SOUTH QUALITY

PROFICIENCY TESTING PROVIDER

REPORT No 11425

Date of issue: *December 12, 2025*

Status: FINAL REPORT

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EN 50618

ELECTRIC CABLES FOR PHOTOVOLTAIC SYSTEMS

Program: SQ-2560.V11

****

Prepared by:	Reviewed by:	Approved by:
cn=VALENTYN E. KRAVCHENKO, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=tech@ptsouthquality.com, c=AR 2025.12.12 14:22:13 -03'00'	cn=ESTEBAN DI MARCO, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=edimarco@ptsouthquality.com, c=AR 2025.12.15 10:48:30 -03'00'	cn=Emiliano Medina, o=SOUTH QUALITY, ou=PT SOUTH QUALITY SAS, email=quality@ptsouthquality.com, c=ES 2025.12.15 16:29:28 -03'00'
Valentyn Kravchenko Assistant Technician	**Eng. Esteban Di Marco** Electromechanical expert	**Eng. Emiliano Medina** Quality Assurance Lead

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1. FOREWORD

This report summarizes the results of the SQ-2560.V11 proficiency testing program for verification of compliance with construction, dimensional and test requirements of photovoltaic (PV) system cables. This program is conducted in a bilateral format, following the A.3.3 classification of the ISO 17043 standard ("Split-sample testing schemes").

South Quality conducted the testing program in October 2025 with the aim of assessing the laboratory's ability to competently perform the designated tests.

2. ORGANIZATION

Program Coordinator:	Eng. Esteban Di Marco
Assistant Technician:	Valentyn Kravchenko
Statistic:	Lic. Manuel Tozaki
Supervision:	Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine the compliance with test requirements. The following tests will be verified:

- Compatibility
- Cold bending
- Ozone resistance
- Dynamic penetration

These tests are carried out in accordance with the following standard:

Standard
EN 50618: 2014

To verify this, batches of photovoltaic (PV) system cables have been selected.

Participants in this program have not been previously informed about the expected behavior of the samples they receive.

4. PARTICIPANT

Company: **ITEN - Instituto Tecnológico de Ensaios LTDA**

Laboratory: **ITEN**

Country: Brazil

Client ID: C080

Contact person: Luana Silva
Administrativo
administrativo@itensp.com.br

5. HOMOGENEITY

Several batches were prepared identically by the staff at South Quality.

Subsequently, a homogeneity study was conducted with an ISO 17025 accredited laboratory.

The control process followed ISO 33405: 2024, clauses 7.4.1.1 / 7.4.1.2. Stratified random sampling was applied, and samples were selected using random number generation software.

The results of this test are presented below:

Size of each batch: **500 units** Tested samples from each batch: **100 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LEM3517	BATCH: LEM3518	BATCH: LEM3519
Compatibility (7.3.4)	NO	YES	YES

Size of each batch: **200 units** Tested samples from each batch: **20 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LEM3715	BATCH: LEM3716	BATCH: LEM3717
Cold bending (7.3.6)	YES	YES	NO

Size of each batch: **150 units** Tested samples from each batch: **15 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LEM3511	BATCH: LEM3512	BATCH: LEM3513
Ozone resistance (7.3.8)	YES	YES	NO

Size of each batch: **200 units** Tested samples from each batch: **40 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LEM3721	BATCH: LEM3722	BATCH: LEM3723
Dynamic penetration (7.3.10)	NO	NO	YES

The samples for this program are taken from the selected batches identified as **LEM3512**, **LEM3518**, **LEM3715**, and **LEM3723**.

For the indicated batches, the values determined in the homogeneity study are utilized as the assigned values.

The analysis of the test data indicated that the selected samples exhibited sufficient homogeneity for the program. Therefore, the results of participants identified as outliers cannot be attributed to sample variability.

6. SAMPLE INFORMATION

The following samples were sent for testing:

Batch:	LEM3512
Sample ID:	07
Characteristics:	Red cable - 4 mm^2 - 20 cm - 3 units

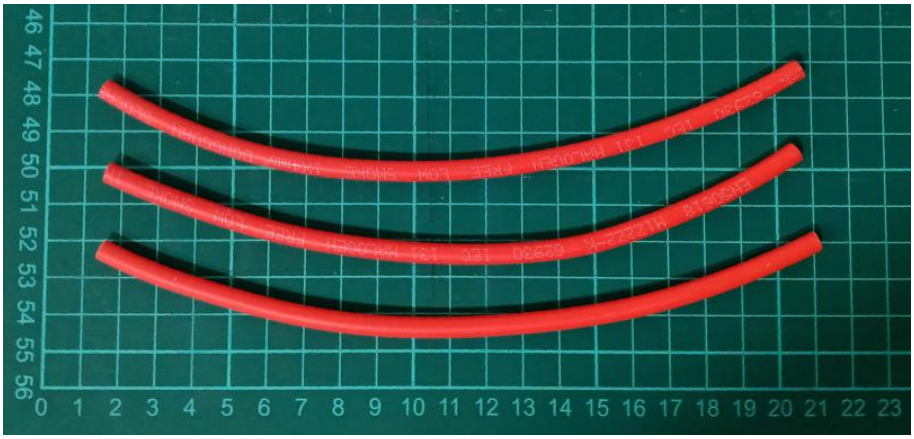
Batch:	LEM3518
Sample ID:	13
Characteristics:	Red cable - 4 mm^2 - 25 cm - 10 units

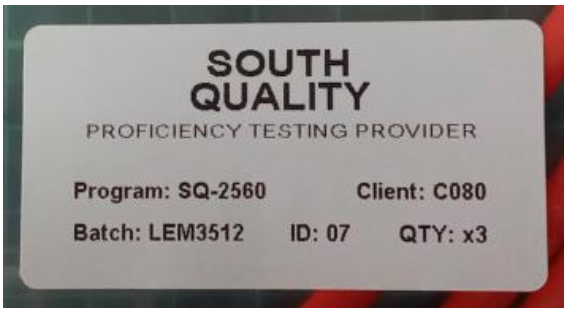
Batch:	LEM3715
Sample ID:	05
Characteristics:	Black cable - 4 mm^2 - 100 cm - 2 units

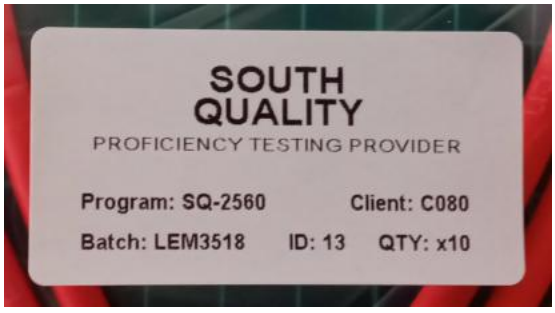
Batch:	LEM3723
Sample ID:	02
Characteristics:	Black cable - 4 mm^2 - 15 cm - 4 units

7. IMAGES

SAMPLES







SAMPLES


SOUTH
QUALITY
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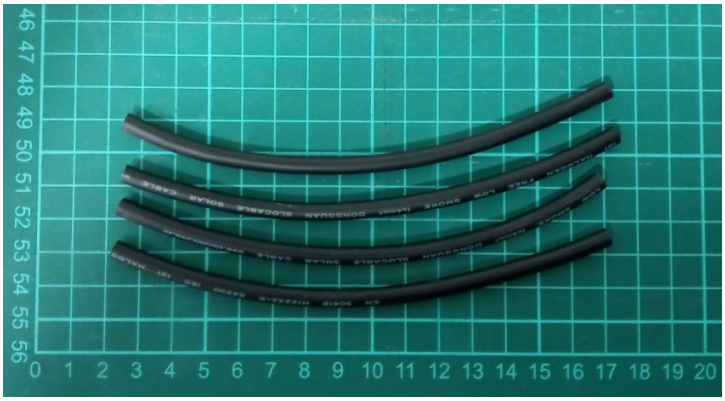
Program: SQ-2560
Client: C080
Batch: LEM3715
ID: 05
QTY: x2




SOUTH
QUALITY
PROFICIENCY TESTING PROVIDER
Program: SQ-2560
Client: C080
Batch: LEM3723
ID: 02
QTY: x4

8. ASSIGNED VALUES

BATCH: LEM3518			
DETERMINATION: Compatibility		MEDIAN VALUE	SD
ORIGINAL SAMPLES	TENSILE STRENGHT (MPa)	12.0	0.18
	ELONGATION (%)	205	6.5
AGED SAMPLES	TENSILE STRENGHT (MPa)	14.2	0.12
	ELONGATION (%)	220	11.5

BATCH: LEM3715	
DETERMINATION	RESULT
Cold bending	PASS

BATCH: LEM3512	
DETERMINATION	RESULT
Ozone resistance (Method B)	PASS

BATCH: LEM3723		
DETERMINATION: Dynamic penetration	MEDIAN VALUE	SD
TEST FORCE (N)	109	1.3

9. PARTICIPANT RESULTS (SEE APPENDIX B)

CODE: LEM3518-13		
DETERMINATION: Compatibility		MEDIAN VALUE
ORIGINAL SAMPLES	TENSILE STRENGHT (MPa)	11.7
	ELONGATION (%)	200
AGED SAMPLES	TENSILE STRENGHT (MPa)	14.0
	ELONGATION (%)	225

CODE: LEM3512-07	
DETERMINATION	**RESULT**
Ozone resistance (Method B)	PASS

CODE: LEM3715-05	
DETERMINATION	**RESULT**
Cold bending	PASS

CODE: LEM3723-02	
DETERMINATION: Dynamic penetration	**MEAN VALUE**
TEST FORCE (N)	107

10. STATISTICS

The results must be treated as qualitative and quantitative.

According B.3.1.3 of ISO 17043 the appropriate technique is to compare participant results with the assigned values.

a) For the determination of **Ozone resistance / Cold bending**, the comparison will be made directly against the assigned values, so any difference will be evaluated as **Unsatisfactory**.

b) For the determination of **Compatibility / Dynamic penetration**, the comparison is made through ***z* score** (B3 - ISO 17043).

$$z = \frac{x - X}{\hat{\sigma}}$$

x is the participant's result

X is the assigned value

$\hat{\sigma}$ is the standard deviation

The performance evaluation of each sample is carried out with the following criteria:

$|z| \leq 2.0$ indicates "satisfactory" performance and generates no signal;

$2.0 < |z| < 3.0$ indicates "questionable" performance and generates a warning signal;

$|z| \geq 3.0$ indicates "unsatisfactory" performance and generates an action signal;

11. EVALUATION OF PERFORMANCE

A. QUALITATIVE RESULTS

BATCH	OZONE RESISTANCE (METHOD B)		PERFORMANCE RESULT
	PARTICIPANT RESULT	ASSIGNED RESULT	
LEM3512	PASS	PASS	SATISFACTORY

BATCH	COLD BENDING		PERFORMANCE RESULT
	PARTICIPANT RESULT	ASSIGNED RESULT	
LEM3715	PASS	PASS	SATISFACTORY

B. QUANTITATIVE RESULTS

BATCH: LEM3518					
DETERMINATION		COMPATIBILITY		| z score |	PERFORMANCE RESULT
		PARTICIPANT RESULT	ASSIGNED VALUE		
ORIGINAL SAMPLES	TENSILE STRENGHT (MPa)	11.7	12.0	1.7	SATISFACTORY
	ELONGATION (%)	200	205	0.8	SATISFACTORY
AGED SAMPLES	TENSILE STRENGHT (MPa)	14.0	14.2	1.7	SATISFACTORY
	ELONGATION (%)	225	220	0.4	SATISFACTORY

BATCH: LEM3723				
DETERMINATION	DYNAMIC PENETRATION		| z score |	PERFORMANCE RESULT
	PARTICIPANT RESULT	ASSIGNED RESULT		
TEST FORCE (N)	107	109	1.5	SATISFACTORY

12. CONCLUSIONS

The overall performance of this **SQ-2560.V11** program from the participant laboratory **ITEN - Instituto Tecnológico de Ensaios LTDA - ITEN**, is **SUFFICIENT** based on expected results.

The criteria used for evaluating the overall performance are as follows:

- **SUFFICIENT** performance: No unsatisfactory/questionable results were obtained.
- **ALMOST SUFFICIENT** performance: No unsatisfactory results were obtained, but one questionable result was found.
- **INSUFFICIENT** performance: An unsatisfactory result or two questionable results were obtained.

APPENDIX A

INSTRUCTIONS

INSTRUCTIONS

PROGRAM:	Electric cables for photovoltaic systems
CODE:	SQ-2560
VERSION:	11
STANDARD:	EN 50618
COORDINATOR:	Eng. Esteban Di Marco (edimarco@ptsouthquality.com)

1 - General

This document serves as a guide for managing the results of the **SQ-2560.V11** program.

2 - Standard

EN 50618: 2014

3 - Tests involved

TESTS
7.3.4 - Compatibility 7.3.6 - Cold bending 7.3.8 - Ozone resistance (Method A or B) 7.3.10 - Dynamic penetration

4 - Samples

CODE	SAMPLE	QUANTITY	TEST
LEM3518-13	Red cable - 4 mm^2 - 25 cm	10 units	Compatibility
LEM3715-05	Black cable - 4 mm^2 - 100 cm	2 units	Cold bending
LEM3512-07	Red cable - 4 mm^2 - 20 cm	3 units	Ozone resistance
LEM3723-02	Black cable - 4 mm^2 - 15 cm	4 units	Dynamic penetration

5 - Notes

a) Being a bilateral program, there is no deadline for submitting results.
b) The participant must submit the results using the usual report employed by their laboratory.
c) Samples should be treated like routine laboratory samples. All testing, recording and reporting should be performed in accordance with EN 50618.
d) Samples must be retained until the end of the program, which concludes with the submission of the final report.
e) To review the results, test images would be appreciated. Images can be attached at the end of this document or sent by email.

PHOTOGRAPHS

APPENDIX B

PARTICIPANT RESULTS (TR # RCLe-009 / 2025)

ENSAIOS NBR ISO/IEC 17025 CRL 0323	**ITEN - INSTITUTO TECNOLÓGICO DE ENSAIOS LTDA.** **"Testing laboratory accredited by Cgcre according to ABNT NBR ISO/IEC 17025, under number CRL 0323".** **Laboratory belonging to the RBLE.**	ITEN INSTITUTO TECNOLÓGICO DE ENSAIOS

PRODUCT TEST REPORT (REP):	**n.º RCLe-009/2025**	**Issued:** 10.31.2025

Requestor:	SOUTH QUALITY
Address:	Pareja 3981, C1419GVG Cdad. Autónoma de Buenos Aires, Argentina
	ZIP code: --- **Phone:** +54 9 11 2614-6800
	e-mail: contact@ptsouthquality.com

Manufacturer:	---

Sample Description:	Red cable - 4 mm² - 25 cm - Code: LEM3518-13 - 10 units Black cable - 4 mm² - 100 cm - Code: LEM3715-05 - 2 units Red cable - 4 mm² - 20 cm - Code: LEM3512-07 - 3 units Black cable - 4 mm² - 15 cm - Code: LEM3723-02 - 4 units		
Code/ Reference:	Program: SQ-2560 V11 - Client: C080		
Business Proposal:	RCLe-009/2025 **Service Order:**	RCLe-009/2025	
Quantity received:	19 test specimens	**Seal:**	No
Start/ End test:	07.22.2025 / 10.10.2025	**Date of receipt:**	06.25.2025

Standards used:

- EN 50618: 2014 - Electric cables for photovoltaic systems;
- EN 50396: 2005 + AMD1: 2011 - Non electrical test methods for low voltage energy cables;
- EN 60811-401: 2012 - Electric and optical fibre cables - Test methods for non-metallic materials - Part 401: Miscellaneous tests - Thermal ageing methods - Ageing in an air oven;
- EN 60811-504: 2012 - Electric and optical fibre cables - Test methods for non-metallic materials - Part 504: Mechanical tests - Bending tests at low temperature for insulation and sheaths.

Test requested: Items of EN 50.618 / Description of the test (s):			**Test measurement uncertainty:**
7.3.4	Compatibility	Tensile strength	U = 0.20 MPa
		Elongation	U = 0.37 %
7.3.6	Cold bending		NA
7.3.8	Ozone resistance		NA
7.3.10	Dynamic penetration		U = 1.5 N

- **Observations:** This test report may be reproduced, only in full, with the authorization of ITEN.
The test results in this report refer only to the items tested and sampled.
- **Address and location of laboratory activities:**
Estrada dos Cravos, 41 - Jd. Santa Maria - Osasco - SP - Brazil - CEP: 06150-480.
- **Phone:** (11) 3606-7373 / 3431-4145 - **E-mail:** lays@itensp.com.br / jane@itensp.com.br - **Site:** www.itensp.com.br

Form. 10 - Revision: 16 - 06.05.2025 **Legend:** NA - Not applicable **Page** 1 / 6

REP n.º: RCLe-009/2025	ITEN - INSTITUTO TECNOLÓGICO DE ENSAIOS LTDA. "Testing laboratory accredited by Cgcre according to ABNT NBR ISO/IEC 17025, under number CRL 0323".

Used instruments:	Code:	
Load cell	CCT	001
Stopwatch	CRO	020
Dynamometer	DIN	003
Universal testing machine	ECD	031
Millimetric scale	ESC	008, 023
Caliper	PAQ	011, 013
Rotameter	ROT	037
Thermocouple sensor	SEN	063, 064, 070
Thermo-hygrometer	TEH	022, 026
Thermometer	TER	005, 009

Specific test conditions, including environmental conditions, when not covered in the report, are available in the specific raw data for one year.

Items of EN 50.618 / Description of the test (s):

7.3.4 - Compatibility (EN 60811-401)

- Tested sample:

Red cable - 4 mm² - 25 cm - Code: LEM3518-13.

Results found (original):

Test	1	2	3	4	5	Median
Tensile strength (MPa)	12.2	12.0	11.7	11.7	11.7	11.7
Elongation (%)	205	210	200	190	185	200

- Test parameters:

Temperature: 135 ±2 °C;

Duration: 168 h.

Results found (aged):

Test	1	2	3	4	5	Median
Tensile strength (MPa)	14.1	13.8	14.0	14.0	14.3	14.0
Elongation (%)	245	195	225	220	240	225

REP n.º: RCLe-009/2025	ITEN - INSTITUTO TECNOLÓGICO DE ENSAIOS LTDA. "Testing laboratory accredited by Cgcre according to ABNT NBR ISO/IEC 17025, under number CRL 0323".

7.3.6 - Cold bend (EN 60811-504)

- Tested sample: Black cable - 4 mm² - 100 cm - Code: LEM3715-05.	
- Test parameters: **Temperature:** -40 ±2 °C; **Duration:** 16 h.	
Cold bend:	**Result found:**
	After exposure, no cracks or fractures were observed in the specimens

7.3.8 - Ozone resistance (EN 50396)

- Tested sample: Red cable - 4 mm² - 20 cm - Code: LEM3512-07.	
- Test parameters: **Method used:** Method B; **Temperature:** 40 ±2 °C; **Relative humidity:** 55 ±5 %; **Duration:** 72 h; **Ozone concentration:** (200 ±50) × 10^{-6} %.	
Ozone resistance:	**Result found:**
	After exposure, no cracks or fractures were observed in the specimens

7.3.10 - Dynamic penetration (Annex D)

- Tested sample: Black cable - 4 mm² - 15 cm - Code: LEM3723-02.			
- Test parameters: **Environmental conditions:** Temperature: 22.4 °C; Relative humidity: 58 %; **Conductor diameter:** 3 mm.			
Dynamic penetration:	**Results found (N):**		
	C.P. 1	**C.P. 2**	**C.P. 3**
	108	108	105

"The opinions and interpretations, expressed below, are not part of the scope of accreditation of this laboratory."

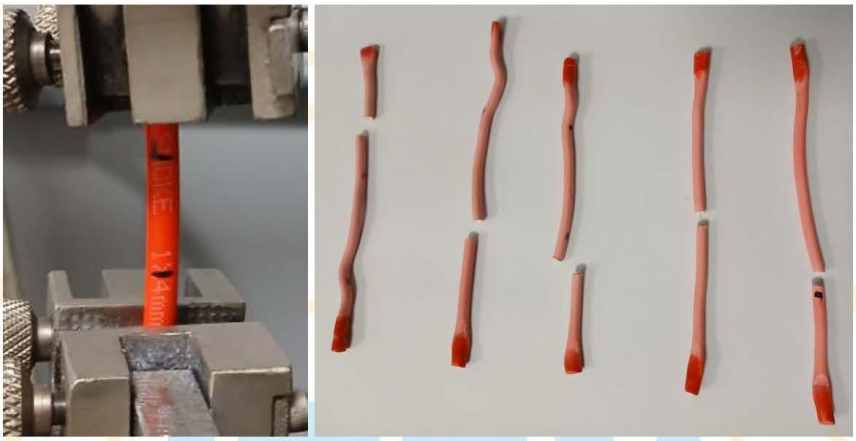
Concluding remarks:

If this report presents test results, in blue, they correspond to results that did not meet the requirements and/or limits specified by the standards and/or contracted requests.

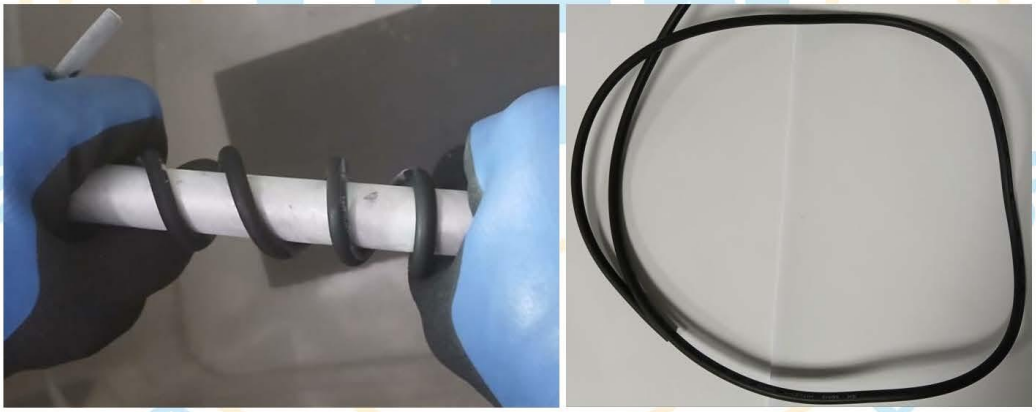
ITEN - INSTITUTO TECNOLÓGICO DE ENSAIOS LTDA
LABORATÓRIO DE ENSAIOS
RAFAEL CESCON

ITEN - INSTITUTO TECNOLÓGICO DE ENSAIOS LTDA
DIRETOR TÉCNICO
CREA 0601383350
JOSÉ APARECIDO SEIXAS

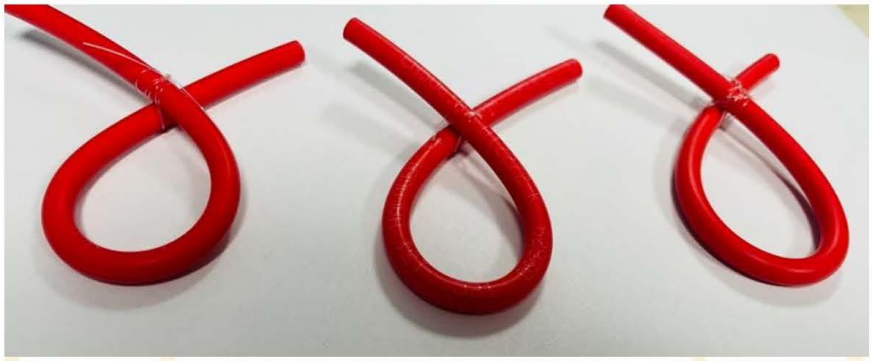
Annex: Details of the test specimens



7.3.4 - Compatibility (during / after)



7.3.6 - Cold bend (during / after)



7.3.8 - Ozone resistance (after)

7.3.10 - Dynamic penetration (during / after)

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