OCBS
Vereniging zonder winstoogmerk
Ravensteinstraat 4
B 1000 BRUSSEL
www.ocab-ocbs.com

TOEPASSINGSREGLEMENT	TRA	345
	Herz. 6	2021/12

TOEPASSINGSREGLEMENT VAN HET BENOR-MERK IN DE SECTOR VAN STALENPRODUCTEN VOOR GEWAPEND BETON - CONTROLE MODALITEITEN TOEPASSELIJK OP DE GEBRUIKERS VAN HET MERK VAN WAPENINGSNETTEN

HERZIENING 6

BENOR vzw

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Application Regulation
TRA 345 Revision 06

Application regulation of the BENOR-mark in the sector of concrete reinforcements - Methods of assessment applicable to the "Users of the mark" – Producers of welded fabrics[1]

1 Introduction

This Application Regulation (TRA[2]) was prepared by the Technical Bureau 1 of OCAB-OCBS, sectoral organization, "Concrete reinforcing steels" for the BENOR certification of concrete reinforcements.

According to the regulation of use and control of the BENOR-mark[3] and its article 9, this Application Regulation of OCAB-OCBS constitutes the reference certification scheme to the BENOR-mark.

2 Reference documents and definitions

2.1 Reference documents

- Règlement d'usage et de contrôle de la marque BENOR / Algemeen reglement voor het beheer van het Benor-merk[4].
- Règlement général pour la gestion de la marque BENOR / Algemeen reglement voor het beheer van het Benor-merk[5].
- 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 de warmgewalste staalproducten en in de sector van het koudvervormde staal voor gewapend beton, BRP 279[6].

In theory, the last edition of the standards and PTV applies. If necessary, an addendum to the present regulation would be published in the event of incompatibility following the revision of one of the documents quoted hereafter.

- 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 24-304, Produits sidérurgiques - Aciers pour béton armé – Treillis soudés / Staalproducten - Betonstaal - Gelaste wapeningsnetten.
- NBN EN ISO 15630-2, Aciers pour l'armature et la précontrainte du béton – Méthodes d'essai – Partie 2 : Treillis soudés et treillis raidisseurs / Staal voor de wapening en voorspanning van beton – Beproevingsmethoden, Deel 2: Wapeningsnetten en tralieliggers.
- 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

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[1] Table of contents at the end of the document
[2] **TRA**: **T**oepassings**r**eglement – **R**èglement d'**A**pplication
[3] (Reference BENOR[asblvzw] : NBN/RVB.CA/RM2012-10-02 and following editions in force)
[4] (Reference: NBN/RVB.CA/RM2012-10-02 and following editions in force) with Document CM10 1998-12-09 in appendix
[5] (Reference: NBN/RVB.CA/RG2012-10-02 and following editions in force) with Document CM10 1998-12-09 in appendix
[6] According to the last edition in force

OCAB [asbl] **OCBS** [vzw]
Phone: + 32 2 509 14 09 Fax: + 32 2 509 14 00 E-mail: ocab@ocab-ocbs.com
Website: www.ocab-ocbs.com

- betonstaal, Geribde koudvervormde draad met lage ductiliteit.
- PTV 304, Aciers pour béton armé, Treillis soudés / Gewapend betonstaal - Gelaste wapeningsnetten.
- TRA 418, Modalités de contrôle applicables aux Usagers de la Marque – Annexes statistiques / Controlemodaliteiten toepasselijk op de gebruikers van het Merk - Bijlage statistiek.
- ECU 606, Application of the BENOR-mark in the sector of concrete reinforcements - Methods of assessment applicable to the "Users of the mark, Processors and Distributors of BENOR products" - Equipment of control, determination of the "λ-value" for the computation of f_R or f_P, simplified procedure for the setting of a straightening machine.
- Manuel de qualité de l'OCAB / Kwaliteitshandboek van het OCBS[7].

2.2 Basic definitions and requirements

2.2.1 Laboratories

2.2.1.1 Internal laboratory

It is the own internal laboratory (laboratory of the producer[8]). To be recognized as such, this laboratory must fulfil the following requirements:

- The tensile testing machines are equipped with a system of measurement of total elongation under the maximum load.
- The tensile testing machines of this laboratory must be calibrated in accordance with standard NBN EN ISO 15630-2. They must display the different levels of class defined by that standard regarding the loads and the elongations; the last calibration carried out by a service independent of the laboratory, cannot go back to more than one year.
- **All the tensile testing machines used within the framework of BENOR certification** must be the subject of paired comparisons with the tensile testing machine of the control laboratory[9] according to the provisions of the **preliminary examination**.
- During the yearly check by the sectorial organization[10], the test results of at least one testing machine must be subjected to the ones of a control laboratory. Each tensile testing machine must be subjected to a paired comparison with a control laboratory at least once every three years. If the producer uses other tensile machines in the internal laboratory, those machines are yearly compared with the machine for which the comparison with the control laboratory is carried out. If it is not possible to compare those other tensile machines with this machine (e.g. because of different capacity), a yearly comparison with a control laboratory must be carried out for each machine concerned.
- All the other measurement and testing devices must be calibrated at least once a year.

2.2.1.2 Control laboratory

Laboratory accredited according to ISO 17025 and quoted by document OCAB-OCBS 503a[11].

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[7] According to the last edition in force

[8] COUNCIL DIRECTIVE of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (85/374/EEC), Article 3.1: '***Producer***' *means the manufacturer of a finished product, the producer of any raw material or the manufacturer of a component part and any person who, by putting his name, trademark or other distinguishing feature on the product presents himself as its producer.*

[9] See definition in 2.2.1.2

[10] OCAB-OCBS

[11] Document 503 a, « Lijst – Liste – List, Keuringsinstellingen (OCI), Laboratoria (Labs), Organismes de contrôle (OCI), Laboratoires (Labs), Control Bodies (OCI), Laboratories (Labs) »

3 Preliminary examination prior to the granting of the authorization of use of the BENOR-mark

3.1 General information

The preliminary examination is based on the tests of current control carried out by the services of the producing factory and on complementary tests carried out by an external laboratory on request of the sectoral organization or his representative[12]. The purpose of this preliminary examination is to check that the producer can manufacture the products for which he asks for the authorization of use of the mark and to maintain a regularity for the properties of these products in current manufacturing.

3.1.1 Principle

The conformity of the products to the prescriptions being the subject of standards NBN A 24-301 and -304 and technical specification PTV 304 is checked by the preliminary examination prior to the granting of the authorization of use of the BENOR-mark.

The authorization of use of the mark is granted by product. The products made from wires or bars of different grades are considered as **different products** (see PTV 304, § 5.1).

3.1.2 Technical file

Any producer applying for authorization to use the BENOR-mark for a given product must first establish a technical file. This technical file describes the methods (processes) and means of production (machines) used in the manufacture of the products. In this case, the producer must describe the welded fabrics that he considers to be "standard welded fabrics". The initial technical file is sent to OCAB-OCBS. The technical file must be adapted for each change made to the administration (organization, …) and production (other machine, other steel quality, diameters, etc...). The technical file, together with each of its amendments, shall be signed for approval by the representative of the sectoral organization for granting authorization to use the mark.

3.1.3 Random sampling

The sectoral organization selects, as much as possible randomly, the applicable number of products for control among the available products (see § § 3.1.6 and 3.1.8).

All these available products come from the installations planned for the manufacturing of these products.

3.1.4 Requirements

It is necessary to check that the specified properties fulfil the criteria defined in the above-mentioned standards and technical specifications and clarified in articles 4.2 and 4.3 of this document.

3.1.5 Marking and Identification

The wires or bars with ribs or indentations shall be marked in accordance with NBN A24-301 and the PTV 302 or 303 normative documents enabling their origin to be identified. In addition, each bundle of welded fabrics is fitted with one or more labels bearing the following information (see also NBN A24-301 - § 4.7):

- the designation “welded fabric”[13]
- the guaranteed grade of steel and the diameter by direction, the number of pitches[14], the size of the pitches
- a reference number to ensure the traceability of the autocontrol (see 4.1.4)
- the name of the producer and the place of manufacture.

[12] In the following of the text and for simplification reasons, the term "sectoral organization" includes her representative as well as the inspection body and his representative, as it is defined in the quality handbook of OCAB-OCBS.

[13] *Treillis soudé* / *(gelast) wapeningsnet*

[14] *Maille* / *Maas*

Labels must be indelible and strong enough to withstand the handling or manipulation of the welded fabric. Labels must be submitted to the sectoral organization for approval.

The welded fabrics shall be accompanied by delivery slips in accordance with the requirements of Chapter 7 of document 279.

3.1.6 Presentation and sampling

3.1.6.1 Necessary products to be presented

The producer defines for which products and for which diameters per product, he requests the authorization of use of the BENOR-mark.

The overall geometric properties of a welded fabric shall be checked for each of the presented welded fabric types, as follows:

- the *pitch* or distance between elements
- the overall flatness
- the *overhang*, namely the exceeding length at the extremities of the welded fabric.

For the control of mechanical and geometrical properties, the producer shall present to the sectoral organization a quantity of products, in the condition in which they leave the plant, according to the following indications:

1. **During the examination for the issue of an authorization to use the BENOR-mark**,
   - If the product has four or more different diameters, the producer shall present at least 50 tons of the product with minimum 10 tons per type.
   - If the product consists of 3 different diameters or less, the types of welded fabric presented (minimum 10 tons per type) must include all diameters[15].
   - Sampling shall be carried out as described hereunder.

a. The product consists of bars or wires of the same diameters in the same direction
   - o If the product consists of a single steel grade, the sectoral organization shall designate 3 types of welded fabric, one of the types with equal small diameters, one of the types with equal large diameters and one of the types with the smallest ratio of diameters ($\mathbf{R_d}$)[16] (in the absence of the latter type, a third type with equal diameters will be designated). In each of the types with equal diameters designated as described above, the sectoral organization shall take 30 samples of bars or wires; in the type with different diameters, it takes 30 samples of bars or wires of the smallest diameter. The sampling is performed so as to test the different available presented coils. If the welded fabric is made from bars previously straightened, 6 samples, from different bars of a single welded fabric, will be taken at the maximum. If the welded fabric is made partly from straightened bars and partly from coil, not more than 2 samples of previously straightened different bars shall be taken by welded fabric. By designated type, the sectoral organization shall also take welded joints; the number is equal to the number of longitudinal wires of a welded fabric. Each welded joint comes from a different longitudinal rod. (**See Table below and Case 1a1**)
   - o If the product consists of two different grades of steel, the sectoral organization shall designate 2 types of welded fabric, one where the ratio of diameters is the largest and one where the ratio of diameters is the smallest[17]. The sectoral organization shall take, in the type with the largest diameter ratio, 30 samples of bars or wires per grade of steel; in the

[15] In that case, a maximum of three types of welded fabrics must be presented. The overall geometric properties of a welded fabric shall be checked for each of the presented welded fabric types, although depending on the sampling scheme, it is possible that only two fabrics must be tested for the other properties

[16] $\mathbf{R_d}$ = "ratio of diameters" shall always mean: $\mathbf{d_{min}/d_{max}}$.

[17] In case where $\mathbf{R_d}$ would be equal to 1 ($d_{min} = d_{max}$), both types of welded fabrics correspond respectively to the smallest and biggest diameters.

type where the ratio of diameters is the smallest the sectoral organization takes 30 samples of bars or wires per grade of steel. The sampling is performed so as to test the different available presented coils. If the welded fabric is made from straightened bars, a maximum of 6 samples of different bars shall be taken by shade of steel and by welded fabric. If the welded fabric is made partly from coils, the sample shall be taken on the basis of one sample per coil for the part of the production based on straightened bars, 6 samples of different bars per welded fabric. By designated type, the sectoral organization also takes several welded joints. The number is equal to the number of longitudinal rods per welded fabric. Each welded joint comes from a different longitudinal rod. The restriction of the number of "6 samples per welded fabric" shall not apply to hot-rolled wire; in this case, it is limited to 1 sample per bar. (**See Table below and Case 1a2**)

b. The product consists of bars or wires of different diameters in the same direction
   - o If the product consists of a single grade of steel, then the sectoral organization designates 2 types of welded fabric, respectively in one of the smallest diameters whose ratio of the smallest diameter in one direction with the largest diameter in the other direction is the smallest and one out of the largest diameters whose ratio of the smallest diameter in one direction with the largest diameter in the other direction is the smallest. Of each of the types indicated, the sectoral organization takes 30 samples of the smallest bar or wire diameter and possibly of the largest diameter. The sampling is performed so as to test the different available presented coils. If the welded fabric has been made from previously straightened bars, then a maximum of 6 samples shall be taken from several bars of the same welded fabric; if the welded fabrics have been made partially out of coils or out of bars previously straightened, a maximum of 2 samples shall be taken by welded fabrics out of the different bars previously straightened. In parallel, several welded joints shall be taken from the largest diameter of the nodes and the smallest diameter in the other direction by the type indicated; the number is equal to the number of welded joints on the longitudinal wires; each welded joint has a different longitudinal rod. (**See Table below and Case 1b1**)
   - o If the product consists of two grades of steel, the sectoral organization shall then designate 3 types of welded fabric, one with the largest diameter ratio, one from the smallest diameters whose ratio between the smallest diameter and the largest diameter in the other direction is the smallest and one from the largest diameters whose ratio between the smallest diameter and the largest diameter in the other direction is the smallest. Starting from the type with the largest diameter, 30 samples of bars or wires shall be taken by steel grade. From the type with the largest diameter ratio, 30 samples of bars or wires shall be taken by steel grade; for the designated type with the smallest diameter ratio, 30 samples of bars or wires of the smallest diameter shall be taken. The sampling is performed so as to test the different available presented coils. If the welded fabric is made from straightened bars, a maximum of 6 samples of different bars shall be taken by grade of steel and by welded fabric. If the welded fabric is made partly from coils, the sample shall be taken on the basis of one sample per coil for the part of the production based on straightened bars, 6 samples of different bars per welded fabric. By designated type, the sectoral organization also takes several welded joints. The number is equal to the number of longitudinal rods per welded fabric. Each welded joint comes from a different longitudinal rod. The restriction of the number of "6 samples per welded fabric" shall not apply to hot-rolled wire; in this case, we limit ourselves to 1 sample per bar. (**See Table below and Case 1b2**)

Case	SDSD (*)	Grade (**)	Welded fabrics to be presented			Samples
			Number	Types	Diameter	Nr & d (***)
1a1	YES	1	3	R_d = 1 [R_d = max]	Smallest	30 d_{min}
				R_d = 1 [R_d = max]	Biggest	30 d_{max}
				R_d = min [R_d = 1]	Intermediate	30 d_{min}
1a2	YES	2	2	R_d = max [R_d = 1]	Grade 1	30 d
					Grade 2	30 d
				R_d = min [R_d = 1]	Grade 1	30 d_{min}
					Grade 2	30 d
1b1	NO	1	2	R_d = min	Smallest	30 d_{min}
				R_d = min	Biggest	30 d_{min}
						30 d_{max}
1b2	NO	2	3	R_d = max [R_d = 1]	Intermediate	30 d Grade 1
						30 d Grade 2
				R_d = min [R_d = 1]	Smallest	30 d Grade 1
						30 d Grade 2
				R_d = min [R_d = 1]	Biggest	30 d Grade 1
						30 d Grade 2
All Cases	By designated type of welded fabric, the sectoral organization shall also take welded joints; the number is equal to the number of longitudinal wires of a welded fabric. Each welded joint comes from a different longitudinal rod.					
(*) Same diameter in same direction						
(**) Number of grade(s) of steel in one welded fabric (1 or 2)						
(***) Number of samples for tensile testing and diameter						

2. When the producer requests to extend the mark available to him for a product to other diameters,

He shall present the extreme diameter.

If the extension covers both small and large diameters, both extreme diameters shall be presented; the quantities presented are 10 tons per type of welded fabric.

Sampling shall be carried out as described above.

3.1.6.2 Examination for the issue of a first authorization of use of the BENOR-mark

During the examination for the issue of a first authorization of use of the BENOR-mark (see 3.1.6.1 § 1 above), each sample is divided into three thirds: the first third is intended for control by the internal laboratory, the second third of one of the series is sent to the control laboratory, the third and last third of all the samples and the rest of the second thirds is to be kept in reserve. The length of each third of sample must make it possible to carry out control:

- o of the conventional section
- o of the surface configuration[18]
- o of the tensile characteristics
- o by a rebend test.

The plant shall, in the presence of the sectoral organization, carry out the above-mentioned tests of each of the types selected on the basis of:

- ✓ a tensile test and a determination of the conventional section on the first part of each of the 30 samples (see 3.1.6.1)
- ✓ a surface configuration determination and a rebend on the first part of 10 of the 30 samples (see 3.1.6.1)
- ✓ a determination of the shear force on each of the sampled welded joints (see 3.1.6.1).

The control laboratory proceeds in its turn on 30 samples of the corresponding series[19] dedicated to the determination of the tensile characteristics (determination of the conventional area and tensile test. The tests are carried out in accordance with the regulations of the standards.

3.1.6.3 Examination for the delivery of use of the BENOR-mark to another product

During the examination for the delivery of use of the mark to another product, each sample is subjected to the checking of its geometrical properties, that is to say:

- conventional section
- surface configuration
- Moreover, the length of each sample must make it possible to control complementarily by:
  - o tensile characteristics
  - o rebend test
  - o shear test

3.1.7 Tensile testing machines

The testing machines tension of the two laboratories must be in conformity with the regulations of § 2.2.1.1 of this regulation.

3.1.8 Chemical properties

The producer must be in possession of the certificates of analysis of the half-products unless these half-products are delivered under the BENOR mark. The results of these analyses must meet the "cast analysis" criteria of the standards.

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[18] The determination of the surface configuration can be made, at the choice of the producer:

1. Either through the measurement of the height and the spacing of the ribs (depth and spacing of the indentations)
2. Or through the measurement of the relative rib or indentation area f_R (f_P).

[19] **IMPORTANT NOTICE**: It is to be recalled that each tensile machine of the internal laboratory concerned with the BENOR preliminary certification must be subjected to paired comparisons. Therefore, if the producer uses one tensile machine for the whole BENOR certification, only 30 samples are tensile tested in the control laboratory. In other cases where the producer uses several machines for the whole BENOR certification, each machine must be subjected to 30 tensile tests made in the control laboratory. The organization of the series of triplicate 30 samples must therefore be made in accordance with the actual encountered conditions.

3.1.9 Authorization of use of the BENOR-mark

The authorization of use of the BENOR-mark cannot be granted before the preliminary examination is completed.

3.2 Interpretation of the results

The results of the factory must be in conformity with §§ 3.2.1, 3.2.2 and 3.2.4. In addition, in the case of the examination for the delivery of the authorization of use of the BENOR-mark, the statistical comparison must be in conformity with § 3.2.3.

3.2.1 Controls by measurements

For each property being checked by measurement, namely:
1. yield strength
2. tensile strength
3. R'_m/R'_e ratio
4. total elongation under maximum load (A_{gt})
5. the relative rib or indentation area (f_R or f_P)[20]

one calculates, by diameter, the average “m”, the estimate of the standard deviation “s” and the estimate of the characteristic value “m - k.s”[21].

One compares the estimates of the characteristic values with the values specified in the standards.

3.2.2 Controls by attributes

For each property being checked by attribute, i.e.:
- conventional section
- height of the ribs (depth of the indentations)[22]
- spacing of the ribs (spacing of the indentations)[23]
- rebend test
- chemical analysis on cast, semi-finished product, or (end) product
- pitch between the elements, overhangs and flatness of the welded fabric
- shear strength of welded joints.

It is necessary to determine the number of specimens not answering the criteria of the standard.

3.2.3 Comparison between the results of the tests carried out in the factory and those of the control laboratory

For the tensile strength and the yield strength, one proceeds to the statistical comparison of the results of the tests carried out with the factory with those of the control laboratory by the method of the paired observations (see TRA 418).
The comparison must show that the series of tests are statistically identical.

If the comparison shows that the series of tests are not statistically identical, it is necessary to search the causes of them:
- if it appears that the causes are inherent to control by the internal laboratory, this one adapts its test procedure and starts again the tests on the products kept in reserve,
- if it appears that the causes are inherent to the control laboratory or, if it is not possible to detect the cause of the divergences, the sectoral organization considers measures to be taken.

[20] In the case that the determination of surface configuration is achieved through the relative rib or indentation area f_R - f_P.
[21] The coefficient k for m = 30 is equal to 2,08 (reliable failure rate 5% - probability β risk 10%) for properties 1, 2 and 5; and 1,66 (reliable failure rate 10% - probability β risk 10%) for properties 3 and 4 (see tables 4.2.2).
[22] In the case that the determination of surface configuration is achieved through the height and the spacing of the ribs (depth and spacing of the indentations).
[23] See above footnote over the determination of the surface configuration.

The flow chart at the end of present chapter 3 summarizes the process to be followed.

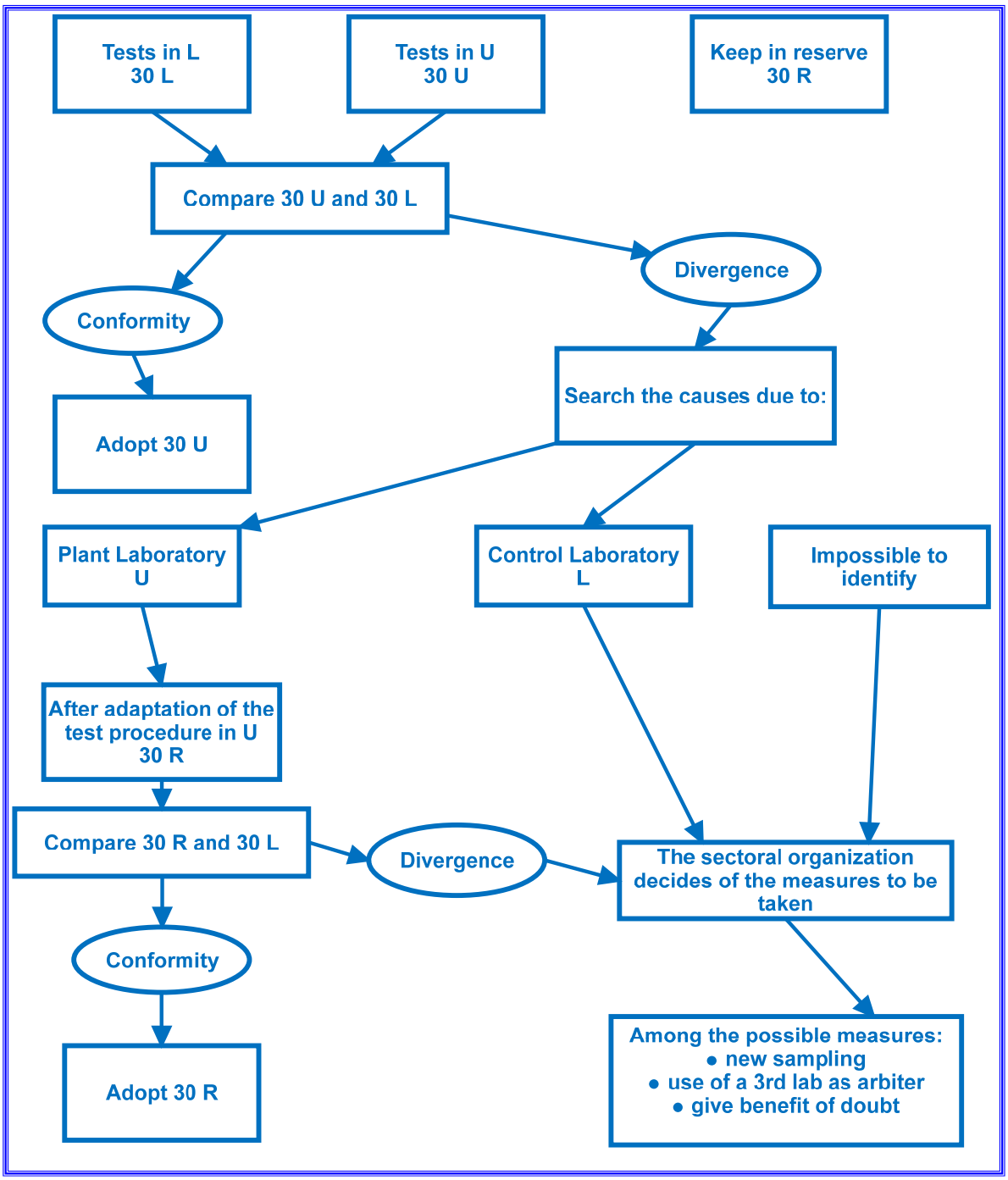
3.2.4 Conditions of acceptance

It is needed that, for each diameter of the group of products chosen according to the indications of paragraphs 3.1.6, all the criteria of the standard are satisfied, namely:

- for the properties controlled by measurements, values “m - k.s” must answer the criteria of the standard,
- for the properties controlled by attribute there can be no unsatisfactory specimen,
- the comparison of the tensile characteristics must show that they are statistically equivalent.

Flow chart for 1 diameter

L = control laboratory / U = internal laboratory / R = reserve



4 Industrial autocontrol

4.1 General information

4.1.1 Methods of control

The producer must have the methods of control allowing to check, during the manufacturing of one or several product(s) for which he obtained the authorization of use of the BENOR-mark, the respect of the criteria fixed by the standards relating to it for the entirety of the production bearing the recorded rolling marks (see § 3.1.5).

4.1.2 Sampling and tests (by product)

In all cases, statistical exploitation requires 30 test results of at least the same diameter per grade of steel from continuous or non-continuous production over a period of at least the last three months and at most twelve months.
Sampling and testing shall cover all manufacturing teams and machinery.

For this purpose, the producer shall sample:

a) randomly at least one welded fabric per maximum of 40 tons of products in order to carry out the tests prescribed by the standard, i.e.:
   - a measurement of the conventional section
   - a tensile test on the longitudinal wire
   - a tensile test on the transverse wire
   - a rebend test on the longitudinal wire
   - a rebend test on the transverse wire
   - shear strength of welds
   - a determination of the welded fabric geometry, namely: the pitch, the overhand and the flatness
b) at least one sample per maximum of 100 tons of products of the same nominal diameter intended for the control of the surface configuration.

Where rod guaranteed by the BENOR-mark is used for the manufacture of the products, the frequency of tests to be carried out on the assembled rods (measurement of the conventional section, tensile test, rebend test, surface configuration) may be reduced by half.

The tests shall be carried out in accordance with the standards.

4.1.3 Chemical analysis

4.1.3.1 Method and device of analyses

The method and the device used for the chemical analyses must give results representative of the product, whatever the structural heterogeneity of this last.

4.1.3.2 Chemical analysis on semi-finished products

The producer mill must have the certificate of analysis of all its semi-finished products per cast. Moreover, all the semi-finished products must be located with the indication of corresponding cast.

4.1.3.3 Chemical analysis on end products

The producer is not held to carry out the chemical analyses on end products; however, checks can be carried out by the sectoral organization at the time of the periodic visits at the same time as the calibration of the devices of chemical analysis. If the producer does not have the necessary equipment, the chemical analyses can be required in external laboratory at the cost burden of the producer.

4.1.4 Recording and analysis of the results of the autocontrol

All the results of controls are numbered and recorded. The classification of the tests is done in particular in reference to the numbers of manufacturing and identification of the products (see § 3.1.5) so as to ensure the traceability. One uses a register in pre-numbered and pre-signed pages by the sectoral organization. The register can be made up of loose sheets. If the monitoring service of the factory uses a system of continuous classification of the test results, or a computerized system, the aforementioned register is not essential. This system of classification must offer all the guarantees and be approved by the sectoral organization.

The results are kept for a period of 10 years by the producer.

The results are exploited statistically by the producer according to a calculation program approved by the sectoral organization and the results of this statistical exploitation are sent to the sectoral organization in the thirty end days of the month concerned. The producer can eliminate from this

statistical exploitation the results coming from products withdrawn of the trade-circuit (see § 4.4) and certain too favourable aberrant results (see § 4.2.2). The attachments relating to the encountered problems and their solutions must be joined (see § 4.3.2).

4.2 Statistical control by measurements

This control applies to:
1. yield strength
2. tensile strength
3. R'_m/R'_e ratio
4. total elongation under maximum load (A_{gt})
5. the relative rib or indentation area (f_R or f_P).

4.2.1 Principle

The interpretation of the results of the tests is done using the statistical methods:
- by adopting a reliable failure rate of 5 % [p = 0,95] at a probability of 90 % (risk of 10 %) for properties 1 and 2 (R'_m, R'_e) and 5 (f_R or f_P)
- by adopting a reliable failure rate of 10 % [p = 0,90] at a probability of 90 % (risk of 10 %) for properties 3 and 4 (ratio R'_m/R'_e and A_{gt}).

4.2.2 Statistical interpretation of the results of the tests

The statistical interpretation of the test results shall be performed monthly by product from the production of the same diameter and grade of steel from the last 3 months.

However, the producer is free to divide his production into several homogeneous lots. In this case, this division must be clearly reflected in the statistical interpretation documents which it transmits for inspection to the sectoral organization.

For each examined property, one determines for n available results, the arithmetic mean “m” and the estimate of the standard deviation “s”. One calculates the estimate of the characteristic value “m - k.s”.

The tables hereafter give the constant of acceptance “k” according to the number of available results (according to NBN EN 10080: 2005).

If this value does not satisfy the specified value, the producer can draw aside no more than half of the values provided for control under consideration, but on the condition that doing it in the order of the values classified while starting with most favourable and to calculate: “$m_i - k_i . s_i$”.

If these new values still do not satisfy the specified value, the whole of the products considered is to be sheared to scrap in accordance with Article 2.6.1. of the Particular Regulation BRP 279.

4.2.2.1 Coefficient k as a function of the number (n) of test results for a reliable failure rate of 5 % (p = 0,95) at a probability of 90 %

n	k	n	k
5	3,40	30	2,08
6	3,09	40	2,01
7	2,89	50	1,97
8	2,75	60	1,93
9	2,65	70	1,90
10	2,57	80	1,89
11	2,50	90	1,87
12	2,45	100	1,86
13	2,40	150	1,82
14	2,36	200	1,79
15	2,33	250	1,78
16	2,30	300	1,77
17	2,27	400	1,75
18	2,25	500	1,74
19	2,23	1000	1,71
20	2,21	∞	1,64

4.2.2.2 Coefficient k as a function of the number (n) of test results for a reliable failure rate of 10 % (p = 0,90) at a probability of 90 %

n	k	n	k
5	2,74	30	1,66
6	2,49	40	1,60
7	2,33	50	1,56
8	2,22	60	1,53
9	2,13	70	1,51
10	2,07	80	1,49
11	2,01	90	1,48
12	1,97	100	1,47
13	1,93	150	1,43
14	1,90	200	1,41
15	1,87	250	1,40
16	1,84	300	1,39
17	1,82	400	1,37
18	1,80	500	1,36
19	1,78	1000	1,34
20	1,77	∞	1,28

4.3 Statistical control by attributes

This control applies to the following properties:

- chemical analysis
- conventional section
- rebend test
- shear strength
- height of the ribs (depth of the indentations)[24]
- spacing of the ribs (spacing of the indentations)[25]
- the pitch (distance between elements)
- the overall flatness
- the overhang.

4.3.1 Principle

The interpretation of the results of the tests is based on a simple sampling, by adopting a reliable failure rate of 10 % [p = 0,90] at a probability of 95 % (risk of 5 %).

4.3.2 Interpretation of the test results

The interpretation of the chemical analysis applies to all casts of steel. This interpretation takes place, prior to the production, on the basis of certificate of analysis of cast (see 4.1.3.2). No unsatisfactory result is accepted.

For the other examined properties, the interpretation of the results of the tests is to be carried out monthly for the products coming from the production the last three months in the same diameter. One admits a maximum number of insufficient results according to the number of results necessary to respect the criterion, as indicated in the table hereafter.

As soon as an unsatisfactory result arises and leads to the going beyond the admitted number, either the producer shears to scrap the concerned unit of autocontrol in accordance with article 2.6.1 of the Particular Regulation BRP 279, or he samples from this unit (40 tons or 100 tons according to the test – cf. § 4.1.2) a minimum of 5 samples including one in the same coil or the same bundle of bars and 4 others in a random way.

If all the results are satisfactory, the unit of autocontrol is accepted and the first result is not taken any more into account. In the contrary case, the products are sheared to scrap.

The anomaly, the results of the complementary tests, its probable cause as well as that the pursuant corrective action (measurements taken to cure it or put to scrap) must always be consigned and be the subject of an attachment to the transmitted results of autocontrol.

[24] The determination of the height and the spacing of the ribs (depth and spacing of the indentations) may, at the request of the producer, be replaced by the determination of the relative rib or indentation area f_R (f_P) and shall in this case be evaluated following § 4.2.
[25] See above footnote over the determination of the relative rib or indentation area (f_R, f_P).

Maximum admitted amount of unsatisfactory results	Minimum amount of results necessary to respect the criterion
0	29
1	46
2	63
3	78
4	92
5	106
6	119
7	132
8	145
9	158
10	170
11	182
12	195
13	207
14	219
15	231
16	243
17	255
18	267
19	279
20	291
21	303

4.4 Products not likely to bear the BENOR-mark

All precautions must be taken so that the products which do not fulfil the requirements of the standard and which cannot bear the BENOR-mark cannot be confused with those which bear the BENOR-mark.

4.5 Register of the claims

All the complaints being technical and relating to the delivered products are gathered in a register.

They are transmitted to the persons in charge concerned for treatment.

The register is held with provision of the sectoral organization.

5 Periodical checking by the sectoral organization

5.1 Products being in the producing factory

5.1.1 General information

The requirements on the authorization of use of the BENOR-mark (regularity in the manufacturing of the products and conformity of the products bearing the BENOR-mark to the standards) are checked periodically by the sectoral organization.

This checking consists in being ensured:

- that the tensile testing machines and their extensometer are in conformity and are calibrated in accordance with the regulations of § 2.2.1.1 and that their last calibration does not go back to more than one year,
- that the producer disposes of all the certificates of chemical analysis of semi-finished products which he used,
- by means of representative samples, that the calibration of the devices used for the chemical analysis is correct,
- that the industrial autocontrol is carried out correctly,
- that the results of the industrial autocontrol are correctly interpreted.
    - With this intention, the sectoral organization carries out the checking of the statistical exploitation of at least two series of results a year.
- that the results of the industrial autocontrol are satisfactory,
- that the results obtained and recorded during this industrial autocontrol are in conformity with reality by carrying out check tests on products manufactured under the BENOR-mark and autocontrolled or on samples of casts or semi-finished products preserved to this end (see § § 4.1.3.1 and 4.1.3.2),
- that all actions were taken so that the products already provided with the BENOR-mark, but which must be sheared, are stored separately from conform BENOR steels,
    - The proof of shearing must be presented at initiative of the producer to the sectoral organization.
- the technical file is kept up to date and corresponds effectively to the methods (processes) and means (machines) used.
- that when anomalies were noted, necessary corrective actions were taken to cure it.

The producer makes all the provisions to facilitate this checking; in particular, he communicates to the sectoral organization:

- the name of the person in charge of the quality control services of the factory,
- the date of the start-up of a slightly modified production, i.e. products lying within the perimeter of the certification but comprising certain minor modifications.

He keeps at disposal all the results of autocontrol according to § § 4.1.3 and 4.1.4.

He also communicates to the sectoral organization, for each monthly period starting from the date of delivery of the authorization of use of the BENOR-mark, the quantity of products delivered under the BENOR-mark as well as the quantity of sheared products. The quantities are clearly subdivided by type of product (coil, bars, rod resulting from straightened coil, manufacturing processes, geometrical profile) and by diameter.

5.1.2 Periodicity of the visits of monitoring

For the period following a decision of the first certification, the user of the mark is subjected to a one-year probationary period comprising six visits.

During this period, documentary audits or complementary visits can be applied based on result of the initial audit (in function in particular amongst nonconformities) and of a decision of the Certification Committee.

The same principles are applicable in the event of extension during a one-year period, the number of basic visits being in this case limited to 4.

The audits which are conducted by the sectoral organization during the current time of certification, are made in theory four times a year.

This periodicity is of once a month in the following cases:

- on decision of the sectoral organization, when the results obtained on the samples taken during a routine checking and those obtained by the internal laboratory on the samples coming from the industrial autocontrol present a statistically significant difference (see § 5.1.4.2) and that the producer could not justify it satisfactorily,
- on decision of the sectoral organization, when other situations make it possible to question the level of product quality or its regularity.

5.1.3 Test sample selection

5.1.3.1 Routine checking

Each product is checked at least once a year. During the visit, the sectoral organization shall select at least one product and not more than two products; by product, he takes 15 samples[26]; each of these 15 samples is of the same diameter and grade of steel. In case the welded fabric is made from coils, the 15 samples come from different coils. In the case where the welded fabrics are made from straightened bars, the samples shall be distributed evenly over at least 3 identical welded fabrics. The 3 collected welded fabrics come from different production batches. These samples shall be of sufficient length to permit a tensile test, a rebend test, a determination of the conventional section, a measurement of the rib configuration, a shear test of the welded nodes and possibly the chemical analysis. Artificial aging must be carried out just before the tensile test and in the presence of the sectoral organization (except for hot rolled bars where the choice - aged or not aged - is determined by the producer during his autocontrol).

The chemical analysis is limited to 3 per diameter.

On the product under examination, a welded fabric shall also be measured with regard to the pitch, the overhang and the flatness.

If there are no finished products in stock, the sectoral organization shall check the production books and delivery notes by consulting them to ensure that the theoretical stock is effectively zero.

If the products are regularly insufficient to carry out the sampling of the 15 samples, the producer shall transmit to the sectoral organization the production program indicating the probable dates of dispatch.

5.1.3.2 Annual checking

Once a year, at the time of one of its visits, the sectoral organization takes the 15 samples and let them be cut out in two equal parts. First half is submitted for testing at the internal laboratory within the framework of routine checking according to § 5.1.3.1; the second half is sent for tensile test in a control laboratory.

For the producers who profit from an authorization of use of the BENOR-mark for several products, the tests in a control laboratory take place only once a year.

[26] Whenever possible, sampling shall be carried out in such a way as to enable the comparison of variances and means between self-checking and periodic inspection tests to be carried out satisfactorily.

5.1.4 Tests and interpretation of the results

5.1.4.1 Tests

The internal laboratory proceeds, in the presence of the sectoral organization, with the tensile tests on the 15 specimens, and with the rebend tests and measurements of surface configuration on at least 5 of the 15 specimens.

The samples for the possible chemical analysis are controlled in the internal laboratory. The calibration of the devices used for this purpose is controlled via representative samples (see § 3.1.8).

5.1.4.2 Interpretation of the results

5.1.4.2.1 Case of routine checking

The interpretation of the test results of tensile consists in:

1. comparing the results of yield strength R'_e and tensile strength R'_m with those obtained during the autocontrol of the corresponding production. For this purpose, appendix B of TRA 418 is used.
2. checking that the results of R'_e and R'_m satisfy the following regulations
   - each individual value is higher than the specified characteristic value
   - and the mean value of R'_e and R'_m is higher than the specified characteristic value increased by 10 N/mm²
3. to check that for the R'_m/R'_e ratio and total elongation A_{gt}, each individual value is higher than the specified value.

All the results of the determination of the conventional section, the rebend test, the determination of the height of the ribs (depth of the indentations) and of the spacing of the ribs (or indentations) or the relative rib or indentation area, the shear strength test of the welded joints, the pitch, the overhang and the flatness, and any chemical analyses shall meet the standard.

5.1.4.2.2 Case of the annual checks in control laboratory

For the results of the yield and tensile strength obtained in the control laboratory, the interpretation consists in checking by the method of the paired observations (see Appendix A of document TRA 418) that there is conformity between these results and those obtained by the internal laboratory on the specimens coming from the same samples.

For information, the results of R'_e, R'_m, R'_m/R'_e, A_{gt} and of the conventional section are interpreted as described with 5.1.4.2.1.

5.1.5 Official report of monitoring

The results of the monitoring are consigned to each visit in a report.

This report must include the following indications:

1. producer and factory
2. identification of the products
3. data on the test sample selection
4. results of the tests carried out in the presence of the sectoral organization and corresponding results of the industrial autocontrol
5. overall evaluation
6. place and date
7. signatures.

The report, if necessary, is supplemented later by a copy of the official report of the tensile tests carried out in a control laboratory.

The report must be kept for a period of at least 10 years by the producer and by the sectoral organization.

5.2 Products bearing the BENOR-mark and being apart from the producing factory

5.2.1 Controls carried out on the initiative of the sectoral organization

5.2.1.1 Principle

If the sectoral organization judges it necessary, samples can be taken in the stores of the stockists-distributors, a processor-distributor or on a building site to check that the products there stored and considered to bear the BENOR-mark, answer the applicable criteria of the Belgian standards.
According to the agreement taken beforehand and for the mechanical tests only, the tests are carried out in a control laboratory or, in the presence of the sectoral organization, in the internal laboratory.

5.2.1.2 Conditions for implementation of control

The taken samples are numbered and cut in 3 equal parts. A series of tests is carried out in a control laboratory as described in 5.2.1.1. The two other series are preserved for possible complementary tests in the producer or in a second control laboratory.
During the sampling, the sectoral organization takes note of markings, and copies of all the documents concerning to the controlled products. It preserves the labels attached there to find, if necessary, the results of the tests of autocontrol.
The results of the tests are communicated to the producer. In case anomalies or irregularities are noted, the producer is invited to provide a justification within a fixed deadline.
The costs of the tests are charged to the producer when anomalies or irregularities are noted.
In the event of registration of non-observance of the provisions of the regulations of the BENOR-mark or Particular Regulation (cf. chapter 2 of BRP 279), the concerned procedures are applied by OCAB-OCBS to the users of the mark.
In the event of disclosure of fraud, OCAB-OCBS reserves the right to prosecute the person in charge of the fraud.

5.2.2 Controls carried out by the sectoral organization in the case of an external claim

One or more sampling tasks are carried out, contradictorily, on the products being the subject of the litigation, by the sectoral organization, the producer or his representative in Belgium and the distributor having been duly convened.
The tests are carried out on the first and second thirds of samples during normal periodic controls in the internal laboratory and a control laboratory. The third and last third of the samples is preserved for possible complementary tests.
The possible chemical analyses on products are carried out in a laboratory selected by mutual agreement. The methods and devices used must give results representative of the average of the product, whatever the structural heterogeneity of this last.
The results of the tests are communicated to the producer. In case anomalies or irregularities are noted, the producer is invited to provide a justification within a fixed deadline.
After assessment of the results, the conclusions of the decision-making bodies of the sectoral organization are communicated to the producer, to the plaintiff and to the concerned internal bodies of the sectoral organization.
The costs of the tests are charged to the producer when anomalies or irregularities are noted.
In the event of registration of non-observance of the provisions of the regulations of the BENOR-mark or Particular Regulation (cf. chapter 2 of BRP 279), the concerned procedures are applied by OCAB-OCBS to the users of the mark.
In the event of disclosure of fraud, OCAB-OCBS reserves the right to prosecute the person in charge of the fraud.

5.2.3 Controls carried out on the initiative of a user

Whatever the results of the tests, the expenses of those are with exclusive charge of the user who took the initiative of it unilaterally.
The users who estimate themselves injured can address their claim justified to OCAB-OCBS.
As soon as possible, OCAB-OCBS rules on the admissibility of the claim and possibly decides to carry out controls and tests. OCAB-OCBS then applies the procedure described into 5.2.2 if the products

being the subject of the litigation are still available or according to the procedure described into 5.2.1 in the contrary case.

6 History of the revisions

6.1 Revisions 0 to 3

- Creation, updates

6.2 Revision 4

- General adaptation of the document to integrate the imprinted steels.
- Slight administrative changes of some chapters.

6.3 Revision 5

- Reference to BENOR$^{asbl}_{vzw}$ regulations
- Adaptation of the periodicity of inspection visits after a first certification.

6.4 Revision 6

- Edition in the English language
- Updating of requirements regarding sampling and surface configuration.

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