

EQUIPMENT OF CONTROL AND USAGE	ECU	625
	VERSION 12	2024/04

# APPLICATION OF THE BENOR-MARK IN THE SECTOR OF PRESTRESSING STEEL PRODUCTS - ASSESSMENT METHODS APPLICABLE TO THE USERS OF THE BENOR-MARK - CONTROL EQUIPMENT

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## **FOREWORD**

On 01.04.2024, the npo's PROBETON, BE-CERT, OCAB-OCBS and PROCERTUS merged in accordance with article 13 of the Code of Companies and Associations. On that date, PROBETON, BE-CERT and OCAB-OCBS were automatically dissolved, and all their rights and obligations were transferred to PROCERTUS, which alone continues their activities.

# CONTENTS

<b>1</b>	<b>OBJECT</b>	<b>4</b>
<b>2</b>	<b>TESTING METHOD</b>	<b>4</b>
<b>3</b>	<b>INTERPRETATION OF RESULTS</b>	<b>4</b>
3.1	General information	4
3.2	Tensile test	4
3.3	Reverse bending test	5
3.4	Relaxation test	5
3.5	Fatigue test	5
3.6	Corrosion test	5
3.7	Deflected tensile test	6
3.8	Geometric characteristics (including dimension and mass)	6
<b>4</b>	<b>VERIFICATION AND CONTROL OF THE CONTROL EQUIPMENT</b>	<b>6</b>
<b>5</b>	<b>MEASUREMENT UNCERTAINTY</b>	<b>6</b>
	Table 1 - Equipment and requirements	7
<b>6</b>	<b>HISTORY OF REVISIONS</b>	<b>9</b>

# 1 OBJECT

This document supplements the provisions of the various Implementation Rules for the Benor mark in steel products for concrete sector, describing the control procedures applicable to producers of prestressing reinforcement.

## 2 TESTING METHOD

Products meeting the NBN I10-001 to NBN I10-003 and PTV 311, 312, 314 and 315 PROCERTUS series of standards, as well as NBN I10-008, shall be inspected in accordance with the test methods described in ISO 15630-3 supplemented by the standards listed below. These supersede the contrary requirements contained in the above-mentioned documents. The Implementation Rules should be considered adapted accordingly.

## 3 INTERPRETATION OF RESULTS

### 3.1 General information

The test results to be reported to PROCERTUS always include the measured values (force, length and mass).

The interpretation of results is carried out in accordance with the rules, either on the basis of individual values – interpretation by attributes, or calculated statistical values – statistical interpretation. When the value of the coefficients to be used is not directly in the table, either the worst case value of "k" should be chosen or interpolated between the given values.

Subject to the exceptions explicitly mentioned below, the comparison of the values obtained with the values specified in the standards, it is necessary to compare the figures with the same number of decimal places as the values cited in the standards (example: an elongation value of 3.36% shall be rounded to 3.4%, and is less than the criterion of 3.5% of PTV 311, 312 and 314).

The standards provide that the tests are carried out at a temperature between 10 and 35 °C; Therefore, except in case of doubt (feeling of discomfort due to too low or excessive temperature), it is not necessary to check the ambient temperature.

### 3.2 Tensile test

The test is carried out in accordance with ISO 15630-3 and specified by the test method described in ISO 6892.

Any abnormalities during the test shall be reported.

#### **Equipment:**

The traction machine used must be recorded on the gear (especially when several machines are available with overlapping area). The length of the extensometer base should be registered.

#### **Determination of $F_m$ and $F_{p0.1}$ or $F_{p0.2}$ (see circular 619):**

The Belgian standards NBN I10-001 to -003 and the additional PTV 311, 312 and 314 define and specify that the yield strength is the load to which corresponds a permanent relative deformation of 0.2% ( $F_{p0.2}$ ), although the  $F_{p0.1}$  is also determined.

So far, it is the value of  $F_{p0.2}$  that is covered by the BENOR mark.

In the future EN 10138, only  $F_{p0.1}$  is considered.

This is why PROCERTUS wants to offer users of the BENOR mark the possibility to opt for themselves by choosing under the BENOR mark, either  $F_{p0.1}$  or  $F_{p0.2}$ . This choice implies a decision that applies to all BENOR production.

Users of the BENOR Mark are therefore invited to communicate the date on which they wish to switch from the guarantee from F<sub>p0.2</sub> to F<sub>p0.1</sub>. As long as this date is not communicated, the current warranty of F<sub>p0.2</sub> is maintained.

#### **Determination of the Agt :**

The method of determining the total elongation under maximum load must be mentioned: extensometer until breakage or displacement of the sleepers.

In the case of measurement of elongation via an extensometer until rupture, failure outside the measurement base shall be reported.

In the case of elongation measurement via an optical extensometer, the reflective strip used for the elongation marks during the tests shall be the same as that used during the calibration.

#### **Determination of module E:**

The calculation of the E-modulus is carried out using the nominal cross-section of the test specimen (ISO 15630-3 § 5.3.2).

### **3.3 Reverse bending test**

The test shall be carried out in accordance with ISO 15630-3 and specified by the test method described in ISO 7801.

#### **Checking the mandrel:**

The verification of the diameter of the mandrel is done using a measuring instrument accurate to the mm. The use of a smaller diameter chuck is permitted. The diameter of the mandrel actually used is noted.

### **3.4 Relaxation test**

The test is carried out in accordance with ISO 15630-3.

### **3.5 Fatigue test**

The test is carried out in accordance with ISO 15630-3.

The range of stress to be applied during the test is calculated using the actual cross-section.

#### **Calibration verification:**

The verification of the calibration of the fatigue machine can be carried out according to ISO 7500-1.

### **3.6 Corrosion test**

The test is carried out in accordance with ISO 15630-3. It is done using solution A.

#### **Interpretation:**

The measurement is carried out in hour(s) and minute(s). Rounding is done over tens of minutes, i.e.

$$4\text{h}52' = 4\text{h}50' < 5\text{h}00'$$

$$4\text{h}56' = 5\text{h}00'$$

### 3.7 Deflected tensile test

The test is carried out in accordance with ISO 15630-3.

#### *Interpretation:*

The coefficient D is calculated as the average of the individual results of the 5 samples. However, if the standard deviation of the 5 values  $D_i$  is greater than 15% of their mean value, 5 additional specimens are tested; the highest and lowest individual value of the series of 10 results are discarded and the coefficient D is then the average of the remaining 8 results (regardless of the value of the standard deviation on the 8 samples).

### 3.8 Geometric characteristics (including dimension and mass)

Measurements are made in accordance with ISO 15630-3.

#### *Measurement accuracy:*

ISO 15630-3 states in § 1 5.2 that length and mass shall be measured with an accuracy of at least  $\pm 0.5\%$ . The accuracy of the measuring instrument is not defined unequivocally but deduced from the object to be measured. To guarantee this accuracy, PROCERTUS considers that the reading must be made at  $\pm 0.25\%$ .

The accuracy of the balance will depend on the diameter, i.e:

- 0.1 g for wire of  $\varnothing 4$  - length 600 mm
- 2 g for strand of  $\varnothing 15.2$  - length 1000 mm

## 4 VERIFICATION AND CONTROL OF THE CONTROL EQUIPMENT

The list of the most common control equipment is given below in table 1, as well as the minimum frequency of calibrations and checks required.

PROCERTUS may authorise exceptions from the implementation of these Rules at the written request of a user and on the basis of the opinion of its competent technical advice bureau.

## 5 MEASUREMENT UNCERTAINTY

Except for special cases, PROCERTUS does not ask to mention and justify the measurement uncertainty as aimed for by the ISO/IEC 17025 standard.

**Table 1 - Equipment and requirements**

<b>Calibration and control of equipment</b>						
<b>Equipment</b>	<b>Property</b>	<b>Method</b>	<b>Frequency</b>	<b>Criterion</b>	<b>Performed by</b>	<b>Measures in the event of exceeding the control criteria</b>
Balance	Weight	EN 45501	At commissioning	0.25 %	2	Fitting or downgrading
		One or two points inspection using standard weights of class M2 according to OIML	1 x / year	0.25 %	4	Fitting or downgrading
Meter, graduated slat	Length(strand, wire, sheath)	EN 45501	At commissioning	0.25 %	2	Fitting or downgrading
		Visual damage	1 x / month		4	Downgrading
Extensometer	E and Yield strength	ISO 9513	1 x / year	Class 1	1	Fitting or downgrading
	Total elongation	ISO 9513	1 x / year	Class 2	1	
Tensile machine		ISO 7500-1	1 x / year (+after any repair or move)	Class 1	1	Fitting or downgrading
Deflected machine		ISO 7500-1	1 x / year (+after any repair)	Class 1	1	Fitting or downgrading
Relaxation machine		ISO 7500-1	1 x / year (+after any repair or move)	0-1000kN ± 1% > 1000 kN ± 2%	1	Fitting or downgrading
Fatigue machine		ISO 7500-1	1 x / year (+after any repair or move)	Accuracy ≥ ± 1%	1	Fitting or downgrading
Corrosion machine		ISO 7500-1	1 x / year (+after any repair)	Accuracy ≥ ± 2%	5	Fitting or downgrading
Dynamometer	Initial resistance to friction	ISO 376	1 x / an	± 1 N	2	Correction of read values, fitting or downgrading
Bending mandrel	Reverse bending	using a measuring instrument accurate to the mm	At commissioning	+ 1 mm		
Slide calliper	Indentation spacing, lenght	Using calibrated standard blocs corresponding to the entire range of use	1 x / an	± 0,05 mm	4	Correction of read values, fitting or downgrading
Micrometer	Diameter	Using calibrated standard blocks corresponding to the entire range of use	1 x / an	± 0.01 mm	4	Correction of read values, fitting or downgrading
Slide calliper,	Sheath thickness	Using calibrated standard blocs corresponding to	1 x / an	± 0.02 mm	4	Correction of read values, fitting or

## Calibration and control of equipment

Equipment	Property	Method	Frequency	Criterion	Performed by	Measures in the event of exceeding the control criteria
micrometer		the entire range of use				downgrading
Depth gauge	Indentation depth	Using calibrated standard blocs corresponding to the entire range of use	1 x / an	± 0.01 mm	4	Correction of read values, fitting or downgrading
Slide calliper, micrometer, depth gauge	See lines above	Visual damage, oxidation. Control mobility and play. Check the starting control of legibility value of the measuring field and possibly adjust it. Check the value measured by the standard hold corresponding to the maximum value of the range of use	1 x / month	See lines above	4	Correction of read values, fitting or downgrading
Profile projector	Geometrical characteristics	Using calibrated standard bars	1 x / month		3 (at commissioning) 4	Correction of read values, fitting or downgrading
Bars, blocks and weight reference		Comparison with the standard of reference	1x/5 years		1	Fitting or downgrading
Hammer (drop weight)	Impact resistance of the sheath	Verification of the weight	At commissioning	weight ± 10 gr	2	Downgrading
		Visual inspection of the hammer and machine	1 x / year		4	Downgrading
Thermometer for ambient temperature	Temperature	Visual inspection	Not mandatory	± 1 °C. No visible deterioration	4	Fitting or downgrading

Calibrations/controls are performed by:

- 1 = an external laboratory accredited by BELAC or by another member of EA; or failing that, accepted by the certification body for the calibration of the equipment in question;
- 2 = the supplier of the measuring devices;
- 3 = the producer himself under the supervision of the inspection body and following a procedure described in the technical dossier;
- 4 = the producer himself following a procedure described in the technical dossier and following the prescribed method;
- 5 = one year out of 2, calibration can be carried out by the producer himself following the requirements of ISO 7500-1. The other year by an external laboratory, see "1".

In all cases, calibration may be performed by a higher category body.



## 6 HISTORY OF REVISIONS

### Revisions 0 to 1

- Creation, adaptations.

### Revision 2

- §2: reference to PTV 315 added, §3.2 and 3.8 :little modifications, table 1: modifications and new equipment's + grouping of the 2 tables

### Revision 3

- Transfer of asbl OCAB-OCBS vzw to asbl PROCERTUS vzw
- Editorial and linguistic corrections