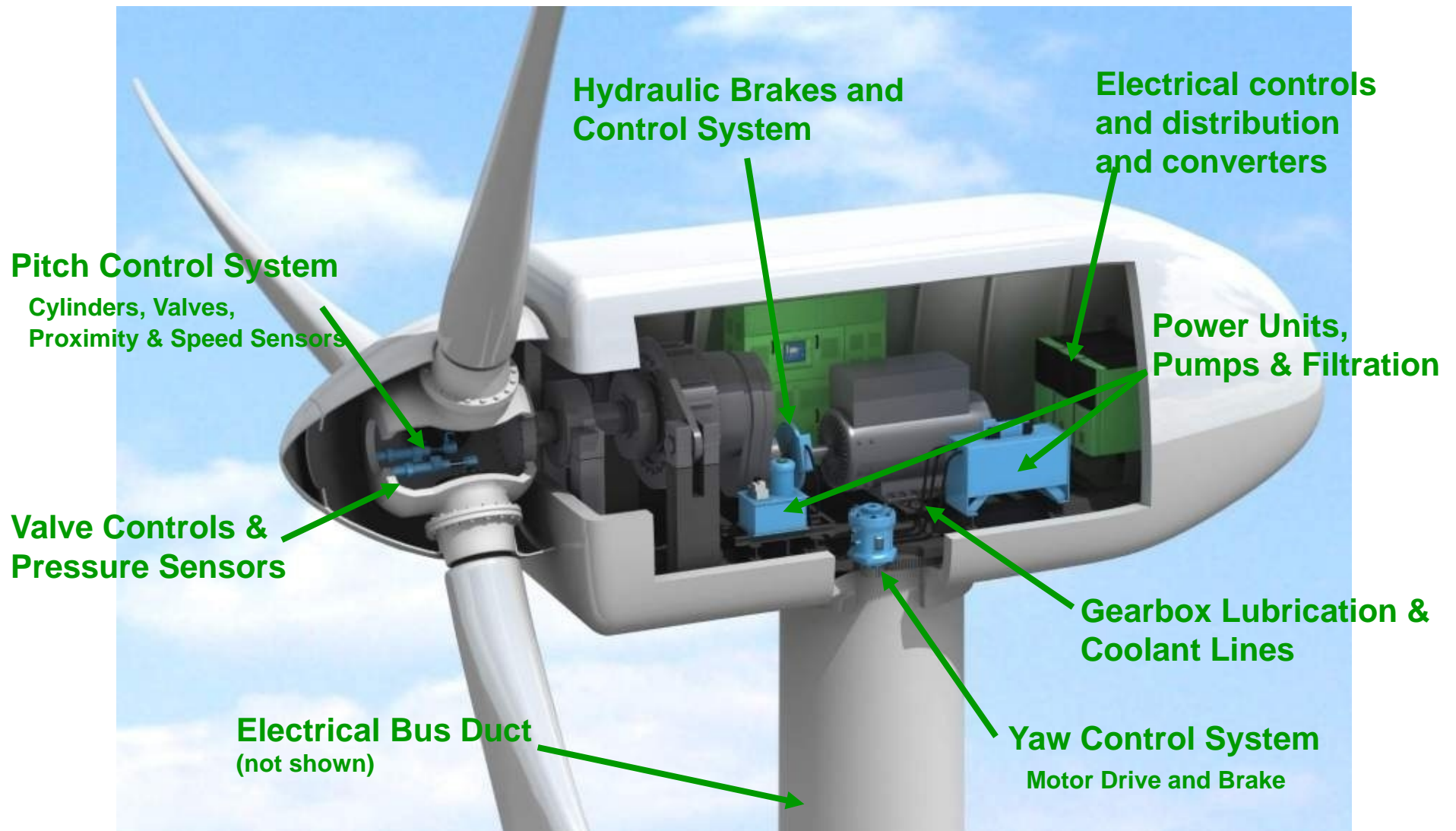
Eaton Inside (and Out) – Solutions for *Safe, Reliable, and Efficient* Wind Energy



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Eaton Wind Applications



Eaton Wind Applications (Cont.)

- Base and Tower Solutions



Successful History of Serving the Wind Industry



Our Technologies, Your Tomorrow





Eaton *Electrical* Solutions for Wind Energy



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Electrical Solutions for Power Conversion



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Power Conversion

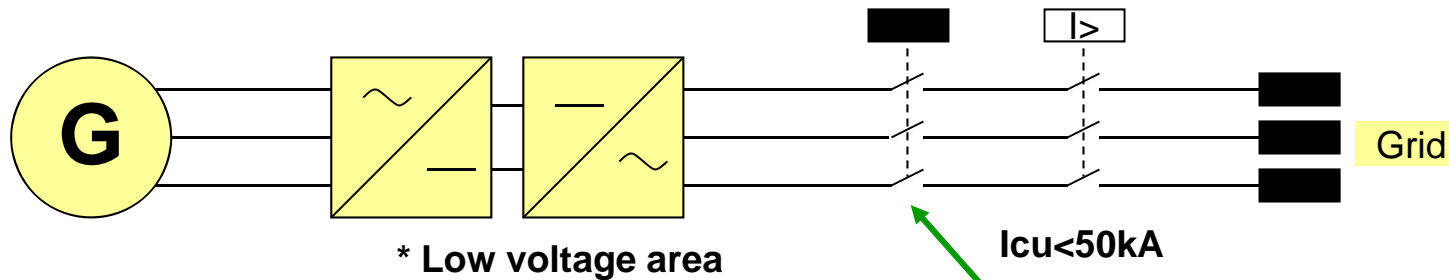
- (A) LV Molded Case Circuit Breaker
- (B) LV Air Power Breakers
- (C) LV Vacuum Contactors
- (D) MV Vacuum Contactors
- (E) LV Drives
- (F) MV Drives

Metering & Monitoring

Pitch Control System

Yaw & Drive Brake System

Eaton's best-in-class contactors are used by many leading turbine manufacturers



Fluctuating winds cause frequent reconnections of the generator output to the power supply network.

Eaton contactors **reliably** switch generator to the grid

- 3-15X operation frequency rate compared to competitors
- 30-40% space savings versus air break
- 2-10X electrical & mechanical life
- Globally certified



* Low voltage is up to 690V and frequencies both 50Hz and 60Hz

Eaton has a full line of globally certified Low Voltage Breakers that deliver critical benefits

Magnum Series Power Breakers

- **Flexibility** for custom configurations for switchgear and switchboards
 - Multiple sizes for compact enclosures with fixed and drawout versions.
- **Safe and reliable** operation
 - Human access with the door closed for maximum safety
 - Inspection, modification, and maintenance easily performed in the field



Series NRX Power Breakers

- **Power circuit breaker capabilities at half the size**
 - Single size simplifies design, integration time, and parts inventory
 - Also with fixed and drawout configurations
 - Easily installed Plug-N-Play accessories
 - Worldwide platform



Molded Case Circuit Breakers

- **Increased performance in less space than standard circuit breakers**
 - Complete range and highest fault protection ratings in the industry

NZM range MCCB's - motor starter combinations

- **Now up to 690V / 80KA high switching capacity**









Eaton's GREEN switchgear for Green Energy

Large range of SF₆-free medium voltage switchgear and grid connect solutions for ANSI and IEC applications

Eaton's SF₆-free switchgear for medium voltage

Eaton's medium voltage switchgear systems are based on the use of vacuum interrupters combined with solid insulation material. This is an environmentally-friendly technology in comparison with the methods used by many other suppliers, which use SF₆ as an insulation gas.



				
Xiria 3,6 - 24 kV	SVS 3,6 - 24 kV	Power Xpert[®] FMX 3,6 - 24 kV	Power Xpert[®] UX 3,6 - 24 kV	MMS 3,6 - 24 kV

Eaton's Innovative technology has NO harmful SF₆:

- Minimal maintenance
- Dramatically better for the environment
- Lower overall cost of ownership

Additional Services

- Turnkey substation construction services
- **Arc Flash Studies**
- Electrical Safety Training



An Eaton Green Solution

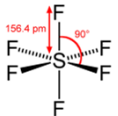


www.eaton.com/greensolutions

Others still use SF₆!

- Highest global warming potential greenhouse gas: > 3000 years atmospheric lifetime!
- Requires regular inspection and maintenance
- High end of life costs for "recycling"

sulfur hexafluoride (



Eaton offers the full range of proven electrical products used in Wind Energy systems: From UPS to Switches, Sensors, PLCs & Operator Interfaces



Inductive Sensors detect speed and position for critical nacelle, spinner and blade operations

Interlock and Limit Switches provide operational safety



A full range of UPS systems as well as all power distribution.

Lossless, high-accuracy and isolated AC & DC current sensors, switches and ground fault devices



Modular PLCs provide monitoring and motion control and share data over communication networks.

Scalable Operator Interfaces are high performance yet cost-effective, providing machine control and SCADA functions



Eaton Solution for Germany Small Wind

NEW



Grid and plant protection (NA-Schutz) according to VDE-AR-N 4105

- Product range: versions for 43, 55, 86 and 100 kVA
- Energy-efficient (low sealing consumption)
- Suitable for all grids - Fully wired with 4-pole contactors
- Declaration of CE Conformity
- Protection from under- and overvoltage
- Protection from under- and over frequency
- One-fault-proof with monitoring of connected switches (defeatable)
- Preset according to VDE-AR-N 4105

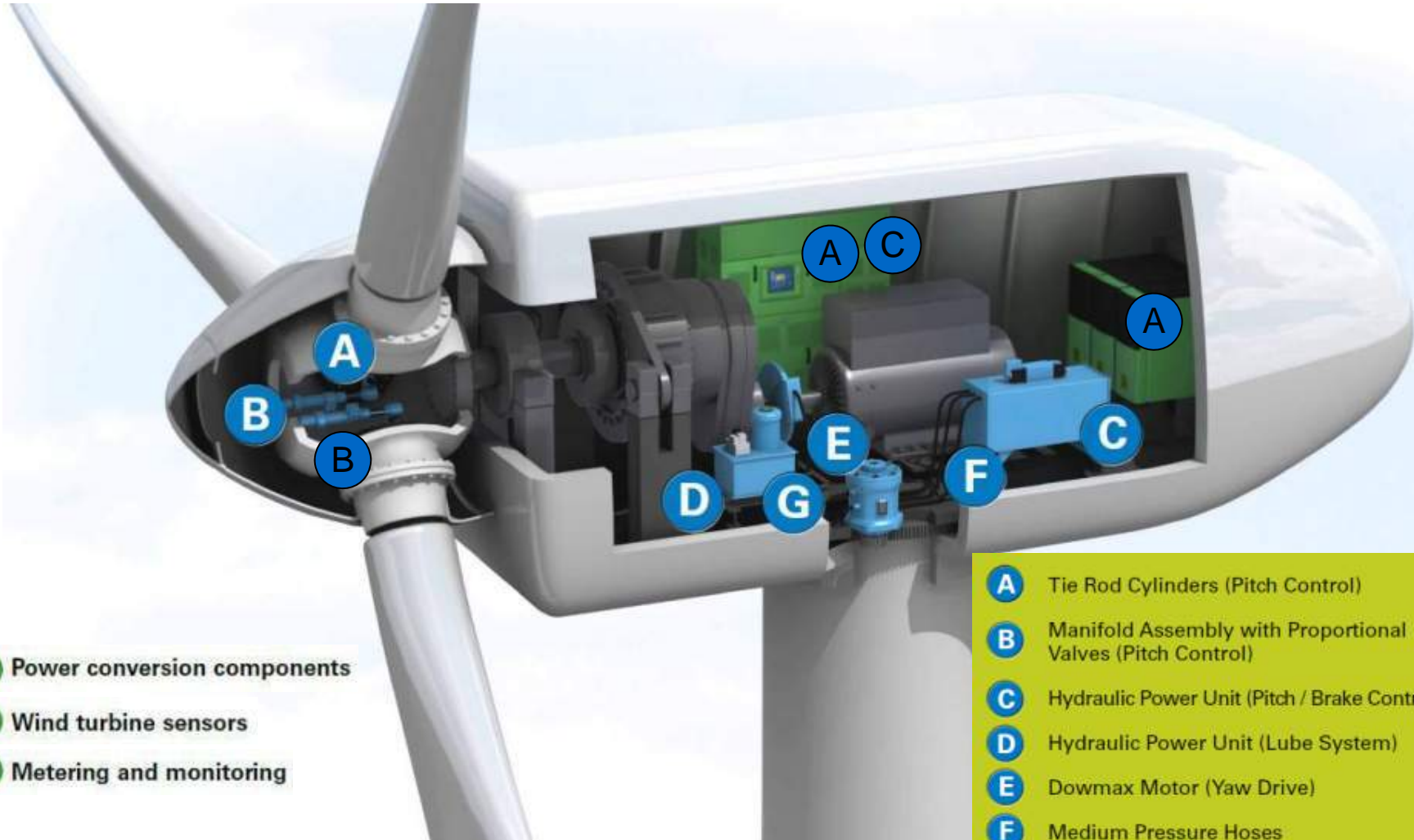
Eaton *Hydraulics* –
Leaders in Wind Power Solutions



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Eaton Nacelle Solutions



- A** Power conversion components
- B** Wind turbine sensors
- C** Metering and monitoring

- A** Tie Rod Cylinders (Pitch Control)
- B** Manifold Assembly with Proportional Valves (Pitch Control)
- C** Hydraulic Power Unit (Pitch / Brake Control)
- D** Hydraulic Power Unit (Lube System)
- E** Downmax Motor (Yaw Drive)
- F** Medium Pressure Hoses
- G** Low Pressure Hoses

Leaders in Pitch Control

Customer Requirements

- 24/7 operations – productivity
- 20-year life expectancy - durability
- Pitch positioning 0.5°- accuracy
- Plug and play – easy to use

Application Challenges

- Lightning
- Corrosive & moist environment
- Ambient temp -40° C to 50° C
- Vibration and shock
- Accessibility

KB Series Proportional Valve

- Enhanced version, HALT test proved

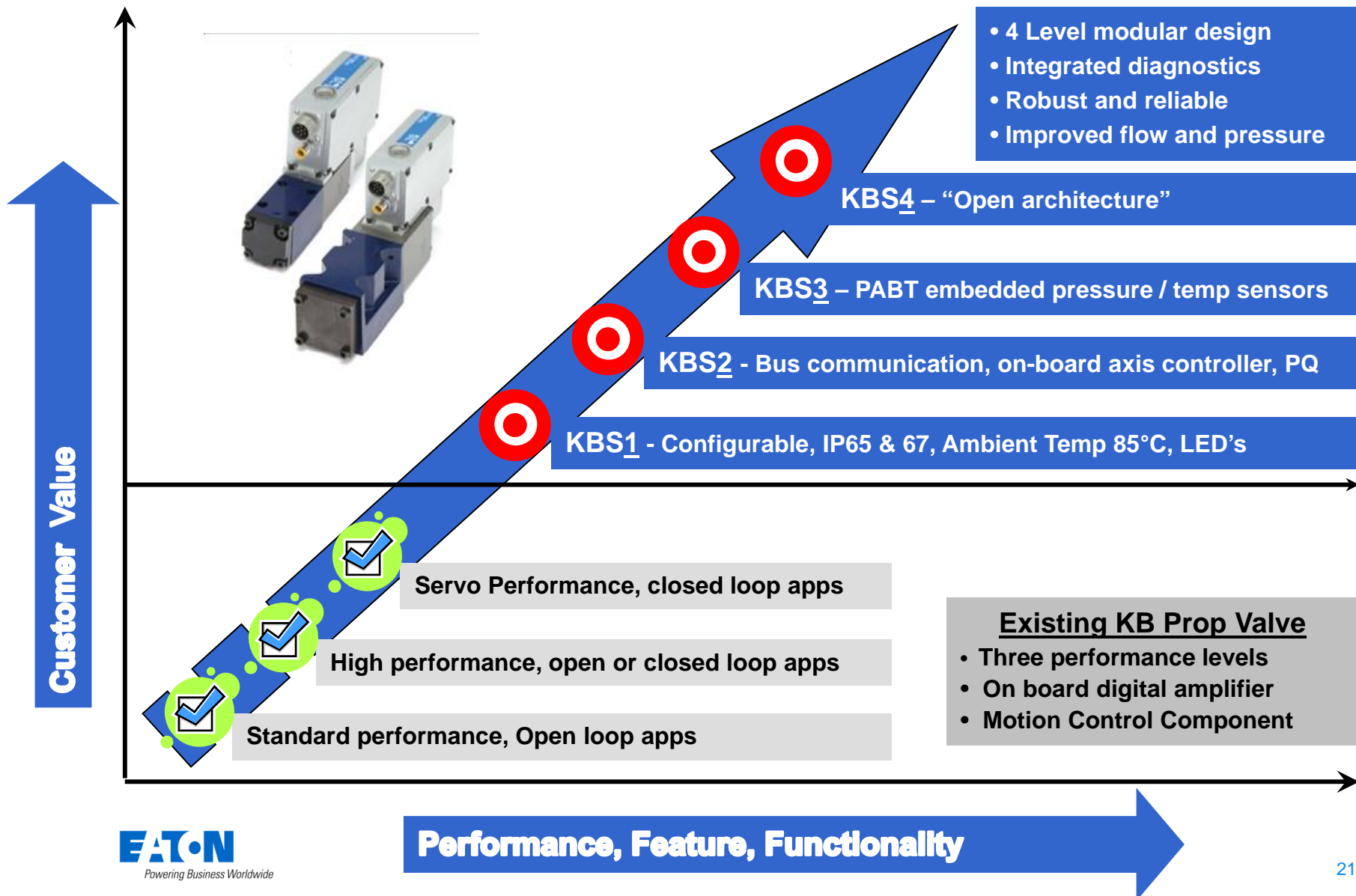
More than 45,000 valves in field globally

Solution Examples



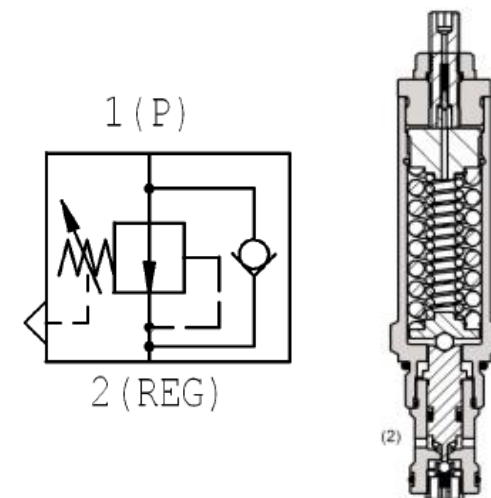
Demanding Applications - Proven Durability !

AxisPro™ Next Generation Proportional Valves



New pressure reducing valve 1PDC5

- Designed for wind turbine applications
- 6 l/min, 350 bar
- Low leakage
- Energy efficient
- Maintains pressure in accumulator – reduces frequency of power pack re-start



LifeSense® Hydraulic Hose Condition Monitoring

- Electrical measurements sense localized condition changes and detect forthcoming failure
- Proven field test success
- Design configurations
 - Wired
 - Wireless
- In development
 - TTC fittings
 - Spiral hose
 - Battery-free wireless



Wired



Wireless



Fatigue



Abrasion

Eaton Walterscheid

Metric Tube Fitting Systems (acc. to DIN EN ISO 8434-1)



Eaton Walterscheid Approvals:



- **Systems:** Eaton-Walterscheid-Trilogy
 - **WALPRO** Two edge cutting ring, available in carbon and stainless steel 1.4571
 - **WALRING** Two edge cutting ring with additional soft seal
 - **WALFORMplus** Tube Forming System
 - Tube forming system **WALFORMplus** for carbon and stainless steel
 - Tube forming system **WALFORMplus-M** (Metallic sealing for various materials)
 - **WALFORMplus-SR** for thin wall thicknesses in carbon and stainless steel 1.4571

Eaton Walterscheid

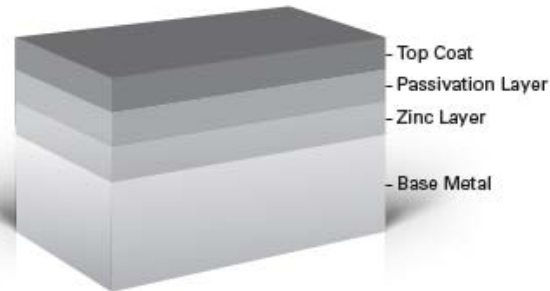
Guardian Seal™ Chrom-6-free surface technology

- **Eaton Guardian Seal™:**

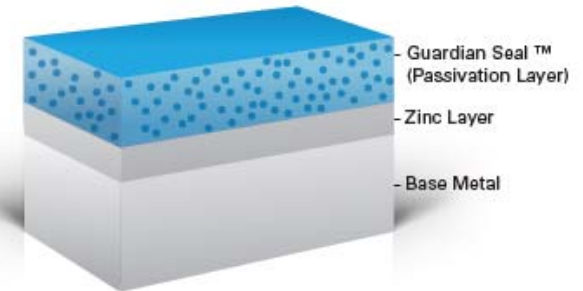
- Meets the VDMA 24576 class no. 5 (**360 hrs WR / 720 hrs RR**)
- **Free of Nickel**
- **Same friction level** like Chrom-3 parts
- Available from 2013 on
- Structure:



Hexavalent Chrome Free Plating



Eaton Guardian Seal™



- **Test results:**



Salt Spray Fog Test according to DIN EN ISO 9227-NSS after **360 hrs / 720 hrs / 1.400**

hrs

Eaton *Filtration* Solutions for Wind Energy



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Lubrication Systems, Filter Systems, and Accessories for Wind Power Gears

- It is particularly important that wind turbine lubricants provide appropriate protection of gearboxes against corrosion, wear and tear.
- Most lubrication and hydraulic systems failures are caused by oil contamination. That is why proper oil maintenance, monitoring, and filtration are an essential part of preventive, structured maintenance programs

Experts recommend equipping wind power systems with:

- **Additional filtration systems**
- **Metal particle monitoring systems**
- **Solid contamination monitoring systems**
- **Water-in-oil monitoring systems**
- **Water removal systems**
- **High quality desiccant breathers**
- **Heating systems for cold environments**
- **Cooling systems**

Filtration - Scope of Business

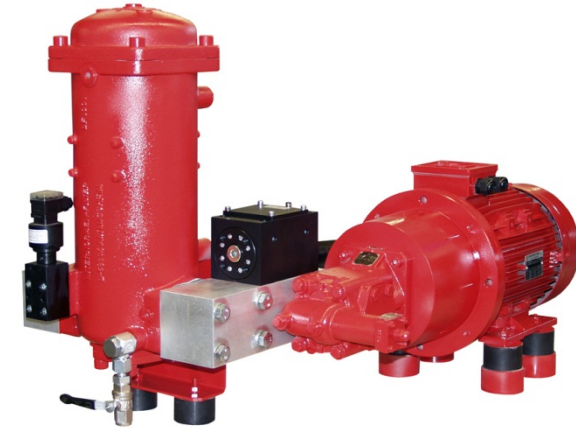
- Wind Turbine Manufacturers
- Gearbox Manufacturers
- Gearbox Design Companies
- Engineering Companies
- Service Companies
- Wind Turbine Users
- Wind Park Owners



Hydraulic & Lubrication Filters and Systems

Twinfil Filter Systems (TWF)

- Specially designed lubricating systems for gears, able to perform reliable supplying of all lubricating points in the gear, filtration and deaeration of the system
- Ensure low noise emissions, indicate operating conditions, and are extraordinary simple to be serviced
- Operate in cold weather conditions with additional pump-assisted heating system



Stationary Off-Line Filter Units (US)

- Designed for servicing oil at gears with high viscosity lubricants
- Perform off-line filtration to improve gearbox performance and extend service life



Condition Monitoring

Oil Condition Monitor (OCM 01)

- Mobile diagnostic system able to determine the aging condition of oil by measuring solid contamination, water saturation, temperature, viscosity and relative dielectricity
- Applicable for both pressure and suction lines
- Can effectively be used when working with foamed oils in gears
- Enables the user to make a precise assessment of a system's condition and perform cost-effective maintenance on time



Metal Particle Sensors (MPS)

- Detection of metal particles
- In-line monitoring solution for stationary and permanent operations
- Suitable for installation in new or existing systems



Hydraulic Filter Accessories

Heating Systems (HS)

- Provide quick additional heating of oil in the gears, when due to low temperatures and extreme conditions the oil viscosity reaches up to 160 000 cSt (mm²/s).
- Two types are available, operating at 8 or 12 bars maximum pressure, fitted for temperatures up to 80°C and down to -40°C,
- Maintenance-free, equipped with a monitoring device which prevents oil overheating



Maintenance Units (WGR)

- Inexpensive maintenance unit meant for quick, clean change of filter elements without oil loss

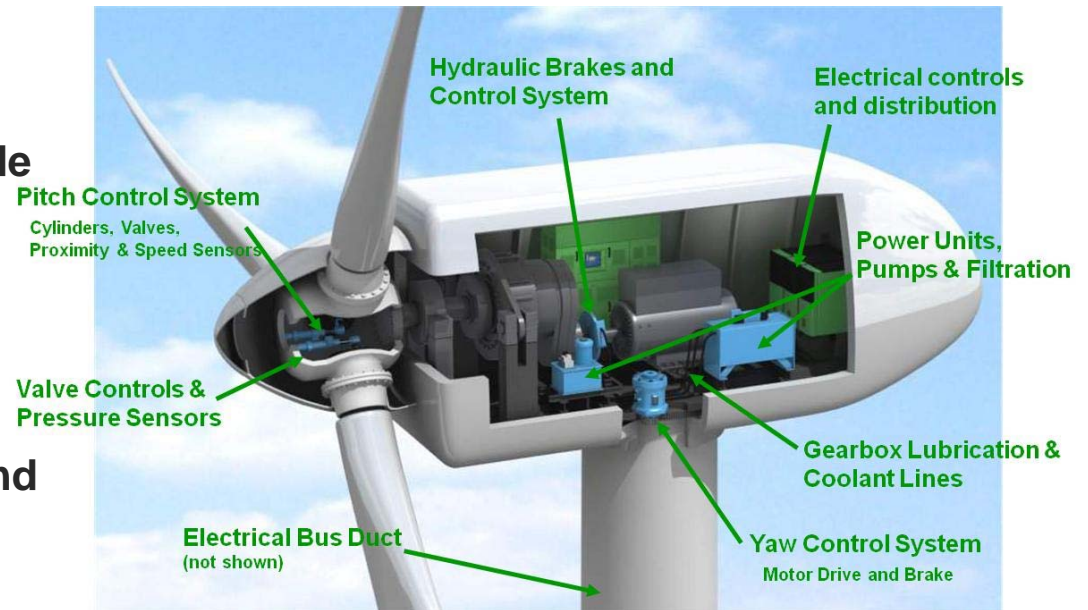




Summary

Eaton for Wind Summary

- **Eaton:** A global power management company enabling our customers to **safely, reliably, and efficiently** provide world class electrical, hydraulic and mechanical systems for the production of **Wind Energy**
- **Eaton Electrical:** Enabling safe, reliable, and **green** conversion of wind power to electricity.
- **Eaton Hydraulic:** Energy Efficient Power and Motion control
- **Eaton Filtration:** Monitoring, Filtration and Lubrication Systems for improved dependability & extended service life
- **Eaton:** Global offerings for Inside (and Out) of Wind Power Systems!





Any Questions?

Thank you for
your attention !



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