

Masterflow[®]

Well-founded expertise
for wind power



 **BASF**
The Chemical Company

BASF more than a group

BASF for Sustainable Wind Energy

BASF is the world's leading chemical company: The Chemical Company. Our portfolio ranges from chemicals, plastics and performance products to agricultural, fine chemicals, oil and gas. As a reliable partner, BASF helps customers to be more successful in virtually all industries. With high value products and intelligent solutions, BASF plays an important role in finding answers to global challenges such as climate protection, energy efficiency, nutrition and mobility.

BASF's Construction Chemicals division is the leading supplier of chemical systems and formulations for the construction industry. Continuous innovation and tailor-made solutions ensure that our customers stay at the forefront of technology.

The BASF Admixture Systems division specifically helps customers in the ready-mix, precast and other concrete industry products. The use of BASF's admixtures can be tailored to achieve the best concrete mix for the foundation design and geotechnical conditions, whilst minimizing the CO₂ footprint of the concrete. Our range of superplasticizers, curing agents, release agents, air entraining agents, accelerators and corrosion-inhibiting admixtures provide the flexibility for material innovation to address these challenges whilst increasing productivity and delivering whole-life cost benefits.

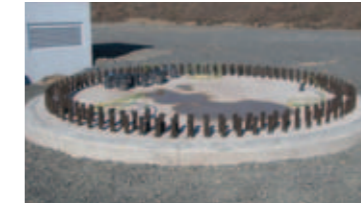
For the construction of modern, giant wind turbines BASF's Construction Systems division offers high-performance **Masterflow**[®] ExagROUT materials, adhesives and sealants. Whatever the type of the foundation in on- or offshore installations, BASF offers special new **Masterflow**[®] ExagROUTs that are able to absorb the enormous vibrations, wave actions, torque and wind power during the entire lifetime of the wind turbines.

Based on BASF's long-term technological experience and our innovative power, we strive continuously to develop new products to meet our customers ever increasing requirements. We support wind turbine manufacturers with innovative epoxy systems and specialized coatings materials for rotor blades – **Baxxodur**[™] and **Oldodur**.

With BASF's global presence and technical expert network, we can guarantee our customers solid support in all regions of the world.



Epoxy systems and coating materials for rotor blades



Admixture Systems for the best concrete mixes in foundations



Ultra-high performance **Masterflow**[®] ExagROUTs for wind turbines



BASF wind power specialist

Innovative products for specific applications

The latest technical developments in the construction of wind turbines are giant towers capable of producing more and more renewable energy. The foundations of these towers need to meet ever higher quality requirements while at the same time the construction period needs to be reduced.

Wind power turbines are high, slender constructions that are dynamically exposed to high wind loads and other service stresses. The interaction of the machine with the load transferring components of the installation – tower, foundation and anchors – requires therefore special attention in the design of a wind turbine.

The most important loads acting on a wind turbine structure are:




- Axial load
- Vibration
- Rotation
- Bending
- Torsion

All these loads need to be transferred / absorbed by the grout connecting the tower to the foundation structure. A careful design and selection of the grouting material is therefore of utmost importance. Safe and durable installation of wind turbines largely depend on high performance building materials which connect the tower to its base / foundation.

BASF has specially developed ultra-high performance materials – **Masterflow**® Exagrouts – for faster installation and long term maintenance free operation of on- and offshore wind farms.

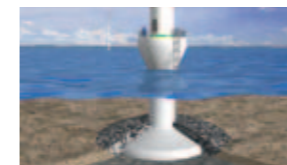


Masterflow 9500®
“Statement of compliance”
12NE7QE-41-2TJUT8_EP

-  **Fatigue resistant Masterflow® Exagrouts:**
 - Ultra-high final strengths
 - Excellent long term durability
-  **Opportunity for wider weather windows:**
 - **Masterflow**® Exagrouts are applicable down to +2°C
 - Rapid strength development, even at cold temperatures
-  **Masterflow® Exagrouts are validated by Det Norske Veritas:**
 - For grouted connections in offshore installations
 - For grouting onshore wind turbines to the foundation
-  **Improved risk management:**
 - Products installed by licensed contractors
 - BASF provides extended warranty
-  **Cost effective installations:**
 - **Masterflow**® Exagrouts can considerably reduce the overall installation time
-  **Faster return on investment:**
 - **Masterflow**® Exagrouts safeguard project completion on time
 - Wind turbines may even be earlier connected to the grid
 - Even earlier electricity production is possible



The new ExagROUT for offshore wind turbines



Gravity based foundation



Monopile foundation



Tripod foundation



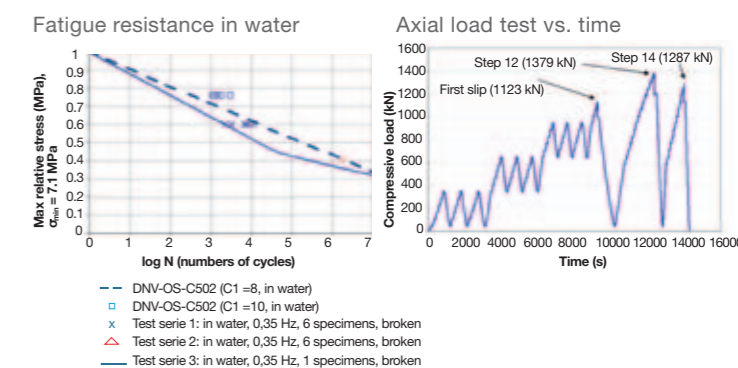
Jacket foundation



Masterflow® 9500 is a new generation of ultra high strength, high modulus, fatigue resistant cement based ExagROUT for grouting offshore wind turbine installations. The material has been especially formulated for large scale, pump applications:

- Grouting of wind turbine installations where excellent fatigue resistance is required, e.g. in grouted connections in monopile, tripod or jacket type foundations.
- Grouting under very harsh conditions, e.g. off-shore applications or below water grouting, at temperatures as low as 2°C.
- All void filling from 25 mm to 200 mm where high strength and fatigue resistance is important, e.g. with gravity based foundations.

Masterflow® 9500 exhibits long term durability and guarantees a fast, secure and cost effective installation of the offshore wind farm.



- 20 Years** **Excellent durability:**
 - High fatigue resistance, absorbing dynamic loads
 - Zero autogenous shrinkage; volume stable
 - High flexural strength, even without the addition of fibres
 - Freeze / Thaw resistant
 - Very low porosity and water absorption
- Secure installation:**
 - Ultra-high axial load capacity
 - Excellent long term load transfer
 - Validated by Det Norske Veritas (DNV)
 - High ultimate strengths
 - Installation by BASF licensed contractors
- €** **Fast and cost effective installation:**
 - Rapid strength build-up, even at cold temperatures
 - Short overall installation times and earlier operation of the wind farm
 - Faster energy production, earlier return on investment safeguard project completion on time

Masterflow® 9300

ExagROUT for onshore wind turbine installations

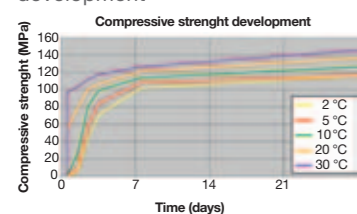
Masterflow® 9300 is an ultra high strength, fatigue resistant cement based ExagROUT with metallic aggregates for grouting onshore wind turbine installations.

Masterflow® 9300 has been especially formulated for:

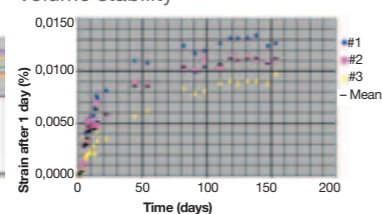
- Grouting of wind turbine installations, e.g. under the load transfer plate or T-flanges of pre-stressed towers
- Grouting under very harsh conditions, e.g. at temperature-ranging from as low as 2°C to 30°C
- All void filling from 25 mm to 200 mm where high strength, fatigue resistance and high modulus is important.

Masterflow® 9300 ExagROUT shows excellent long term durability and guarantees safe and cost effective onshore wind farm installations.

Masterflow® 9300 strength development



Autogenous swelling - Volume stability



Excellent durability:

- Contains metallic aggregates
- Excellent abrasion resistance
- High toughness index
- Freeze / Thaw resistant
- Very low porosity and water absorption



Secure maintenance free installation:

- Autogenous swelling; volume stable
- No need for permanent post-tensioning of anchors
- Excellent long term load transfer
- Being validated by Det Norske Veritas (DNV)
- High ultimate strengths
- Installation by BASF licensed contractors



Fast and cost effective installation:

- Rapid strength build-up, even at temperatures as low as +2°C
- Earlier pre-stressing of anchors at all temperature ranges
- Short overall installation times and earlier operation of the wind farm



Concrete foundation ready to install the turbine



Grouting the T-flange of the wind turbine



Hardened Masterflow® 9300 ExagROUT & pre-stressed bolts



Support in Risk Management



Wind turbines are special - their safe and durable installation largely depends on the correct design and interaction of all components – and require high performance **Masterflow®** Exagrouts to guarantee long term and maintenance free operation of the wind farm.

Minimizing risks and optimizing the electricity generation are at the heart of any investor in wind energy, whether the wind park is operated in on- or offshore conditions.

BASF helps the wind industry to be more successful by better understanding the needs of our partners and reducing the risks involved in the construction and exploration of modern wind farms.

Managing risks means for BASF Construction Chemicals amongst others:

- **Masterflow®** Exagrouts installed by BASF Licensed Contractors
- Independent documentation of the material properties
- Detailed installation methods as part of the Quality Assurance
- Validation and “Fit for Purpose” verification by DNV
- On-site consultancy
- Production of **Masterflow®** Exagrouts to highest quality standards
- Extended warranties for correctly installed and operated wind farms
- Compulsory training of BASF Licensed Contractors

With its global presence, BASF offers this high level risk management for all projects - on and off shore - independent of the country or region where the wind farm is being built

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Licensed Contractor Statement

Name of System: Offshore grouting contractor
Description: Offshore grouting contractor

Name of Product: **Masterflow® 3500**
Product Validated by: Detlev Verbeke (DVE) - Report #: 1267/02-4-1-07A/09 EP

Licensed applications: Grouting in offshore applications such as grouted connections of foundations for wind turbine installations, oil platforms and similar, e.g. monopile foundations, jackets, spacers, etc.

This is to state that: The licensee has successfully demonstrated their capability to install the "One Shot" Masterflow 3500 in offshore conditions.

Installation: BASF Construction Chemicals has verified and validated and confirms that the licensee:

1. has demonstrated many years of successful experience in this industry, and has a long track record with offshore grouting applications
2. uses only experienced crews for these types of applications
3. has the specialized equipment for installing Masterflow 3500 in offshore installations as described above
4. has successfully used in a specific testing on the correct use of Masterflow 3500 by BASF Construction Chemicals
5. has their personnel regularly re-trained by BASF Construction Chemicals
6. installs Masterflow 3500 according to BASF's technical statements and grants BASF the insight into all relevant Quality Assurance documents

Date of license validation: December 1, 2010
Validity: This document only applies to the System and product mentioned above.

On behalf of BASF Construction Chemicals: **BASF** Licensed Contractor
Leo Weidner
Key Account Manager
Wind Power Europe

Intelligent Solutions from BASF Construction Chemicals

Whatever your construction problem, whatever the structure is you are building, BASF Construction Chemicals has an intelligent solution to help you be more successful.

Our market leading brands offer the widest range of proven technologies to help you build a better world.

CONICA® – Sports Surfaces

CONIDECK® – Hand and Spray Applied Waterproof Membrane Systems

CONIROOF® – PU Based Roofing Systems

EMACO® – Concrete Repair Systems

HECK MultiTherm – Insulation Systems

MASTERFLOW® – Precision and Structural Grouts

MASTERFLEX® – Joint Sealants

MASTERSEAL® – Coatings and Waterproofing

MASTERTOP® – Decorative and Industrial Flooring Solutions

PCI® – Tile Fixing, Cement Underlays and Waterproofing Systems

RAJASIL® – Solutions for Building Refurbishment and Preservation
of Cultural Heritages and Monuments

UCRETE® – Flooring Solutions for Harsh Environments

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