

Implementation rules	TRA	554
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Implementation rules for BENOR certification

Methods of assessment applicable to producers of filled sleeve couplers for reinforcing bars

The valid version is available on the PROCERTUS extranet STEEL: extranet-steel.procertus.be/en/

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DOCUMENTS TO BE CONSULTED

Certification rules

The following certification rules apply:

- Règlement d'usage et de contrôle de la marque BENOR / Reglement op het gebruik en het toezicht van het BENOR-merk¹.
- Règlement général pour la gestion de la marque BENOR / Algemeen reglement voor het beheer van het BENOR-merk².
- Règlement particulier d'usage et de contrôle de la marque BENOR dans le secteur des produits en acier laminés à chaud et dans le secteur des aciers écrouis à froid pour béton / Bijzonder reglement voor gebruik en controle van het BENOR-merk in de sector van de warmgewalste staalproducten en in de sector van het koudvervormde staal voor gewapend beton, BRP 279³.

Standards and PTV

The last edition of the standards and PTV applies. In the event of an incompatibility following the revision of one of the documents quoted hereafter, an addendum to the present Implementation Rules will be published if necessary.

- NBN A 24-301, Produits sidérurgiques - Aciers pour béton armé - Barres, fils et treillis soudés - Généralités et prescriptions communes / Staalproducten - Betonstaal - Staven, draden en gelaste wapeningsnetten - Algemeenheden en gemeenschappelijke voorschriften.
- NBN A 24-302, Produits sidérurgiques - Aciers pour béton armé - Barres lisses et barres à nervures - Fils machine lisses et fils machine à nervures / Staalproducten - Betonstaal - Gladde en geribde staven - Gladde en geribde walsdraad.
- NBN A 24-303, Produits sidérurgiques - Aciers pour béton armé - Fils écrouis à froid lisses et fils écrouis à froid à nervures / Staalproducten - Betonstaal - Gladde en geribde koudvervormde draad.
- NBN EN ISO 15630-1, Steel for the reinforcement and prestressing of concrete - Test methods - Part 1: Reinforcing bars, rods and wire.
- PTV 302, Aciers pour béton armé, Barres à nervures ou à empreintes et fils à nervures ou à empreintes à haute ductilité / Gewapend betonstaal, Geribde of gedeukte staven en Geribde of gedeukte draad met hoge ductiliteit betonstaal.
- PTV 303, Aciers pour béton armé, Fils écrouis à froid à nervures à basse ductilité / Gewapend betonstaal, Geribde koudvervormde draad met lage ductiliteit.
- PTV 309, Assemblages mécaniques d'acier pour béton armé / Mechanische verbindingen van betonstaal.
- EN 447, Grout for prestressing tendons, Basic requirements
- EN 445, Grout for prestressing tendons, Test methods

¹ Reference asbl BENOR vzw : NBN/RVB.CA/RM2012-10-02 and following editions in force

² Reference asbl BENOR vzw

³ According to the latest applicable edition

FOREWORD

These Application Regulations (TRA) relate to the BENOR mark for filled sleeve couplers for reinforcing bars covered by PTV 309 Steel for reinforced concrete - Mechanical assemblies of steel for reinforced concrete, which serves as the reference technical specification.

This TRA was drawn up by the Sectoral Commission Steel for reinforced concrete and for prestressing (SC ST1) on the basis of a consensus within the sector. The SC ST1 within PROCERTUS is the body in which all relevant stakeholders in this sector are represented:

- public sector users;
- private sector users;
- producers;
- experts;
- suppliers.

The BENOR mark for filled sleeve couplers for reinforcing bars is a voluntary conformity mark which aims, through certification, to establish confidence that the filled sleeve couplers comply with the requirements set out in the abovementioned technical reference specifications, which define quality expectations within the Belgian context.

The CE marking applies to filled sleeve couplers covered by the harmonised technical specification EAD . Under no circumstances may the manufacturer rely on the BENOR mark to confirm that it complies with its legal obligations in this regard. The manufacturer is solely responsible for ensuring that the performance of the essential characteristics of the filled sleeve couplers complies with the declared values.

1 DEFINITIONS

Within the framework of these implementation rules, the following definitions are established and used throughout the text:

1.1 Product

A product is considered different from another product if there are differences in terms of:

- system
- production process
- material specification
- shape and dimensions of the assembly components (for a given diameter of BENOR reinforcing steel)
- type of BENOR reinforcing steel (in the form of bars or wire).

A product is generally intended for use within a range of diameters.

1.2 Producer

The producer is the manufacturer, who supplies the assembly components (grout and sleeve) to the distributor of the mechanical assembly or directly to the construction site.

1.3 Distributor

The distributor is the entity who prepares and markets the mechanical assembly using the assembly components.

Note: A distributor and a producer may be the same party.

2 PRELIMINARY EXAMINATION PRIOR TO THE GRANTING OF THE AUTHORISATION OF USE OF THE BENOR-MARK

2.1 General requirements

The conformity of the products with the requirements of PTV 309 is verified through a prior examination for the granting of the BENOR mark.

Permission to use the mark is granted per product.

The controls for granting the BENOR mark include:

- the control of the implementation and application of an IAC system (industrial auto-control) concerning the processing of mechanical components.
- the review of the description of this IAC system in the technical dossier (DTD⁴) and/or in the documents of a quality system
- the review of the records provided in the IAC system
- the review of the development of the technical dossier (DTD)
- control of the conformity of the origin of the parts of mechanical assemblies

⁴ DTD: Dossier Technique – Technisch Dossier

- control of the nominal dimensions of the parts of the mechanical assemblies of steel for concrete
- verification based on simple manipulation to demonstrate that the parts of mechanical assemblies can be easily assembled
- verification that the company has an implemented training plan for the operators installing the products on site.
- where applicable, verification of the ability to carry out deformation and strength tests, or alternatively the availability of the results of such tests from a laboratory⁵ recognised by PROCERTUS.

2.2 Technical dossier (DTD)

Any producer requesting permission to use the BENOR mark for a specific product must first compile a technical dossier. This technical dossier describes the methods (processes) and production resources (machines) used in the manufacture of the products. The original technical dossier shall be submitted to the certification body or its representative⁶. The technical dossier must be updated for every change in administration (organisation, etc.) and production (different machine, different steel grade, diameters, etc.). The technical dossier, together with each of its updates, must be signed for approval by the representative of the certification body granting permission to use the mark.

When the producer already holds a technical dossier for another certification with PROCERTUS, both technical dossiers may be combined or handled separately.

If any part of the assembly is carried out on-site, the usage instructions required by the producer must be validated by the certification body and included in the technical dossier.

2.3 Marking and identification

The assembly component must be marked in a legible and durable manner (e.g. by stamping) with the identification of the producer, the type, and a lot mark for traceability purposes. Each assembly component can be linked to its manufacturing data, including the casting batch.

Each lot of mechanical assemblies is provided with a label indicating the name of the producer, the lot number, the nominal diameter of the bars and wires, the reference to the category of the assembly (see §3.4), the steel grade according to the Belgian designation of bars and wires, and an identification number ensuring the traceability of the producer's self-control. After the BENOR mark has been granted, the labels are completed with the BENOR logo and the identification number of the user of the mark.

2.4 Delivery notes

Delivery notes shall be prepared in accordance with the provisions of BRP 279, including the specific reference to the type and diameter of the connecting sleeve or assembly component, respecting the designation stated in the certificate.

2.5 Training plan

The producer shall maintain a training plan for the operators who install the products on the production site. This training plan shall include all necessary information to ensure the correct installation of the product, including the checks of the grout to be performed on the construction site. The training shall be made available in a format that operators can consult afterward.

Following the training, a verification will be conducted to ensure that the operators have understood the training and

⁵ The laboratories and inspection bodies working for PROCERTUS within the scope of this document are listed on the PROCERTUS website.

⁶ In the remainder of the text and for the sake of simplification, the term "certification body" shall be understood to include both its representative and the inspection body and its representative.

are able to apply it. Records of this verification will be kept.

2.6 Presentation and selection

2.6.1 General

For the preliminary investigation, the producer shall submit to the certification body the various products and, for each product, the different diameters (bars or wires) for which the application for the use of the BENOR mark is made.

For each product, the certification body selects the specimens to be tested in accordance with the provisions in §2.7. The tests are carried out and may be accepted when the provisions of §2.8 are complied with. Additional arrangements apply for the specific cases listed below.

The tests are intended to confirm the conformity of the products to the requirements, but also to determine:

- the variability of the product and the associated risks of the product not meeting the requirements
- the conditions under which the product, when correctly applied, can be expected to meet the specified requirements

Therefore, tests must be carried out as close as possible to the limits of the product's scope of application, this means at the lowest possible temperature and with the maximum allowed quantity of water.

2.6.2 Coupler of variable length

A coupler of variable length refers to so-called position sleeves designed to connect two bent, curved or straight bars of the same diameter, when neither of the bars can be rotated; typical applications include bent bars, precast cages, and precast structural elements.

All tests must be carried out at the length at which the coupler provides its lowest performance.

- If this length cannot be demonstrated a priori, the static tests shall be carried out for half of the specimens at the shortest length and the other half at the longest length.
- If fatigue testing or the determination of seismic properties is applicable, these shall be performed on the coupler configuration which yielded the lowest performance in the static tests.

2.6.3 Coupler designed for two bars of different diameters

The tests must be carried out on:

- the coupler designed for the largest bar diameter, using mechanical assemblies between that largest diameter and the smallest possible bar diameter as the second bar.
- the coupler designed for the smallest bar diameter, using mechanical assemblies between that smallest diameter and the largest possible bar diameter as the second bar.

2.7 Sampling

2.7.1 Examination for the granting of the right to use the BENOR mark

For the investigation related to the initial granting of the right to use the BENOR mark, the certification body designates the samples to be used for:

1. for the performance of **tensile tests and slip measurements** in accordance with §2.8.1:
 - a) at least three diameters, distributed across the diameter range (one from the minimum diameters, one from the intermediate diameters, and one from the maximum diameters).
2. for the performance of **fatigue tests** in accordance with §2.8.2 when the producer guarantees this property:

- a) at least three diameters, distributed across the diameter range (one from the minimum diameters, one from the intermediate diameters, and one from the maximum diameters),

and:

- b) at least the minimum and maximum diameter for each fatigue category.

When the same amplitude is used for all diameters in the fatigue test within a category, testing the minimum diameter is not required.

Fatigue category F1 for couplers with diameters greater than 32 mm and for end anchors with diameters greater than 22 mm may also be deemed to belong to category F3.

- 3. for the determination of **seismic properties** in accordance with §2.8.3 when the producer guarantees this property:
 - a) at least three diameters, distributed across the diameter range (one from the minimum diameters, one from the intermediate diameters, and one from the maximum diameters).
- 4. for the inspection of the suitability for use of the grout:
 - a) a sufficient quantity originating from at least 6 different production days to carry out all the tests following §2.8.4.

2.7.2 Examination related to an extension to another product

If the producer wishes to include multiple products in their certificate, the initial tests for the different products shall be carried out independently of each other.

2.7.3 Examination related to an extension to another diameter

When the producer applies for the right to use the BENOR mark for an extension of the diameter range of an already approved product, the outermost diameter is checked.

If the extension includes both small and large diameters, both outermost diameters are checked, taking into account §2.7.1 2b) above.

2.8 Test methods and evaluation

2.8.1 Tensile tests and slip measurements (category B)

For each of the designated diameters, the manufacturer must provide at least ten mechanical assemblies.

A test series for each designated diameter must consist, as far as possible, of assemblies manufactured from different casting heats.

The strength and ductility under static load and the slip are evaluated for each test series against the specifications set out in the technical regulations PTV 309. A series of tests is accepted if all results are satisfactory. If not, a new series of assemblies is taken and tested following a mandatory review and, if applicable, modification of the relevant production process.

A reference bar from the same casting heat may be tested to determine the actual mechanical properties of the steel.

2.8.2 Fatigue tests (category FX)

For each of the designated diameters, the manufacturer must provide at least three mechanical assemblies.

A test series for each designated diameter must consist, as far as possible, of assemblies made from different casting heats for the assembly components.

For each series, the producer determines a double amplitude (acceptance level) in accordance with the FX class chosen under PTV 309:

- If all three tests reach at least 2,000,000 cycles for the selected amplitude, this double amplitude ($\Delta\sigma$) is considered the reference value for fatigue resistance.
- If, for the selected amplitude, one of the three tests does not reach 2,000,000 cycles, the producer shall conduct a root cause analysis. The producer may, either immediately or after corrections to the production process, propose a new test series. These tests may be performed on the same production batch or another batch of the same product, provided that this proposal is approved by the certification body. All new sampling must take place under the supervision of the certification body. If all results from the new series are satisfactory, the acceptance conditions are considered fulfilled.
- In all cases, all fatigue tests are considered valid and usable, unless a justification is provided for excluding a test result. The assessment of such justification is the responsibility of the expert group Technical Advice and subsequently the Certification Committee.

2.8.3 Seismic properties (category S)

For each of the designated diameters, the manufacturer must provide at least three mechanical assemblies and three reference bars from the same casting heat as the bars used in the mechanical assemblies.

A test series for each designated diameter must consist, as far as possible, of assemblies made from different casting heats for the assembly components.

The measured characteristics are evaluated for each test series against the specifications of the technical regulations PTV 309. A series of tests is accepted if all results are satisfactory. If not, a new series of assemblies is taken and tested following a mandatory review and, if applicable, modification of the relevant production process.

2.8.4 Tests on the grout

The following characteristics are determined according to the methods specified below.

When different test methods are used in the auto-control, the tests will be executed following both methods.

For each characteristic, the manufacturer shall document in his technical file the desired result and the tolerances to guarantee suitability for use of the grout for the test method used in the auto-control.

- Chloride content according to NBN EN 1015-17
- Fluidity according to §4.3.1 of NBN EN 445
- Slump according to §4.3.2 of NBN EN 445
- Strength according to §4.6 of NBN EN 445

For the purpose of compressive strength testing, the producer shall have moulds enabling the production of six prisms to be tested.

- Setting time according to NBN EN 196-3
- Bleeding according to §4.5 of NBN EN 445
- Expansion tests to confirm the absence of grout shrinkage

2.9 Granting of the right to use the mark

The management of the production parameters - including the inspection of incoming raw materials and the controlled execution of the production -, also the compliance of product characteristics with the technical requirements, and proper management of the technical file, are the key criteria for obtaining the right to use the BENOR mark.

The right to use the BENOR mark cannot be granted before the preliminary investigation has been completed. The boundary conditions within which the product may be used are specified in the technical datasheet.

3 INDUSTRIAL AUTO-CONTROL

Both during the preliminary investigation and during the usage period of the processed reinforcing steel, the producer applies an IAC (industrial auto-control) system.

The procedures, work instructions and records of the IAC system concerning mechanical assemblies cover, among other things:

- the organisation and control of the processing and inspection of the mechanical assemblies
- the mechanical and chemical analyses of the cast batch of purchased incoming products, specifically the associated material certificates 3.1
- inspections of the quality and suitability for use of the grout
- the verification of personnel qualifications
- the management of specific documents (DTD, etc.)
- the maintenance of production equipment
- the calibration of testing and measuring equipment in accordance with ECU 606
- the handling of non-conformities and actions to prevent recurrence
- the handling of complaints

This control is continuously exercised by the producer.

Assemblies for testing are taken from ongoing production. The measured characteristics for each test series are evaluated against the specifications in the technical regulations PTV 309.

3.1 Tensile tests and slip measurements (category B)

Tests may be carried out on assemblies produced by a BENOR-certified distributor or on assemblies produced on the construction site where the necessary equipment to manufacture the samples is available and provided that the traceability system allows verification that the test frequencies defined in this regulation are respected.

In all cases, the producer bears full responsibility for compliance with the requirements concerning industrial auto-control in relation to their certification. In particular, any non-conformity found in assemblies made by a BENOR-certified distributor shall be regarded as a non-conformity within the scope of the producer's certification, regardless of the cause of the non-conformity.

For each product and for each diameter and for each diameter ratio, the testing frequency is 1 per 1000 manufactured connections.

If a test result is non-compliant, the cause must be investigated and corrective measures taken. Three additional samples of the same mechanical connection must be successfully tested.

3.2 Suitability for use of the grout

The supplier of the grout has processes in place to demonstrate that the delivered grout is suitable for its intended application. These processes are controlled by process indicators that include at least the following characteristics:

Characteristics of the grout	Method based on standards	Criteria	Minimum testing frequency
Chloride content	NBN EN 1015-17	As determined by	1x/quarter

Fluidity	NBN EN 445 §4.3.1	the producer	1x/day production of the grout
Strength	NBN EN 445 §4.6		
Setting time	NBN EN 196-3		
Bleeding	NBN EN 445 §4.5		
Expansion test	Internal method to determine grout shrinkage	No shrinkage	

The execution of these tests and the reliability of the results is demonstrated through the implementation of appropriate controls, including random spot-check tests and audits by the producer at the supplier's facility. Records of these controls and of the tests carried out on the grout are available.

On the construction site, before using the grout, a slump test is realised each day according to NBN EN 445 §4.3.2.

3.3 Suitability for use of the steel sleeve

The supplier of the steel sleeve has processes in place to demonstrate that the delivered sleeve is suitable for its intended application. These processes are controlled by process indicators that include at least the tensile tests following NBN EN ISO 6892-1 and the determination of the chemical composition. The tolerances are determined by the producer and documented in his technical file.

The execution of these tests and the reliability of the results is demonstrated through the implementation of appropriate controls, including random spot-check tests and audits by the producer at the supplier's facility. Records of these controls and of the tests carried out on the grout are available.

3.4 Records

The producer shall keep a record of all deliveries and of the construction sites where the products are used. This record shall include the identification of the delivered batches. Inspections and sampling of products on site is carried out on the basis of these records.

This information shall be provided to the certification body upon request and at least on a monthly basis.

4 PERIODIC INSPECTION BY THE CERTIFICATION BODY

4.1 General Information

The conditions for granting the right to use the BENOR mark (regularity of product manufacturing and compliance of the products with the standards referenced by the BENOR mark) are periodically checked by the certification body.

This inspection must verify:

- whether the producer possesses all BENOR delivery notes for the reinforcing steel used in the processed products;
- whether the producer possesses all conformity documents for the steel used in the assembly components, specifically the associated material certificates 3.1;
- whether the producer has measurement results demonstrating that the supplied assembly components meet the geometrical requirements;
- whether the producer has the measurement results and controls demonstrating that the quality of the grout is controlled and complies with the limit values;
- the marking and labelling of parts;
- whether the industrial auto-control is properly carried out;
- whether the results of the industrial auto-control are correctly interpreted;
- whether the results of the industrial auto-control are satisfactory;

- whether competence management is correctly applied and whether all operators have the required qualifications, especially the application of the training plan;
- whether all measures have been taken to ensure that products bearing the BENOR mark but declared defective and scrapped are not stored with products that meet BENOR requirements;
- that the technical dossier (including the user manual) is maintained and effectively corresponds with the methods (processes) and resources (machines) used.

The producer accepts the executed controls and will take all necessary measures to facilitate this inspection. He will specifically inform the certification body of:

- the name of the head of the factory's quality department;
- the date of any change, even minor, in the manufacturing conditions, especially for products within the scope of certification, that have undergone slight or significant modifications;
- the location where the inspection and sampling will take place.

When applicable, the producer shall ensure that the persons responsible for the construction sites where products are delivered accept that inspections and sampling of the products may take place.

The producer shall make all industrial auto-control results available in accordance with §3.

Starting from the date the right to use the BENOR mark is granted, the producer shall report monthly the quantity of products manufactured under the BENOR mark and the quantities scrapped. These quantities must be broken down by product and by diameter.

4.2 Periodicity of the control visits of surveillance

The inspection visits and sampling visits by the certification body normally take place four times a year each. In the period following an initial certification decision, the user of the mark is subjected to a trial period of one year, which includes six inspection visits and six sampling visits. For an extension, this number is limited to four for each type of visit.

Inspection visits and sampling visits are preferably carried out jointly.

Inspection visits take place at least once a year at the production site that manufactures the assembly components. When the assembly component passes through multiple production sites, the inspection visit by the certification body may be extended to these various locations. If inspections take place at a location where it is not possible to physically inspect the products, these may be conducted via videoconference, with a minimum of one on-site inspection per year.

Since sampling visits are carried out at the location where the assembly is made, those may also be carried out at the certified BENOR distributor or on the construction site.

Documentary audits, inspection visits or additional sampling visits may be carried out based on the inspection results (notably on the number of non-conformities) and a decision of the certification committee. The frequency is increased to one per month when certain situations lead the certification body to doubt the quality or regularity of the products.

4.3 Tests

The sampling is carried out under the responsibility of the producer or under the responsibility of their authorised representatives.

4.3.1 Tensile tests and slip measurements (category B)

4.3.1.1 Sampling

During the visit, two series of three samples are taken in order to carry out a tensile and a slip test. If assemblies with couplers designed to connect bars of different diameters are being certified, a third series is selected.

These test series are selected to be as representative as possible of the mechanical assemblies produced.

The samples are always selected so that all diameters of each product are tested over a period of three years, and each product is tested over a period of one year.

If no non-conforming test results are found over a two-year period, the number of samples per series is reduced from three to two.

4.3.1.2 Evaluation

In case of non-conformities, the following rules apply:

- If one test result is non-conforming, three additional samples of the same combination of mechanical assembly must be successfully tested.
- If more than one test result fails to meet the requirements, the cause must be investigated and corrective measures taken. For each concerned series, six additional samples of the same combination of mechanical assemblies must be successfully tested in order to maintain the certification of this product.

4.3.2 Fatigue tests (category FX)

4.3.2.1 Sampling

Once per year, a series of three test pieces is sampled and tested for each product.

The test series are selected to be as representative as possible of the mechanical assemblies produced.

These tests are carried out in a distributed manner across each variant of the mechanical assembly.

4.3.2.2 Evaluation

If this test program meets the criteria, it is assumed that the other diameters of the product also comply with the relevant requirements.

In case of non-conformities, the following rules apply to maintain the fatigue certification for the product:

- If the result of one test piece does not meet the criteria, the cause is first investigated and appropriate corrective measures are taken. The concerned series must be extended with three additional test pieces, all of which must show no deviation.
- If the results of at least two test pieces do not meet the criteria, the cause is first investigated and appropriate corrective measures are taken. For the concerned test series, two additional test series of three test pieces each are evaluated, all of which must show no deviation.

For each non-conforming result, an additional test of the same product shall be performed the following year, either on the same diameter or on a more critical diameter, to confirm the product quality.

4.3.3 Seismic properties (category S)

4.3.3.1 Sampling

Once per year, a series of three test pieces is sampled and tested for each product.

The test series are selected to be as representative as possible of the mechanical assemblies produced.

These tests are carried out in a distributed manner across each variant of the mechanical assembly.

4.3.3.2 Evaluation

If this test program meets the criteria, it is assumed that the other diameters of the product also comply with the relevant requirements.

In case of non-conformities, the following rules apply to maintain the certification of the seismic properties for the product:

- If the result of one test piece does not meet the criteria, the cause is first investigated and appropriate corrective measures are taken. The concerned series must be extended with three additional test pieces, all of which must show no deviation.
- If the results of at least two test pieces do not meet the criteria, the cause is first investigated and appropriate corrective measures are taken. For the concerned test series, two additional test series of three test pieces each are evaluated, all of which must show no deviation.

For each non-conforming result, an additional test of the same product shall be performed the following year, either on the same diameter or on a more critical diameter, to confirm the product quality.

4.3.4 Tests on the grout

4.3.4.1 Sampling

Twice a year, the producer manufactures 6 prisms, all of which are tested at an age of 28 days according to §4.6 of NBN EN 445⁷.

Of the 6 prisms:

- 3 are tested in the laboratory for internal control⁸: the average calculated result is taken into account. The average result forms part of the internal control;
- 3 are tested in an external control laboratory: the average calculated result is taken into account.

4.3.4.2 Evaluation

The results must comply with the specifications, and the difference between the results measured in the internal control laboratory and the external control laboratory shall not exceed 25% of the highest measured value.

In case of non-conformities, the cause shall first be investigated and appropriate corrective actions taken. Six prisms shall be produced again for two different production batches to carry out a counter-test. If the results do not comply, tensile and slip tests shall be conducted on each product made from the concerned production batch of grout.

⁷ An alternative method may be agreed with the certification body if the correlation can be demonstrated.

⁸ Provided that perfect traceability exists, these results may also come directly from the industrial auto-control. The test result from the internal control must be made available before the external test result is available.

5 HISTORY OF REVISIONS

Revision 0

- Document creation