

Method Statement

Conbextra TA : Application of Grout for Wind Turbine Anchor Cage

- 1. Scope and Definition**
- 2. Health & Safety**
- 3. Equipment**
- 4. Storage & Transport Instructions**
- 5. Weather Conditions**
- 6. Foundation Preparation**
- 7. Grouting Process**
- 8. Curing**
- 9. Grout Testing**
- 10. Quality Control and Site Records**
- 11. Referenced Documents**

1. Scope and Definition

This document provides the process for the application of Fosroc grout, Conbextra TA, to the anchor cage tower interface of the turbine foundations.

Conbextra TA is a high performance grout specifically designed for wind turbines. It must be used in accordance with the application method statement in order to achieve the desired performance stated on the technical data sheet. It is recommended that only trained and experienced applicators attempt to use this material for wind turbine bases. If any information contained within this document is unclear, please contact your local Fosroc technical department.

Conbextra TA must be applied in accordance to the corresponding technical data sheet instructions.

Fosroc will not be responsible for any liabilities regarding the grout application. Fosroc will, by agreement, provide technical survey and training for applicators.

5 working days prior to their commencement, Fosroc must be notified of any grouting works using Conbextra TA .

2. Health and Safety

The materials and equipment described in this document should be used in accordance with the health and safety rules and standards of the country. The most up to date safety data sheet should be obtained prior to handling materials. Site specific requirements shall be observed as dictated by the supervising contract administrator.

Corresponding PPE and protection tools should be used. For specific use with Conbextra TA the following precautionary statements should be observed as a minimum requirement.



3. Equipment

The contractor must ensure that equipment on site is suitable, calibrated and in good working order. Wherever possible, spare equipment shall be on-hand for emergencies, especially in the time-critical process of product application.

3.1 Mixing and pumping equipment for bulk handling (Big Bags)

- Pan Mixer
- Piston Pump
- Hoses & spares
- Lifting equipment for handling large packaging.
- Clean water dispenser

It is recommended that for large scale mixing the mixer and pump are separate, as to our knowledge combined pump/mixers on this scale do not exist.

The mixing vessel shall have an internal capacity of $\geq 300L$ and be able of mixing 500 kg of material. In 7 minutes.

The pump shall be a 'two cylinder piston pump' type capable of holding $>350L$, a delivery pressure capability of 68 bar, max particle size 16mm.

Hoses shall have an internal diameter of 50mm. The hose shall be of sufficient length to reach the far side of the tower.

3.2 Mixing and pumping equipment for 25 kg bags

- Pan mixer
- Screw pump or piston pump
- Hoses & Spares
- Lifting platform (for pumping at height)
- Clean water dispenser

The contractor shall make allowance that all grout required for the specific anchor cage shall be placed within a maximum of 150 minutes. See section 7.2.

Hoses shall have an internal diameter of 50mm. The hose shall be of sufficient length to reach the entire circumference of the tower. Application may be undertaken with two pumps simultaneously.

3.3 Testing equipment

- 9 x metal prismatic moulds (40x40x160 mm) in accordance with EN 12190-3. Moulds shall be fully constrained on all sides, including the top.
- EN 13395-2 flow trough/channel or EN 1015-3/ ASTM C230 cone and non-absorbent plate, to measure fluidity (a drop table is not required).
- Timer
- EN 12350 container (optional)
- Electronic scales
- Thermometers: laser, digital, red liquid

- Spatulas & container for samples
- Spirit level
- Tape measure

3.3 Working Equipment

- Tubs, buckets
- Formworks (as dictated by contract requirements)
- Thermal blankets (as required by temperature conditions)
- Fosroc Curing Agent
- Polythene sheeting for curing
- Bolt sheaths
- Clean water (to standard EN1008)
- High pressure water jet

4. Storage & Transport Instructions

Conbextra TA requires correct storage and handling to preserve the characteristics of the product and achieve a quality application. Bags with lumps or cured material must be discarded. They may not be part mixed or sieved.

In general, the optimal storage conditions for Conbextra TA are: in original sealed containers, in a dry place, well protected from rain, condensation and high humidity, protected from frost and direct sunlight. The recommended storage temperature is between +5°C and 35°C.

Grouts are sensitive to moisture. If kept dry, their properties will remain unchanged. The relative humidity must be kept to a minimum in the place of storage

The storage unit must be watertight. The natural land on which the storage sites are located should have good drainage. The storage must be of a sufficient size to ensure the packaged bags can be placed at a suitable distance from the walls and ceiling.

The bags should be stacked together to reduce airflow, but never stacked against external walls (a separation of around 30 cm is recommended). The stacks of bags must not exceed 2 meters in height or bulk sacks (≥500kg) shall contain no more than 2 bags stacked.

Grout that has been stored for long periods can experience "storage compaction", therefore, bags should be stacked following the first in first out system (FIFO).

The grout must arrive at the site of application in its original packaging, factory sealed and remain so until it is used. Never use half-used or open bags.

Only the required amounts of packaged grout for one day's consumption may be deposited outside. The grout bags should be placed on raised planks of wood, on well drained land. If there is risk of rain, they must be covered with large tarpaulins or other waterproof covers.

Avoid exposure to rain in transportation, storage and application.

Shelf life for Conbextra TA is 12 months from date of manufacture.



5. Weather Conditions

The applicator and contract supervisor shall give adequate consideration of the prevailing weather conditions and temperatures in the days prior to the application of Conbextra TA.

Accurate site records must be maintained recording site specific weather conditions including minimum and maximum temperatures during working hours.

Fosroc does not recommend application of Conbextra TA beyond the temperature parameter stated in the technical data sheet (5°C to 35°C). However it is recognised that on exceptional occasions, extreme weather working cannot be avoided. If work is to progress at temperatures outside those stated on the data sheet the site contract administrator must be informed and Fosroc's Technical Department should be consulted. Compromise may only be undertaken under agreement by all parties with a full risk assessment. It is vital that these guidelines are followed.

When checking the temperature parameters, consider all surfaces in contact with the grout (mixer, hoses, foundation etc.), stored material, mixing water, as well as the ambient temperature.

5.1 Hot Climates

Avoid grouting during or immediately before the hottest part of the day. Early morning or night are usually best.

Ensure the substrate does not exceed 35°C. If applied during the day, shade it or covering with damp cloths etc. It is also important to keep the grout and the mixing water in the shade.

If the temperatures are close to the maximum (especially if rising), condition the mixture to ensure the temperature of the grout does not exceed 35°C. To do this use cold water and store the grout at temperatures below 25°C. This prevents the loss of fluidity and rapid setting. Use cold water for saturating to reduce the temperature of the substrate.

Keep the exterior of the hoses wet, to keep them cool. This can be achieved by covering with wet cloths.

In hot conditions, working times will be shorter than those stated on the Technical Data sheet.

5.2 Cold Climates

Conbextra TA must not be applied at ambient or substrate temperatures below +2°C. If applied between +2 and 5°C the temperature should be rising. Beware of falling temperatures.

Where possible, tent and heat the application area. Use warm water for pre-soaking the substrate. The substrate must be free of ice.

If the substrate temperature is equal to or below 5°C hot water must be used for mixing (approximately 50°C), grout and equipment should be warmed.

Use frost blankets to protect the material for 24 hours after application.

In cold conditions technical properties such as strength will be slower to develop than those stated on the data sheet.

5.3 Rain

Rain can increase the water ratio of Conbextra TA, leading to possible segregation, bleeding and cracking as well as reducing the ultimate strengths of the material. If rainwater does get into the mixture, under no circumstances must it exceed 5% of the mixing water specified. Careful flow and density testing is recommended, in accordance with sections 9.1 and 9.3 paying special attention to signs of segregation or bleeding.

Rainwater must be avoided in all phases of the application, If possible, the application area should be sheltered immediately before, during and 24 hours after the application of the grout. The mixing and immediate product storage area shall be protected from rain during application.

Do not allow Conbextra TA to get wet or damp whilst in storage or being transported to site (see Section 4).

Hoses and substrates should have no excess water. If excess water is standing in the hoses or substrate, it is drawn out and a film is formed on the surface creating a smooth finish, with more air and less resistance. Standing surface water will lead to debonded areas of the baseplate.

Do not commence work if storms or lightning are likely, risk of lightning will require all work to cease immediately and the site to be vacated.

6. Foundation preparation

Before pumping the grout, ensure that the substrate is free from oil, grease, soil material and slurry, in order to ensure correct adhesion. This cleaning process can be performed with high-pressure water. All contaminated standing water shall be removed.

Dampen the substrate for at least 24 hours prior to applying the grout.

All the water to be used in contact with the concrete, whether to saturate the support or for mixing the grout shall meet the requirements of EN1008 and it is highly recommended to use drinking quality water. Remove excess water from the surface of the concrete prior to applying the grout ensuring there is no standing water.

Prior to any grouting works the bolts on the anchor cage should be taped and sealed following the instructions of the turbine manufacturer. Check these are in good condition.

7. Grouting Process

7.1 Hose Preparation

It is essential to lubricate the hoses and equipment prior to each phase of grouting. It should be carried out with a slurry consisting of a water OPC cement ratio between 0.40 to 0.45. Alternatively **Conbextra Primer**, may be used. Subsequently the lubrication should be completely eliminated, to ensure it does not mix with the Conbextra TA. This shall be done by discharging Conbextra TA into a waste bin until uniform smooth consistency of grout is being discharged.

7.2 Mixing Process 25kg size

Before commencing mixing ensure all preparation is complete, plant and labour are prepared and sufficient material is available to complete the grouting works.

Full bags of Conbextra TA must always be used, check the condition of the bags, expiry dates, condition of packaging, etc. Ensure batch numbers are noted.

For good process control, place the bags in rows corresponding to each mix lot and measure the mixing water precisely.

The amount of grout to be mixed for each batch will depend on the mixer's capacity, power and condition. Sufficient mixing and pumping capacity shall be provided by the contractor to ensure that all grout required for the specific anchor cage shall be placed within a maximum of 150 minutes. Mixing time of Conbextra TA is approximately 4 to 7 minutes, but depends on the type of mixer. A pre-application site trial is strongly recommended to ensure that powder content, water content, mixing time and pumping time is optimised and any issues are identified.

Begin by pouring the correct amount of water (7.0% to 8.0% by weight of powder. 1.75 L to 2.0 L per 25kg bag) into the mixer. Start the mixer, then add the first bag, gradually add the rest of the bags. Once all the bags have been added, begin timing. Ensure total homogenisation of the product before discharging to the pump hopper.

Note: For some mixers, it may be necessary to add one bag to the mixer pan before the water to prevent water loss.

Upon initial mixing the grout will appear dry, do not add more water than the stated amount. After 2-3 minutes the mix will wet-out.

Once the mixture has been moved to the hopper, re-circulate the grout through the first section of hose back into the hopper. Upon completion of mixing, undertake the required QC as stated in Section 9 and any other QC instructions that are in place from the contract administrator.

During this recirculation process, the next mixture is prepared, proceeding as described above. Commence placement of the grout once the second mix is ready and QC is complete and correct.

7.3 Mixing Process 500kg size

Before commencing mixing ensure all preparation is complete, plant and labour are prepared and sufficient material is available to complete the grouting works.

Full bags of Conbextra TA must always be used, check the condition of the bags, expiry dates, condition of packaging, etc. En-

sure batch numbers are noted.

For good process control, place the bags in rows corresponding to each mix lot and measure the mixing water precisely.

The amount of grout to be mixed for each batch will depend on the mixer's capacity, power and condition. Sufficient mixing and pumping capacity shall be provided by the contractor to ensure that all grout required for the specific anchor cage shall be placed within a maximum of 150 minutes. Mixing time of Conbextra TA is approximately 4 to 7 minutes, but depends on the type of mixer. A pre-application site trial is strongly recommended to ensure that powder content, water content, mixing time and pumping time is optimised and any issues are identified.

Start the mixer, raise the sack over the mixing vessel and cut, ensuring the bag is fully emptied. Once all the material has been added to mixer, add the correct amount of water (7.0% to 8.0% by weight of powder. 35 L to 40 L per 500kg). Begin timing. The mixing time is approximately 4 to 7 minutes, but depends on the type of mixer. Ensure total homogenisation of the product before discharging to the pump hopper.

Upon initial mixing the grout will appear dry, do not add more water than the stated amount. After 2-3 minutes the mix will wet-out.

Once the mixture has been moved to the hopper, re-circulate the mixture through the first section of hose back into the hopper. At this point undertake the required QC as stated in Section 9 and any other QC instructions that are in place from the contract administrator.

During this recirculation process, the next mixture is prepared, proceeding as described above. Commence placement of the grout once the second mix is ready and QC is complete and correct.

7.4 Grout Placement

After the grout has been mixed samples should be taken in accordance with section 9.1 of this document and/or any contractual documents that may be required by the client. If flow tests do not correspond to the correct parameters set out by the document, or if segregation is observed, do not proceed with the application.

During pumping avoid moving the machine from its initial position. For this purpose, you must first plan the logistics of the hoses (at high ambient temperatures keep them damp on the outside), the other machinery and supplies.

A sufficient number of workers must be available during pumping.

At least two persons will be responsible for the mixing process, one to control the mixing time and the amount of water to be added and the other to add the bags to the mixer. Two operators will handle the pumping of the product and control of the hoses.

Placement of the grout should be done in one continuous application, maintaining uninterrupted flow. Ensure that the pumping speed is consistent and suitable for the amount of grout to be placed, allowing mixing of subsequent batches required without any gaps in material delivery. Place the stinger at the bottom of the grout trough in its centre order to reduce the amount of blowholes on the top surface.

The stinger should be shifted around the circumference of the tower to avoid overflow and to minimise the need for the grout to travel long distances, which may result in material segregation. However, the stinger should not be continuously moved, usually grouting from 4 separate points will be sufficient.

The working life for placing the Conbextra TA is typically 150 mins at 20°C, (consult most recent Technical Data Sheet). It is advisable to place the grout without delay, and the recommendation is that placement should typically take place in less than 1 hour wherever practically possible.

Conbextra TA that has been placed has an open time, which allows additional grout to be cast with it provided that it is done as part of a continual process and before the material begins to set. During casting, new grout should not be placed on top of the existing material, the stinger must always be placed at the bottom. In the event of surface skin formation during casting, the skin shall be gently broken and mixed in with the rest of the grout. At the end of grouting a small amount of grout may be manually applied to fill small low-spots. This should be homogenised with the existing grout beneath.

Do not vibrate or agitate Conbextra TA after placement.

8. Curing

The purpose of curing is to prevent the grout from drying out due to water loss and to prevent cracking. The curing process should start immediately after its application. Curing is particularly important in warm climates and in the presence of wind. Water curing is permissible, however the contractor must ensure that the water level is maintained adequately and that accurate record is kept of this process.

8.1 Standard Conditions

Spray-apply Fosroc Concure S, applied according directions on the data sheet. Additionally protect the grout with taped polythene or wet hessian for 48 hours immediately after its application. Ensure the hessian remains damp during that period. After 48 hours, the mortar will have acquired sufficient resistance for the polythene or hessian to be removed. Do not allow curing sheets to sit directly on top of un-set grout.



8.3 Low Temperatures

Spray-apply Fosroc Concure S, applied according directions on the data sheet.

If the ambient temperature is below 5°C it is necessary to protect the grout by providing tents (canvas) with heaters. Alternatively heated blankets may be used. The grout should be protected from the cold for at least 24 hours immediately after application.

9. Testing

Site testing shall be done to the satisfaction of the contract administrator. Accurate records of site conditions, material batches used and product performance tests should be maintained for the duration of the contract. QC measures shall be agreed by all parties well in advance of commencement of works.

9.1 Flow test

A sample is taken to carry out the flow test according to either the EN 1015-3 cone , ASTM C-230 cone or the flow channel (EN 13395-2) to determine whether the grout obtains the specified consistency and there is no segregation/bleeding.

Flow testing should be undertaken in a sheltered location, away from direct sunlight, extremes of temperature and wind. Ensure equipment is clean and has been pre-wetted but with no standing water. Non-absorbent plate or flow trough shall be placed on a firm surface, ensure flatness using a spirit level.

Using a flow channel EN 13395-2, fill the hopper to the demarcated point. Once the grout has settled, release the stopper and allow the grout to completely vacate the hopper. Time the action and measure the distance of flow at 30 seconds.

Using a Flow cone to EN1015-3, ensure the cone is placed firmly on the board, then fill with grout. Once full and level with brim, smoothly lift the cone off the surface and allow the material to flow. After the material has stopped flowing, measure the diameter of the grout in 2 perpendicular directions. Do not use a drop table to conduct the cone test.



Flow Test Method	Min	Max
Flow cone EN 1015-3	270mm	310mm
Flow cone ASTM C230	265mm	315mm
Flow channel EN 13395-2	660mm	780mm

If the batch meets specification it may be used for compressive strength testing.

9.2 Compressive Strength tests

Refer to the project contract documents for number and frequency of required tests. If no information is provided, Fosroc suggests 3 x 3 sets of samples shall be cast per turbine or material batch if more than one batch is used on a turbine. The first specimen will be crushed after 3 days, the next at 28 days strength (3 units) and the last act as a spare.

Metal moulds must always be used to obtain compressive strength values. It is not permissible to use plastic moulds.

The moulds shall be 40x40x160 mm prisms in accordance to EN-12190 unless otherwise agreed. The moulds shall be treated with mould release oil and once cast shall be restrained using a weighted lid.

During casting the moulds must not be vibrated, a gentle tap to the sides is permissible.

Once cast, the moulds should not be moved until set. They should be kept on site for 24 hours (protected from the environment and with curing in the same manner as the cast grout in the foundation). The moulds removed from site will be stored properly as stated in the mentioned standards.

The testing of high strength grout samples must only be undertaken by laboratories with a proven capability to undertake this test and using a calibrated machine.

Records of the results shall be forwarded to the contract administrator, including the mode of cube failure.

Typical Compressive Strength:	
Laboratory Values 40x40x160mm prism	
Age	Strength
1 day	≥50 MPa
3 days	≥80 MPa
7 days	≥105 MPa
28 days	≥130 MPa



9.3 Testing Fresh Wet Density

Following similar basic methodology of EN 12350 test the fresh wet density of Conbextra TA once it has been mixed and passed through the pump.

The container should be metallic and self-supported. Ideally the exact contents should be 1 litre but no less than 500ML. The container should be calibrated.

Weigh the container and record the mass, or reset scales with zero value.

Fill the container with Conbextra TA, remove any overflow with a straight-edge. Clean any spillages. Do not vibrate or compact the grout as this will lead to segregation and bleeding.

Fresh wet density shall be calculated by dividing the mass of the grout (minus the container mass) by the volume of the container. Record, time, date, temperature and water/powder ratio as well as fresh wet density.

Test Method	Min	Max
EN 12350	2.32	2.42



10. Quality Control and Site Records

The accurate recording of details on site is of importance to the smooth running and maintenance of quality throughout the application of the materials. This is the sole responsibility of the application specialist, unless otherwise agreed.

Deviations from the accepted norms must be agreed with all parties involved in the contract.

11. Referenced Documents

- Conbextra TA SDS
- Conbextra TA TDS
- Procedure for applicator approval
- EN 1008: 2002
- EN 1015-3:1999
- EN 1504-6: 2006
- EN 12190: 1999
- EN 12390-3: 2019
- EN 12350-6: 2019
- EN 13395-2: 2002
- ASTM C 230



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