

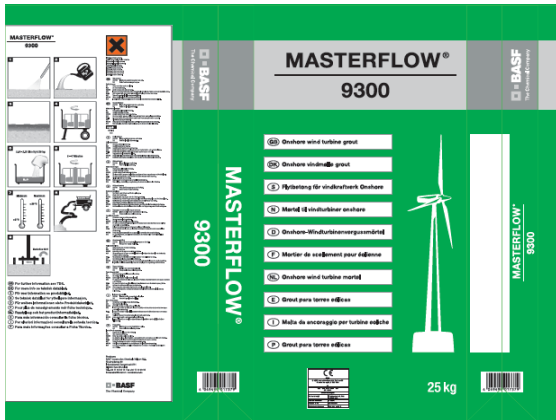


MASTERFLOW[®] 9300
Training – Application Guide

Update, January 2016

Masterflow® 9300

Training Installation Crew



Masterflow® 9300

Application guidelines



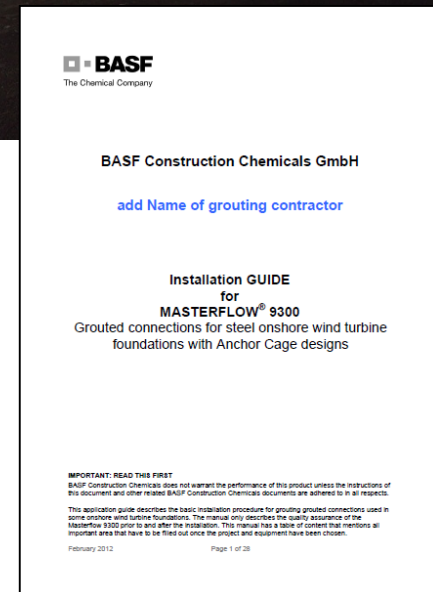
Addition to Siemens' specifications

SWP Minimum requirements for grout

Document ID: E R WP-SM11-40-0000-5006-00

MJSJ/27.06.2011 (CONFIDENTIAL)

- Method Statement is **project specific**
- BASF's application guideline for Masterflow 9300 should be an integer part of the Siemens Installation Guide
- BASF' application guideline covers:
 - General information (determined by contracting party)
 - Preparatory work
 - Grouting operation – step by step:
 - General installation information (by BASF)
 - Detailed equipment (by contractor)
 - Quality assurance sheets (by BASF)
 - MSDS of Masterflow 9300 (by BASF)



Masterflow[®] 9300

Application guidelines – Method statement



Project XYZ – Scope of work:

- Grouting services of # “name of supplier” wind turbines
- Name of wind farm: XYZ1
- Investor: XYZ2
- General contractor: XYZ3
- The erection of the wind turbines and the grouting between concrete foundation + wind turbine will take place in [town/city/region/country](#)
- The installation of the first tower elements and the grouting services will take place in weather windows which allow Masterflow 9300 to develop ≥ 10 MPa compressive strength under jobsite conditions.
- Start of grouting operation: [Scheduled Date](#)
- End of grouting operation: [Scheduled Date](#)



Masterflow® 9300

Checklist. Report per foundation



This document is mandatory, Why?

- To have information about the grouting process
- To have information about the key points of grouting process
- For BASF technical assistance after the grouting.

*Available in different languages

English
Russian
Portuguese
Spanish

Licensed Constructor									
Wind Farm									
OWNER									
Wind Turbine supplier									
Inspection points									
Activity	Inspections points	Sampling Plan	Inspection methods	Acceptance criteria	Result	Location	Suitable	Technical responsible	Date and signature
erflow 9300	verification of roughness and clean surface.	All the areas to be filled	Visual	Rough surface, clean and moisturized to saturation without puddles			yes/No	Responsible of work	
	Checking the temperature	2 measurements per day	Measurement with thermometer	Between 2° to 30 °c	Start time: temp: end: time: temp:		yes/No	Responsible of work	
	Evaluation of rain	Daily		None, wet surfaces but no puddles			yes/No	Responsible of work	
	Verification support	All the areas to be filled	Contact thermometer	Between 2° to 30 °c			yes/No	Responsible of work	
	Thickness: between 30 and 200 mm	Distance between concrete surface and flange	Flexometer	Thickness: between 30 and 200 mm			yes/No	Responsible of work	
	Identification of products to be applied	Expire date and batch number	Visual	According to previous studies and project			yes/No	Responsible of work	
	Adding water	Each batch	Graduated jar	2 at 2,25 litres at 20°			yes/No	Responsible of work	
	Mix 7 minutes	Each batch	Chronograph	7 minutes at 20°			yes/No	Responsible of work	
	Application conditions, Approx 60 minutes at 20°	Each batch	Chronograph	< 60 minutes to 20°			yes/No	Responsible of work	
	Hose replacement during grouting	Each position	visual	yes/no			yes/No	Responsible of work	
	Flow rate	Each batch	Chronograph	20l/min, 7 min/75 kg			yes/No	Responsible of work	
	Temporary formwork and grouting in one direction	1 per foundation	Visual	Consume of bags			yes/No	Responsible of work	
	Checking setting after 24 hours	All the areas to be filled	Visual	Correct setting			yes/No	Responsible of work	
	Removal of formwork.	All the areas to be filled	Visual	Removal of formwork at 24 h, proper curing 2-3 days.			yes/No	Responsible of work	
	Curing of the mortar	filled							
	Checking the shrinkage or cracking of mortar	All the areas to be filled	visual and measurement with gauge	No cracks in the mortar			yes/No	Responsible of work	
	Spread flow test	filled			Diameter:		yes/No	Responsible of work	

Masterflow[®] 9300

Application guidelines – Method statement



Project XYZ – Acceptance criteria:

these are project specific

(examples below but not limited to and prone to major differences)

- Delivery of the grout material & grouting services
- Completion of the grouting work
- Successful laboratory test of samples ???
 - X cubes or prisms to be made and tested
 - Curing regime: X ° C / Y % rel.Hum.
 - Characteristic compressive strength (cubes? prisms?Cylinders?):
Fcu ≥ XYZ MPa
- Delivery of all documentation and jobsite reports



Concrete vs. Mortar

Design watch points !!!

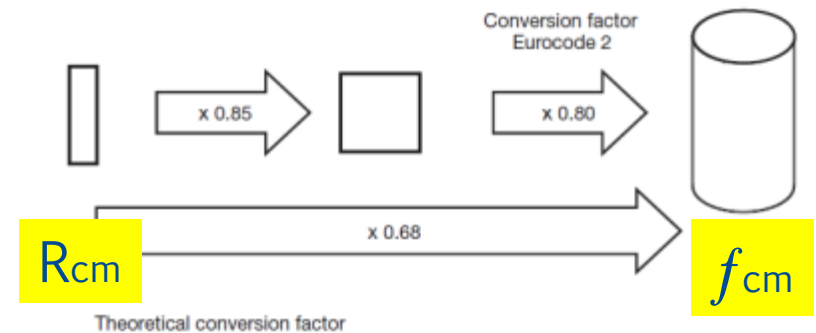
Be aware that **CONCRETE** strength classes for 150x300 mm cylinders or 150 mm cubes do not refer to mortar strength classes on 4x4x16 cm prisms or 50 mm (2") cubes

- Mortars are tested according mortar norms: EN196-1 & EN12190 (4x4x16 cm prisms)
- Concrete are tested according concrete norms: EN12390-3 (150x300 mm cylinders) or EN12390-3 (150 mm cubes) (Design norm EN 1992-1-1)

R_{cm} mean prism compressive strength

f_{cm} mean cylinder compressive strength

f_{ck} characteristic cylinder compressive strength



- Designs for the foundations of wind turbine installation are based on design strengths for concrete. Basis here for is the f_{ck} characteristic cylinder compressive strength
- Mortars are tested according mortar norms, and the reporting thereof only refers to the mean compressive strength on prisms or small cubes.

Masterflow 9300

Siemens installation guide - requirements

Grout strength requirement

- $> 60 \text{ Mpa } (f_{ck})$

Be aware these are **CONCRETE** strength classes for 150x300 mm cylinders or 150 mm cubes.

These strength classes do not refer to mortar strength classes measured on 4x4x16 cm prisms or 50 mm (2") cubes !!!

- Mortars are tested according mortar norms:
EN196-1 & EN12190 (4x4x16 cm prisms)
- Concrete are tested according concrete norms:
EN12390-3 (150x300 mm cylinders) or
EN12390-3 (150 mm cubes)
(Design norm EN 1992-1-1)

SIEMENS

SWP Minimum requirements for grout
Document ID: E R WP-SM11-40-0000-5006-00
MJSJ/27.06.2011
Conveyed confidentially as trade secret

SWP – Minimum requirements for grout

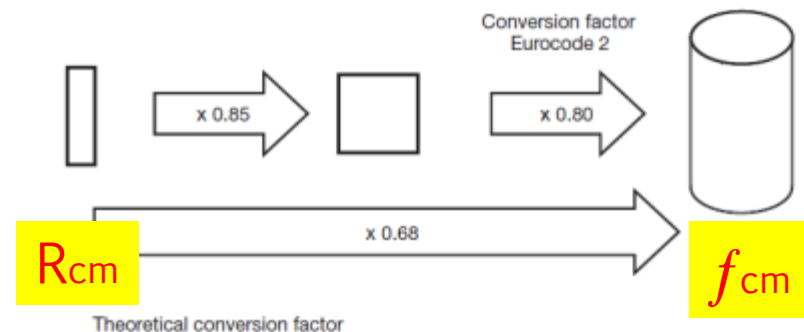
When the foundation designer selects and specifies the grout used for filling the gap between the bottom flange of the tower and the foundation concrete, it must comply with the following minimum requirements.

- The grout must be a non-shrink grout.
- The grout must be suitable for dynamic load transfer.
- The grout must have suitable fatigue properties.
- The grout must be specified, mixed and applied in fluid consistency to ensure that all gaps are filled.
- The grout must harden free of bleeding.
- **The compressive strength at 28 days (20°C) must be at least 60 N/mm² in the fluid consistency.**

R_{cm} mean prism compressive strength

f_{cm} mean cylinder compressive strength

f_{ck} characteristic cylinder compressive strength



Theoretical conversion factor

Masterflow 9300

Gamesa installation guide - requirements




Grout strength requirement

> 70 Mpa (f_{ck})

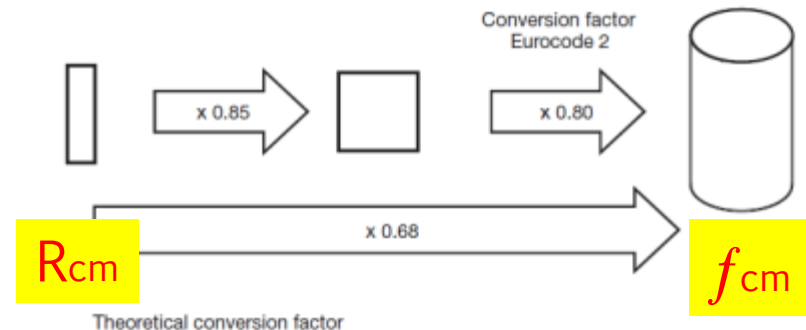
Be aware these are CONCRETE strength classes for 150x300 mm cylinders or 150 mm cubes. These strength classes do not refer to mortar strength classes measured on 4x4x16 cm prisms or 50 mm (2") cubes

- Mortars are tested according mortar norms: EN196-1 & EN12190 (4x4x16 cm prisms)
- Concrete are tested according concrete norms: EN12390-3 (150x300 mm cylinders) or EN12390-3 (150 mm cubes) (Design norm EN 1992-1-1)

REV	DESCRIPTION	DESIG.	REVIS.	FECHA	Nº	ZONA	NOTA DE CAMBIO
REV	DESCRIPTION	DESIG.	REVIS.	FECHA	Nº	ZONA	NOTA DE CAMBIO
	DESIGNACION MAPA:	TITULO PLANO					
	MATERIAL ESPEC. SPEC:	CIMENTACION CIRC NPL D17 H3 128B					
	CLASIFIEZA SEGUN CLASIF. PART TO:	PERSONA WEIGHT	DRAWING TITLE				
	A		FOUNDATION CIRC NPL D17 H3 128B M39 L3000				
	ESCALA SCALE:	MET. PROS. PROYECT.:	PLANO Nº ORIG. NÚ.	REV. REV.	FORMATO. FORMAT.	A1	
			GP233398	R0		3 ^{OP} 4	
JST REVISION STATUS							
FECHA DATE	10.01.13						
FECHA DATE							
FECHA DATE							

Gamesa  Este plano no puede ser usado, publicado, ni comunicado a terceras partes o reproducido sin autorización escrita de GAMESA. This drawing cannot be used, published, nor communicated to third parties or reproduced without written authorization of GAMESA.

R_{cm} mean prism compressive strength
 f_{cm} mean cylinder compressive strength
 f_{ck} characteristic cylinder compressive strength



Concrete vs. Mortar

Example for a Gamesa specification

Grout strengths vs. characteristic cylinder strength

Grout strength requirement by Gamesa

> 70 Mpa (f_{ck})

Druckfestigkeit* N/mm ²	nach 3 Stunden	10,0
	1 Tag	25,0
	7 Tagen	60,0
	28 Tagen	80,0

Grout x

* Lagerung der Probekörper in Anlehnung an DIN EN 196-1:1

Grout xx

Druckfestigkeit*	24 h	N/mm ²	≥ 70
	7 d	N/mm ²	≥ 75
	28 d	N/mm ²	≥ 90

This is not f_{ck} but R_{cm}

The mean strength of these grouts do not meet the > 70 Mpa (f_{ck}) requirement

MasterFlow 9300

Compressive strength (40 x 40 x 160 mm prisms – EN 12190)	MPa
- after 1 day	≥ 60
- after 7 days	≥ 100
- after 28 days	≥ 120
- after 90 days	≥ 140

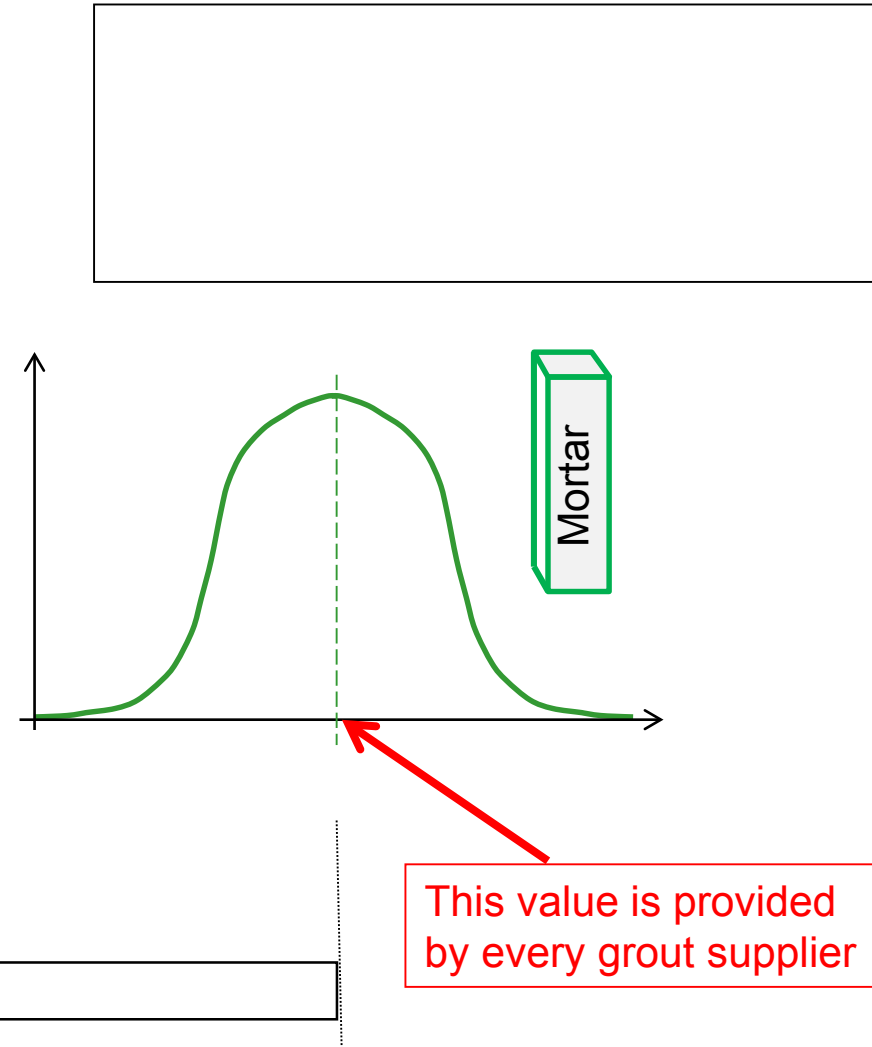
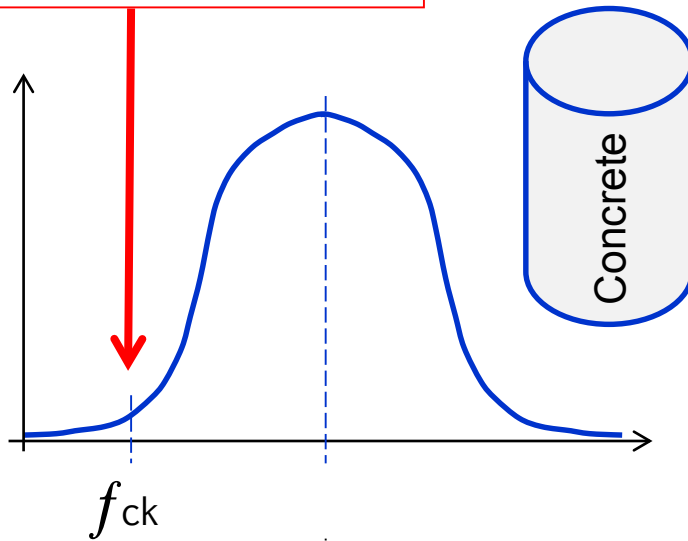
This is not f_{ck} but R_{cm}

But the mean strength of MasterFlow 9300 does meet the > 70 Mpa (f_{ck}) requirement

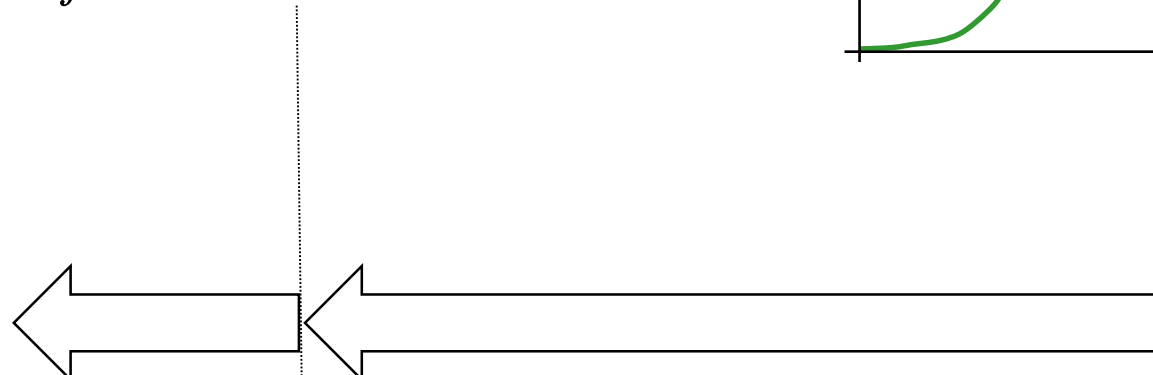
Concrete vs. Mortar

Design watch points !!!

This value is needed by every foundation designer



This value is provided by every grout supplier



Concrete vs. Mortar

Examples of mortar or grout strengths

Difference with characteristic cylinder strength

Grout x	Druckfestigkeit* N/mm ² nach 3 Stunden	10,0
	1 Tag	25,0
	7 Tagen	60,0
	28 Tagen	80,0

* Lagerung der Probekörper in Anlehnung an DIN EN 196, T. 1

Grout xx

Druckfestigkeit*	24 h	N/mm ²	≥ 70
	7 d	N/mm ²	≥ 75
	28 d	N/mm ²	≥ 90

Masterflow 922 / 952

Resistencias mecánicas según EN 12190.

R. Compresión	a 20°C	a 6°C	a 20°C	a 6°C
	aprox. 40	aprox. 3	aprox. 43	aprox. 3
	aprox. 68	aprox. 65	aprox. 62	aprox. 60
	aprox. 80	aprox. 68	aprox. 80	aprox. 75

Typical values		MPa
Compressive strength (40 x 40 x 160 mm prisms – EN 12190)		
- after 1 day		≥ 60
- after 7 days	MASTERFLOW 9300	≥ 100
- after 28 days		≥ 120
- after 90 days		≥ 140

This is not f_{ck} but R_{cm}

Masterflow[®] 9300

Application guidelines – Method statement



Project XYZ – Preparatory work:

- Mobilization and set-up of mixing/pumping equipment
- Verification of functionality of equipment prior to grouting starts e.g. power and water supply
- Double check the necessary amount of grout and fresh water
- Necessary testing equipment and availability
- Necessary number of cubes or prisms
- Hose arrangement and couplings (**no reduction of \varnothing** at couplings – **no hydraulic hoses**). Single hose length preferred.
- Rigid thin wall metal tube, bended to allow easy pumping underneath T-flange of tower and between anchor bolts
- Flush out grout lines
- Dampen concrete foundation



Masterflow[®] 9300

Application guidelines – Method statement



Project XYZ – Grouting operation:

- Environmental conditions:
 - **air & concrete temperature $\geq +2^{\circ}$ C**
 - **steel temperature of tower $\geq +2^{\circ}$ C**
 - protect from rain during and first 24 h after grouting
- Starting procedures: e.g.. lubrication of hoses with cement slurry
- Mixing procedures (see later)
- Quality assurance:
 - counting the bags
 - visual check of homogeneity
 - consistency check e.g. with ASTM C230 ring
 - temperature of mixed material
 - compressive strength
- Flushing / cleaning procedure



Masterflow® 9300

Application guidelines – Method statement

Project XYZ – Contingency plan:

- Blocking of hose
- Maintenance/repair/break-down of pump
- Maintenance/repair/break-down of mixer
- Power failure
- Tenting and heating



Masterflow[®] 9300

Application guidelines – General information



Foundation preparation:

- Foundation must be clean and free from oil, grease, release agents and other materials that can impair adhesion of the grout. This is e.g. best done with high water pressure (e.g. > 200 bar). Protect anchor edges from damaging while cleaning.
- Allow the contractor installing the tower to set the adjustment feet and erect first tower element
- Concrete and steel temperature to be measured. Must be $\geq 2^{\circ}$ C during and after installation. Pre-heating when necessary.
- Dampen the concrete prior to grouting, removing free standing water
- Eliminate sources of vibration, which can cause settlement and bleeding, until grout hardens



Masterflow[®] 9300

Application guidelines – General information



Equipment – Hose arrangement:

- Use forced action pan mixers or paddle mixers capable to mix min. 100 kg at a time (bigger volumes might be required, or alternatively use 2 mixers)
- Use worm driven pumps e.g. Putzmeister S5 EVTMM
 - variable output e.g. 7 – 40 Lt/min
 - delivery pressure up to 25 bar
 - hopper volume at least similar to volume of 1 mix
 - drive motor: 5.5 kW, 400 V/ 50 Hz (alternatively diesel driven)
- Hand-held mixer for mixing cement slurry / lubrication mix
- Hoses + arrangement:
 - only 1", 1.5" or 2" NB flexible hoses **no hydraulic hoses (these have Ø reductions at each coupling)**
 - Larger hose diameters and/or shorter hose lengths may be chosen in order to ease the installation.
 - rigid, thin wall, bended, metal tube



Masterflow[®] 9300

Application guidelines – General information



Lubrication of hoses and pipes:

- Lubrication mix made from OPC and water; mix until lump free
- Volume of lubrication mix: ≥ 50 litres / 25 m hose (depending on hose \emptyset)
- Fill hopper of Putzmeister pump with lubrication mix and pump at low output rate
- Lubricate all hoses and grouting pipes
- Lubrication mix a.s.a.p. followed by:
 - mixing Masterflow 9300
 - pumping of grout
- Trial run before first turbine to be grouted: as above
 - lubrication mix in skip bin
 - when good grout comes out of the hose, circulate into the hopper of the pump and continue for some time



Masterflow[®] 9300

Application guidelines – General information



Lifting & emptying bags:

- Size of bags: 25 kg each allowing manual lifting
- Materials placed as close as possible/practical to mixer
- Safety first: e.g..
 - careful positioning of workers & material
 - sharp cutting knives on the mixers
 - always wear the necessary safety goggles, gloves and dust masks (*irrespective of the fact that Masterflow 9300 is low Chromate and dust reduced*)
 - ...
- Mix entire bags only
- Protect mixer and mixed material from rainfall



Masterflow[®] 9300

Application guidelines – General information



Mixing Masterflow 9300:

- Mix entire, undamaged bags only
- Wet out mixer before 1st mix, remove free water
- Add **potable water** only:
approximately 2 - 2.25 litre / 25 kg of powder
- Mix for minimum **7 minutes** (longer when necessary)
- Check consistency before emptying entire mixer, i.e. measure spread of flow with ASTM C230 ring
 - when OK: start the grouting process
 - when not OK: mix longer and/or add more water without exceeding maximum water amount; check spread again before grouting operation to start;
- Empty mixer and fill hopper of the pump; keep mixed Masterflow 9300 in motion



Masterflow[®] 9300

Application guidelines – General information



Mixing – Watch points:

- Watch the change of consistency with the mixing time !!!
- Long mixing times are required as plasticizers need a long time to take effect due to very low water demand
- Mix for minimum **SEVEN** (7) minutes
- The correct water demand and mixing time at the given environmental conditions should be determined using the ASTM C230 “spread of flow” method
- **Remark: longer mixing will improve flow-ability and spread of flow, especially at cold temperatures**



Masterflow[®] 9300

Application guidelines – General information



Quality Control – at the mixer / pump:

- Visual check of homogeneity:
 - no segregation
 - no separation
 - no bleeding
- Temperature of fresh grout
- Air temperature
- Concrete foundation temperature
- Steel (tower) temperature
- Measurement of consumed volume



Masterflow[®] 9300

Application guidelines – General information



Quality Control – sampling:

- Take samples from freshly mixed material
- Workability / viscosity to be determined with the “spread of flow” method – ASTM C230.
- For each wind turbine installation: a minimum of 1 measurement of the spread of flow needs to be carried out. (2 measurements preferred)
- Compressive strength testing – 75 mm cubes or 4x4x16 cm prisms



Masterflow[®] 9300

Application guidelines – General information

Quality Control – Workability:

- Consistency or “spread of flow” measured with ASTM C230.
- For each wind turbine installation:
 - min. 1 measurement - 2 measurements preferred
 - at the beginning
 - half way through grouting
- Procedure:
 - take freshly mixed material (ca. 1 litre)
 - pre-dampen the surface of the measuring plate without too much free standing water
 - pre-dampen the metal ring, and position in the middle of the plate
 - fill the ring to the top with mixed grout, and level off when necessary
 - lift ring, empty completely and let grout spread
 - measure \emptyset of spread in 2 directions and record



Masterflow[®] 9300

Application guidelines – General information



Quality Control – e.g. Cube testing:

- 75 mm cubes are tested for acceptance; all individually marked
- 4 x 3 cubes shall be casted for each grouting day (= 3 cubes for each testing time)
- Curing at **+20° C**; water immersed; to verify acceptance criteria after 28 days curing
- Curing at jobsite conditions (under tenting when heating is considered); in the mould covered with plastic sheet; to decide when next element can be erected (≥ 10 MPa)
- Strength measurements:
 - set # 1: after 1 day; jobsite conditions
 - set # 2: after 2 or 3 days; jobsite conditions
 - set # 3: back-up (if 10MPa strength is not achieved in the curing time before)
 - set # 4: after 28 days; under lab conditions (as verification of acceptance criteria)



Masterflow[®] 9300

Application guidelines – Additional information



Quality assurance – strength testing:

- Sampling: immediately after completion of mixing, from the middle of the mix
- Casting samples:
 - do not vibrate or tamper samples
 - let them stand for a short while (de-aeration)
 - level off the top of the moulds
- Curing: **20° C (acceptance criteria) or jobsite conditions**
 - protect against evaporation with plastic cover
 - put samples under water as soon as practical
 - de-mould at the earliest after 24 hrs (longer at cold temperatures e.g.. 48 hrs)
at temperatures $\leq 5^{\circ}$ C the cubes are very vulnerable after 24 hours. Handle with care when de-moulding the samples for 24 hr compressive strength testing. Keep other samples (2, and 28 days testing) in the moulds for at least 48 hrs.
 - after de-moulding place the “uniquely marked” cubes in water.



Masterflow® 9300

Application guidelines – General information



Quality Control in general:

You must placing the samples in the same situation as the grout, this means:

1. If grout is covered with thermal blankets, place the specimens with thermal blankets.
2. If grout is covered with plastic, place the specimens with plastics.
3. others.....

Since could be variations between two results, and lead to mistakes on the results.



Masterflow[®] 9300

Application guidelines – General information



Pumping and installation 1:

- Grout should be placed as quickly as possible after mixing and discharging into the hopper of the pump
- Minimum 1" inner Ø hoses (flexible NB) should be used, **preferably 1.5"** or even 2".
- Do NOT use hydraulic hoses as the inner Ø reduces at every coupling (e.g.. from 2" to only 1.8"), consequently leading to increased pump pressures and higher risk for blockages
- Use short lengths of hoses, still practical for the job. Larger hose diameters and/or shorter hose lengths may be chosen in order to ease the installation of the material.
- Use long, smooth reduction pieces when changing from a bigger to a smaller Ø, rather than abrupt reducers



Masterflow® 9300

Application guidelines – General information



Pumping and installation 2:

- Keep hopper of the pump and grout lines filled throughout the complete placement. Keep the hopper at least half full with grout.
- Take care to ensure that air is NOT entrapped. A slug of air entering the pump and lines usually ends up as a void in the placed grout
- Place a sieve / screen over the pump hopper. Lumps or other debris can jam the pump / lines
- Start pumping the grout only after sufficient lubrication of the pipes / hoses
- Start pumping at the lowest output rate of the pump until steady flow of material before increasing speed of pumping.

High output rates at start-up can easily block the lines. Reduce the pump speed if there is a need to interrupt pumping. This will ease start-up again



Masterflow[®] 9300

Application guidelines – General information



Pumping and installation 3:

- Have the following immediately available at all times:
 - Hose connected to a water line
 - Other end connected to a pipe with a smaller Ø than the hose Ø.
- Grouting the cavity is done from one side only (either outer side or inner side of the tower), slowly moving in 1 direction only.
- Start the pumping process against a temporary form (e.g. PU-foam) installed underneath the T-flange and radial in the trench for preventing the grout to flow in two directions.
- Pump the grout into the trench at the bottom, continue until the grout exits the opposite side of the T-flange and the top grout level is level with the concrete.
- In the event of any equipment failure, blockage,... follow the contingency procedures.



Masterflow[®] 9300

Application guidelines – General information

Switching inlets - Flushing:

- After the entire cavity is completely filled, start flushing procedure
- Put a sponge ball into the lines and pump water through the lines, pushing the remainder of the grout into a skip bin.
- Repeat this action until hoses are completely clean.
- Hoses are lubricated again with cement slurry, after setting up for grouting a subsequent tower.
- When the time and distance between 2 subsequent towers is fairly long or in hot weather conditions, additionally clean the entire mixing and pumping equipment before moving to the next position



Masterflow[®] 9300

Application guidelines – General information

Contingencies:

- Have the following available in the unlikely event of blockages or failures:
 - Hose connected to water line with good pressure. Other end connected to a metal pipe with smaller Ø as the grout line. This can quickly be inserted to clean the lines
 - back-up rigid thin wall metal tube, especially shaped
 - back-up pump
 - back-up mixer
 - additional hoses
 - spare parts



Masterflow® 9300

Application guidelines – Watch points



Mixing – Large volume batches:

- Large volume mixes tend to heat up, especially in hot conditions
- A mixed grout temperature under 20° C is preferred to allow for long installation times without interruptions.
 - protect powder from direct sunlight in summer
 - use cold mixing water when necessary
 - empty the bags in the shortest time
 - in case already mixed grout will remain in the mixer before pumping, we advise NOT to continue mixing but interrupt and only briefly re-mix (max. 1 minute) prior to dropping the material into the hopper of the pump



Masterflow[®] 9300

Application guidelines – Watch points

Mixing – Large volume batches:

- Other recommendations:
 - Use two mixers
 - Use a big mixer
 - Possibility to use big bags, 500 kg.
- **And cautions**
 - Never reduce the mixing time



Masterflow[®] 9300

Application guidelines – Watch points



Cold weather grouting (below 10° C):

- Environmental conditions:
During, and minimum 24 to 48 hrs after grouting. Or until the grout has achieved ≥ 20 to 25 MPa strength (whatever takes the longest)

air & concrete temperature $\geq +2^{\circ}$ C
steel temperature of tower $\geq +2^{\circ}$ C

- Cold temperatures retard setting and strength development.
- Warm powder and warm water will raise the as-mixed temperature and should be considered
- **Cold foundations quickly dissipate heat out of the grout.**
- Actual temperature of the foundation, steel tower and the “as mixed” grout is the guiding factor on the decision to start, continue or stop grouting.



Masterflow[®] 9300

Application guidelines – Watch points



Cold weather grouting (below 10° C):

- Mixed grout temperature:
 - optimum storage in cold weather: above 10° C
 - use warm water of approximately 20° C
 - less mixing water results in higher strengths at early age
 - cool grout will be less fluid as warm grout
 - working time of cool, less fluid grout is similar or longer as more fluid, warm grout
- Foundation and equipment temperature:
 - accurately measure the steel and concrete temperature
 - weather window has to allow for a steel and concrete temperature above +2° C until strength ≥ 20 to 25 MPa
- Curing temperature:
 - above +2° C until the compressive strength ≥ 20 to 25 MPa



Masterflow[®] 9300

Application guidelines – Watch points

Cold weather grouting (below 10° C):

- Methods to pump with cold temperatures

- Afterwards the sides of the "tent" will be closed in order to create a hot air chamber.



- A 9 kW heater will be installed on the outside of the tent.



Masterflow® 9300

Application guidelines – Watch points

Hot weather grouting (above 25° C):

- Environmental conditions:

air & concrete temperature $\leq 35^{\circ}$ C

steel temperature of tower $\leq 35^{\circ}$ C

- High temperatures accelerate stiffening, consequently working times are reduced.
- Cold materials will lower the as-mixed temperature and should be considered.
- Reducing grouting lengths and/or increase hose \varnothing are potential alternatives, which allow for faster grout installation
- Actual temperature of the steel tower, concrete and the “as mixed material” is the guiding factor on the decision to start, continue or stop grouting.



Masterflow[®] 9300

Application guidelines – Watch points

Hot weather grouting (above 25° C):

- Store bags in cool place, not in the direct sunlight.
- Use cold water and/or cool the mixing water (e.g. with shaved ice; make sure not to use ice in the mix)
- Cool the equipment with plenty of water
- **Wrap the hoses with wet cloths**, and keep them damp. **Cool the hoses already before pumping.**
- **Alternatively use white hoses, or paint them white**
- **Grout in the early morning or at night**, when temperatures are cooler.
- When cooling can not be achieved, provide increased mixing and pumping capacity
- **Controlling the temperature of the mixed grout ensures: lower water demand, longer working times, higher strengths**



EXTREME CONDITIONS

- In general terms, whenever weather conditions are unfavorable for grouting, execution thereof must be postponed until the conditions are suitable for pouring. When necessary, the following precautions must be observed.

Hot weather grouting ($T_{max} > 28^{\circ}\text{C}$)

Preliminary activities

- 48 hours before grouting, cover the pedestal area with burlap sacks, geotextile or white plastic sheets to protect surfaces from the effects of direct sunlight.
- 24 hours in advance, use cold water ($t < 20^{\circ}$) to spray and moisten the pedestal and flange surfaces continuously until the grout is poured.
- Sacks of grout must be stored somewhere cool and dry (in extreme heat, a refrigerated storage facility will be required)
- Consult the BASF technicians for recommendations specific to the product, especially as regards the water/grout dosage to be applied

Additional materials

- Geotextiles (white): Protect all pump hoses, sacks of product and quality-control molds from the effects of direct sunlight.



EXTREME CONDITIONS

- Bags of ice

- 3 hours before grouting, place bags of ice (open) on the tower flange, formwork, pedestal area that will be in contact with the grout, pump hopper and mixing equipment.
- During the grout pouring process, the hose must be protected with bags of ice wrapped in white geotextile
- Add bags of ice to the mixing water, allowing its temperature to remain below 5°C, but always above 2°C. Do not pour water with ice directly into the mixer (risk of clogging and malfunction).
- During curing, place bags of ice on the edges of the formwork and on the upper flange (the bags must be hermetically sealed)

- Air-conditioned canopy:

Have an air-conditioned canopy system to maintain a constant temperature close to 20°C during the 24 hours before pouring and the 48 hours after pouring the grout.



EXTREME CONDITIONS

Grouting

- In extreme heat (outside air temperature close to 30°), the daytime pouring of grout is forbidden and, in which case, can only begin after dusk and before dawn (time of day with lowest temperatures). Whenever possible, avoid exceptionally hot days.
- The temperature of materials, equipment and surfaces must be intensively controlled throughout the entire process. The temperature of all elements must remain below 28°C (temperatures below 25°C are recommended).

Curing

- Once the grout has been poured, arrange bags of ice on the edges of the formwork and on the upper flange
- Until 72 hours after pouring, keep everything protected from the effects of direct sunlight and, once 72 hours have elapsed after pouring, keep the grout wet at all times.
- If an air-conditioned canopy is used, keep it air-conditioned until at least 48 hours after the grout has been poured.

EXTREME CONDITIONS

- In general terms, whenever weather conditions are unfavorable for grouting, execution thereof must be postponed until the conditions are suitable for pouring. When necessary, the following precautions must be observed.

Cold weather grouting ($T_{min} < 5^{\circ}C$)

Preliminary activities

- Sacks of grout must be stored somewhere warm ($T > 10^{\circ}C$) and dry (e.g. refrigerated storage facility)
- 24 hours before grouting, cover the pedestal area with burlap sacks, geotextile or (preferably black) plastic sheets. Beneath them, install heaters that must be switched on straight away and left on until grouting.
- 12 hours in advance, every 3 hours use hot water ($t < 25^{\circ}$) to spray and moisten the surfaces of the pedestal that will be in contact with the grout
- Consult the BASF technicians for recommendations specific to the product, especially as regards the water/grout dosage to be applied

Additional materials

- Heaters: Install heaters once the outside has been covered with black sacks or plastic sheets. It is advisable to place an extra heater in the area outside the foundation. Heaters specifically for water must also be used..



EXTREME CONDITIONS

- Black plastic sheets:

The exterior of the outside foundation must be protected with plastic sheets, burlap sacks or geotextiles (preferably black)



- Air-conditioned canopy:

In extreme cases ($T_{min} < 0^{\circ}$), use an air-conditioned canopy system to keep a steady temperature close to 20°C during the 24 hours before and after grouting..



Grouting

- In extreme cold (minimum ambient temperature below 0°C), nighttime pouring of grout is forbidden and it must only be carried out at the warmest times of the day. Whenever possible, avoid exceptionally cold days
- The temperature of materials, equipment and surfaces must be intensively controlled throughout the entire process. The temperature of all elements must remain above 5°C (temperatures above 10°C are recommended).

Curing

- Once poured, the grout outside must be protected from frost and cold. The heater must be used for at least 48 hours after grouting. The following can be used:
 - Installation of specific heaters for thermal protection of the grout.
 - Protection by means of insulating blankets (only in cases of $T_{min} > 0^{\circ}C$)
 - Thermal protection of the grout during curing (interior and exterior heaters) must be applied evenly. After 48 hours, withdraw said measures progressively and uniformly (gradually reducing the temperature) to prevent the grout from being subjected to any effects of thermal shock.

Masterflow[®] 9300

Application guidelines – Additional information

Strength development at different temperatures (4x4x16 cm prisms):

Figure 2

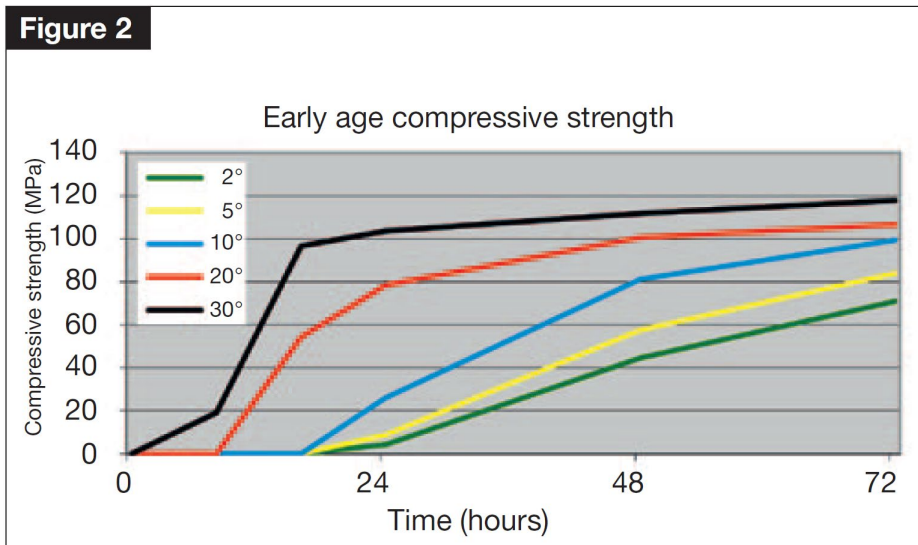
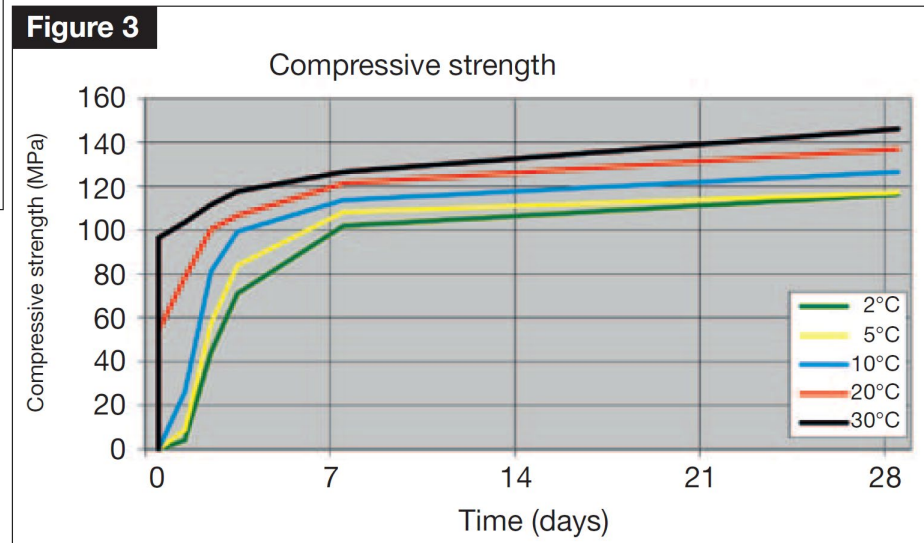


Figure 3



Masterflow® 9300

Application guidelines – Additional information



Material Safety Data Sheet:

- Contains cement
- R 37/38 Irritating to respiratory system and skin.
- R 41 Risk of serious damage to eyes.
- Avoid breathing dust/fume/gas/mist/vapours/spray.
- Wash thoroughly after handling.
- Use only outdoors or in a well-ventilated area.
- Wear protective gloves/protective clothing/eye protection/face protection.

■ First aid:

General information Immediately remove any clothing soiled by the product.

After inhalation In case of unconsciousness place patient stably in side position for transportation.

After skin contact Immediately wash with water and soap and rinse thoroughly.

After eye contact Rinse opened eye for several minutes under running water. Then consult a doctor.

After swallowing Rinse out mouth and then drink plenty of water. If symptoms persist consult doctor.

BASF
The Chemical Company

Safety data sheet

Page: 1/7

BASF Safety data sheet according to Regulation (EC) No. 1907/2006
Date / Revised: 03.07.2009
Product: MASTERFLOW 9300

Version: 1.0
(30486752/SDS_GEN_EU/EN)
Date of print: 17.12.2009

1. Substance/preparation and company identification

MASTERFLOW 9300

Use: Product for construction chemicals

Company:
BASF SE
67056 Ludwigshafen
GERMANY
Operating Division Construction Chemicals
Telephone: +49 621 60-74354
Telefax number: +49 621 60-6674354
E-mail address: info.construction-chemicals@basf.com

Emergency information:
International emergency number:
Telephone: +49 180 2273-112

2. Hazard identification

Possible Hazards

Irritating to respiratory system and skin.
Risk of serious damage to eyes.
If this substance comes into close contact with the skin of hypersensitive persons, sensitization might occur.

3. Composition/information on ingredients

Chemical nature

modified cement mortar

Masterflow[®] 9300

Application guidelines – Ready to go

 **BASF**
We create chemistry

