

REPORT No 11891

Date of issue: July 9, 2026

Status: FINAL REPORT

ISO 6892-1

TENSION TESTING OF METALLIC MATERIALS

Program: SQO-M13 (Round 24)

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TABLE OF CONTENTS

1. FOREWORD	3
2. ORGANIZATION	3
3. OBJECTIVE	3
4. PARTICIPANTS	4
5. HOMOGENEITY	5
6. SAMPLE INFORMATION	6
7. IMAGES	6
8. ASSIGNED VALUES	7
9. PARTICIPANTS' RESULTS	7
10. STATISTICS	9
11. EVALUATION OF PERFORMANCE	10
12. CONCLUSIONS	19
 APPENDIX A	
 A1 - PARTICIPANT DATA	 20
 A2 - PARTICIPANT RESULTS	 20
 APPENDIX B	 25

1. FOREWORD

This report summarizes the results of the **SQO-M13 (Round 24)** proficiency testing program on the determination of tensile properties of metallic materials. This program is carried out under a simultaneous participation format, as described in clause A.2.2 of ISO/IEC 17043: 2023 (Types of PT schemes).

South Quality conducted the testing program in April/May 2026. The aim of the program was to assess the laboratories' ability to competently perform the nominated tests.

2. ORGANIZATION

Program Coordinator: Eng. Alfredo Schmidt
Assistant Technician: Sergio Andrada
Statistics: Lic. Manuel Tozaki
Supervision: Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine the following parameters of metallic materials:

- Yield Strength 0.2 Offset
- Tensile Strength
- Elongation at fracture
- Reduction of area

These parameters are verified using the following standard:

Standard
ISO 6892-1: 2019

Batches of samples bars were selected.

Participants in this program were not previously informed of the values or range of values expected from the samples they receive.

4. PARTICIPANTS

In the present round, 24 laboratories have participated with the following details:

CODE	Country	ISO 17025 accredited	Results delivered
01	Hong Kong	Yes	Yes
02	Germany	Yes	Yes
03	Malaysia	Yes	Yes
04	Chile	No	Yes
05	Australia	Yes	No
06	Brazil	Yes	Yes
07	Argentina	Yes	Yes
08	Czechia	Yes	Yes
09	Vietnam	No	Yes
10	Peru	Yes	Yes
11	South Africa	Yes	No
12	United Kingdom	Yes	No
13	Mexico	No	Yes
14	Spain	Yes	Yes
15	Netherlands	Yes	Yes
16	Germany	Yes	Yes
17	Türkiye	Yes	Yes
18	Spain	Yes	Yes
19	Pakistan	Yes	Yes
20	Italy	No	Yes
21	Portugal	Yes	Yes
22	New Zealand	Yes	Yes
23	France	Yes	No
24	Brazil	No	Yes

5. HOMOGENEITY

Several batches were prepared by South Quality personnel in an identical way.

Then, a homogeneity study was carried out 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 the samples were selected using random-number-generation software.

The results of this test appear below:

Size of each batch: **162 units**

Tested samples from each batch: **18 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	LM3307 (A-F)	LM3308 (A-F)	LM3309 (A-F)
Yield Strength 0.2 Offset	NO	YES	YES
Tensile Strength	NO	YES	YES
Elongation at fracture	NO	YES	YES
Reduction of area	YES	YES	YES

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	LM3538 (A-F)	LM3539 (A-F)	LM3540 (A-F)
Yield Strength 0.2 Offset	YES	YES	YES
Tensile Strength	YES	YES	YES
Elongation at fracture	YES	YES	YES
Reduction of area	YES	YES	YES

Samples for this program are taken from selected batches identified as **LM3308** and **LM3538**.

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 (Participant **Code 20**):

Batch:	LM3308
Sample ID:	A25 / B25 / C25 / D25 / E25 / F25
Characteristics:	Low carbon steel (SAE 1010) - Ø10.9 x 200mm

Batch:	LM3538
Sample ID:	A25 / B25 / C25 / D25 / E25 / F25
Characteristics:	Low carbon steel (SAE 1010) - Ø12.6 x 200mm

7. IMAGES



8. ASSIGNED VALUES

The assigned values are obtained from the results reported by all participants (**Consensus values**).

9. PARTICIPANTS' RESULTS

LABORATORY CODE	BATCH: LM3308 (AVG)			
	Yield strength 0.2 offset (MPa)	Tensile strength (MPa)	Elongation at fracture (%)	Reduction of area (%)
01	570	593	14.8	60.8
02	570	597	12.4	55.0
03	580	587	11.2	61.9
04	552	594	12.5	57.7
06	557	596	13.5	56.9
07	540	597	13.6	55.7
08	556	592	15.1	65.7
09	553	604	11.3	58.2
10	561	598	15.5	69.7
13	567	583	14.3	63.3
14	572	591	16.0	59.9
15	561	588	13.6	58.8
16	567	593	13.7	62.5
17	571	602	12.8	66.2
18	553	599	13.8	68.1
19	551	606	12.5	60.5
20	567	597	14.1	62.0
21	556	589	11.4	61.4
22	561	596	14.8	68.5
24	567	615	15.9	56.8

SUMMARY STATISTICS - BATCH: LM3308

STATISTICS	Yield strength 0.2 offset	Tensile strength	Elongation at fracture	Reduction of area
Number of results	20	20	20	20
Median	561	596	14.0	61.0
IQR	12.5	6.5	2.3	5.83
Normalized IQR	9.27	4.82	1.70	4.32
Uncertainty (Median)	2.6	1.4	0.5	1.2
Robust CV	1.7 %	0.8 %	12.5 %	7.1 %

LABORATORY CODE	BATCH: LM3538 (AVG)			
	Yield strength 0.2 offset (MPa)	Tensile strength (MPa)	Elongation at fracture (%)	Reduction of area (%)
01	766	909	10.7	42.1
02	764	892	12.7	40.8
03	766	887	10.6	41.9
04	741	874	12.4	47.1
06	756	910	12.8	37.8
07	759	904	11.3	37.9
08	745	889	11.8	41.2
09	757	900	13.4	45.0
10	769	892	11.8	35.8
13	754	940	12.7	36.2
14	748	895	12.4	44.2
15	746	905	11.4	36.8
16	740	883	13.1	42.0
17	740	892	12.0	38.7
18	745	873	12.2	43.1
19	748	870	12.6	44.6
20	754	902	12.8	41.4
21	765	897	11.6	35.5
22	750	885	11.1	37.1
24	745	891	12.7	38.4

SUMMARY STATISTICS - BATCH: LM3538

STATISTICS	Yield strength 0.2 offset	Tensile strength	Elongation at fracture	Reduction of area
Number of results	20	20	20	20
Median	752	892	12	41
IQR	15.25	16	1.15	4.73
Normalized IQR	11.30	11.86	0.85	3.50
Uncertainty (Median)	3.2	3.3	0.2	1
Robust CV	1.5 %	1.3 %	6.9 %	8.5 %

10. STATISTICS

The results must be treated as quantitative.

According to B.4.1.3 of ISO 17043 the appropriate technique is to compare participant results with the assigned values. The results can be compared using **z score**.

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

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:

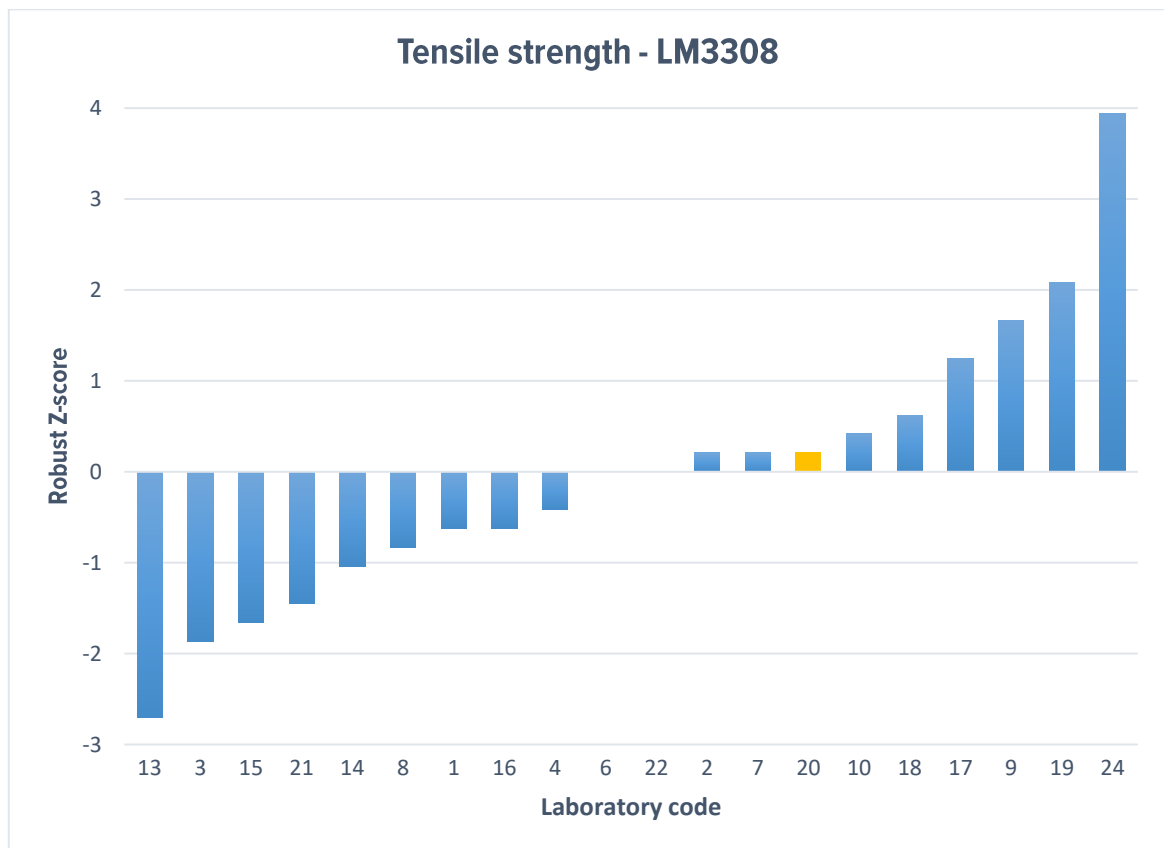
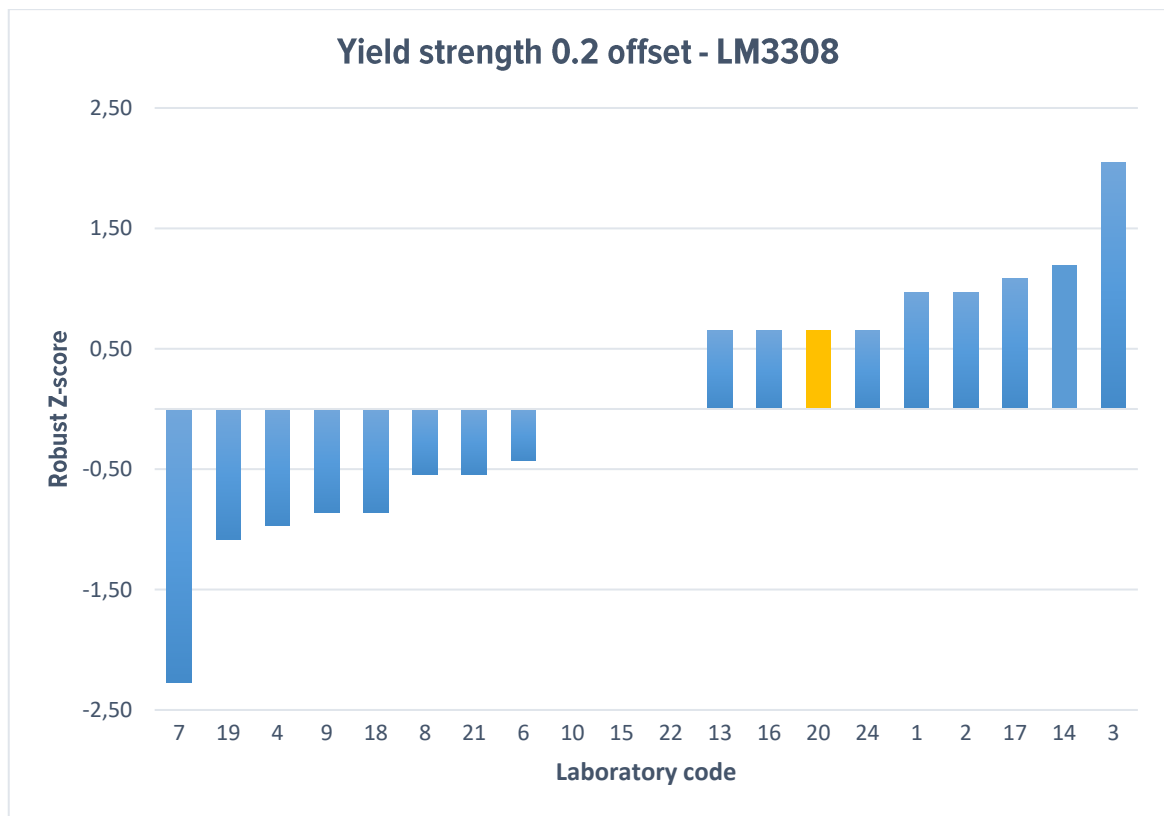
$|z| \leq 2.0$ indicates “satisfactory” performance and generates no signal;

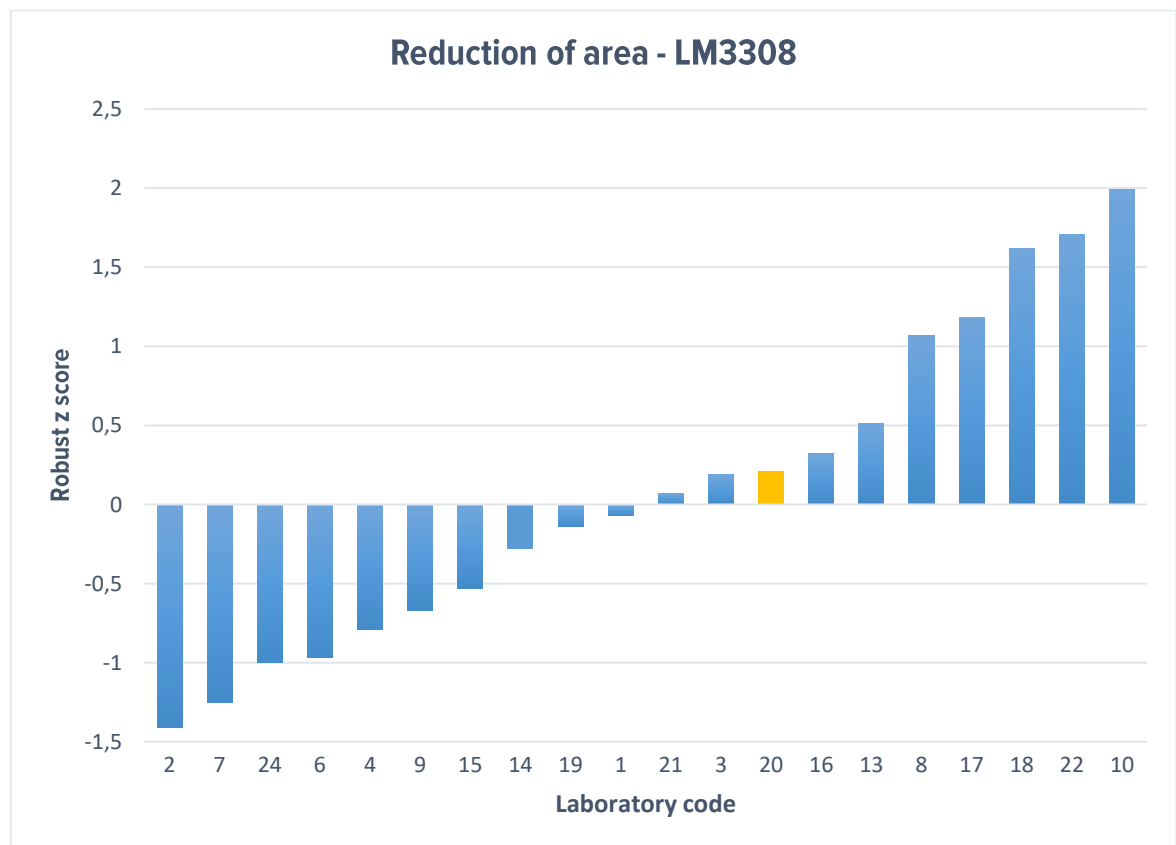
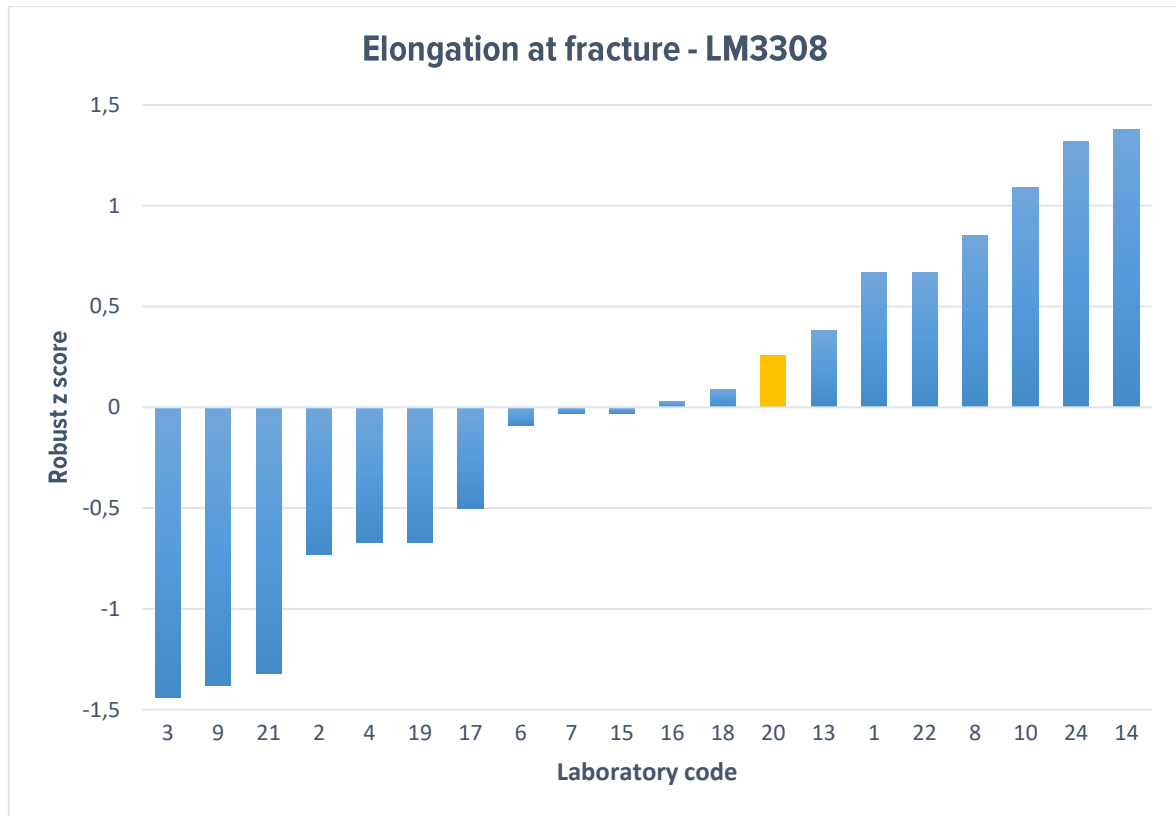
$2.0 < |z| < 3.0$ indicates “questionable” performance and generates a warning signal;

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

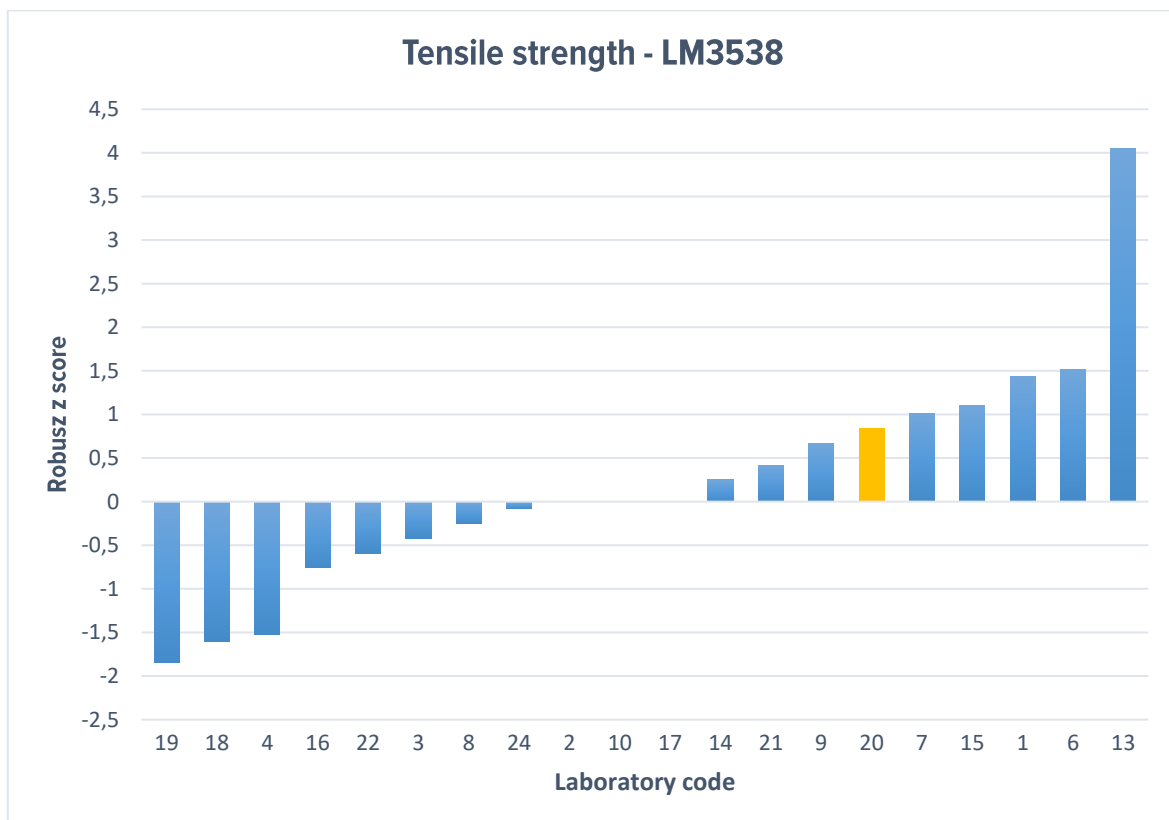
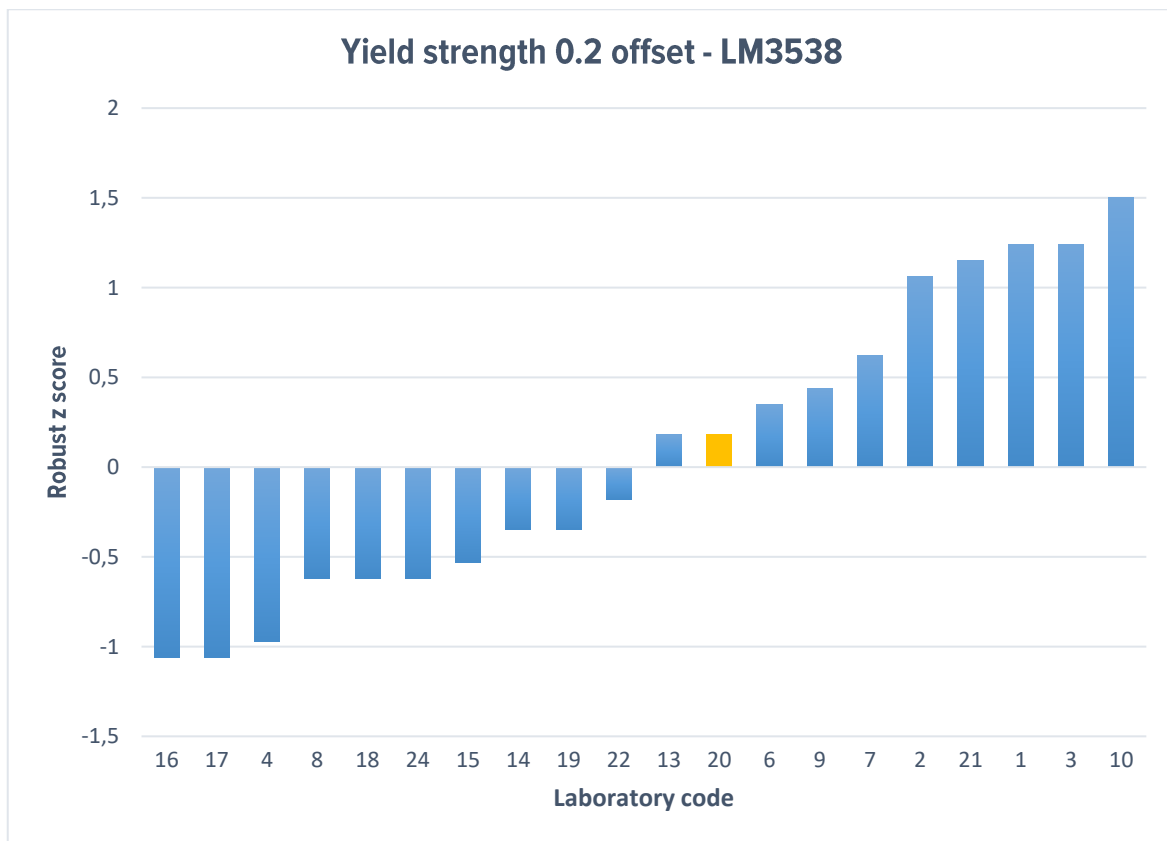
11. EVALUATION OF PERFORMANCE

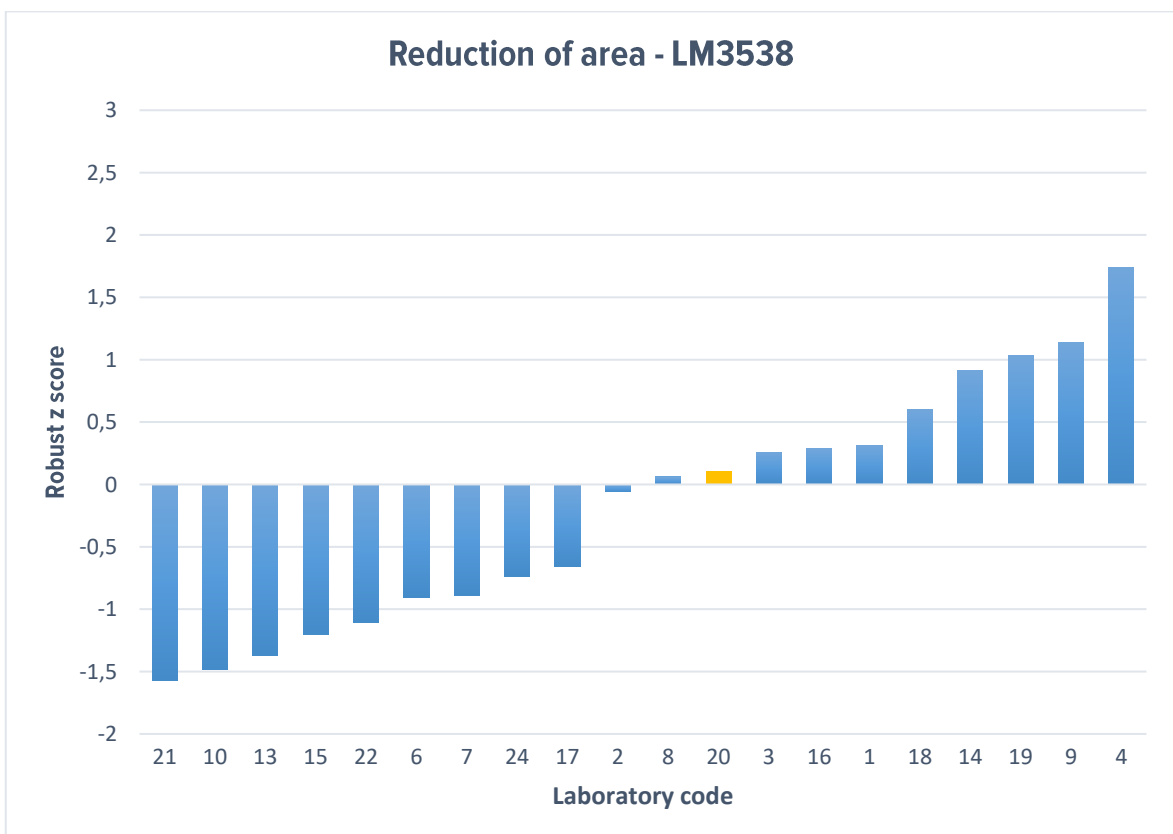
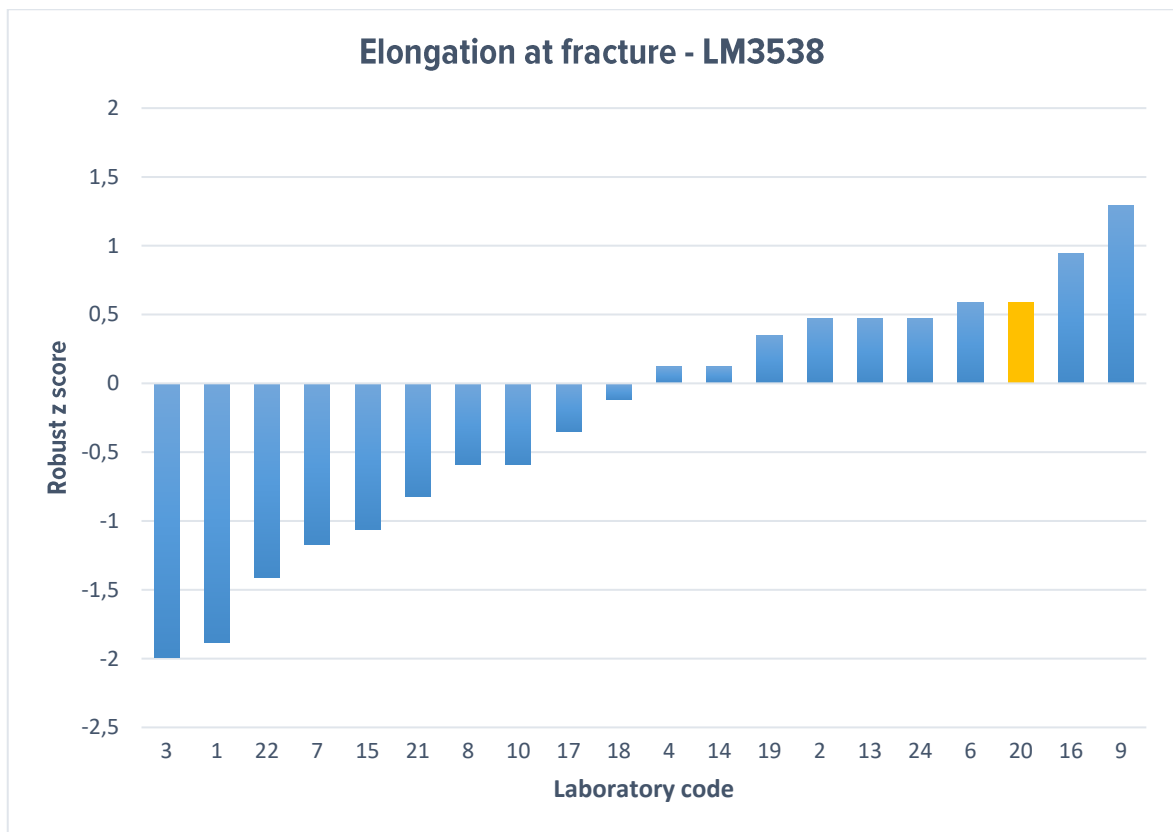
LABORATORY CODE	BATCH: LM3308 - $\bar{z}$ score			
	Yield strength 0.2 offset (MPa)	Tensile strength (MPa)	Elongation at fracture (%)	Reduction of area (%)
01	0.97	-0.62	0.67	-0.07
02	0.97	0.21	-0.73	-1.41
03	2.05	-1.87	-1.44	0.19
04	-0.97	-0.42	-0.67	-0.79
06	-0.43	0	-0.09	-0.97
07	-2.27	0.21	-0.03	-1.25
08	-0.54	-0.83	0.85	1.07
09	-0.86	1.66	-1.38	-0.67
10	0	0.42	1.09	1.99
13	0.65	-2.70	0.38	0.51
14	1.19	-1.04	1.38	-0.28
15	0	-1.66	-0.03	-0.53
16	0.65	-0.62	0.03	0.32
17	1.08	1.25	-0.5	1.18
18	-0.86	0.62	0.09	1.62
19	-1.08	2.08	-0.67	-0.14
20	0.65	0.21	0.26	0.21
21	-0.54	-1.45	-1.32	0.07
22	0	0	0.67	1.71
24	0.65	3.94	1.32	-1.00





LABORATORY CODE	BATCH: LM3538 - z score			
	Yield strength 0.2 offset (MPa)	Tensile strength (MPa)	Elongation at fracture (%)	Reduction of area (%)
01	1.24	1.43	-1.88	0.31
02	1.06	0	0.47	-0.06
03	1.24	-0.42	-1.99	0.26
04	-0.97	-1.52	0.12	1.74
06	0.35	1.52	0.59	-0.91
07	0.62	1.01	-1.17	-0.89
08	-0.62	-0.25	-0.59	0.06
09	0.44	0.67	1.29	1.14
10	1.50	0.00	-0.59	-1.48
13	0.18	4.05	0.47	-1.37
14	-0.35	0.25	0.12	0.91
15	-0.53	1.10	-1.06	-1.20
16	-1.06	-0.76	0.94	0.29
17	-1.06	0	-0.35	-0.66
18	-0.62	-1.60	-0.12	0.60
19	-0.35	-1.85	0.35	1.03
20	0.18	0.84	0.59	0.11
21	1.15	0.42	-0.82	-1.57
22	-0.18	-0.59	-1.41	-1.11
24	-0.62	-0.08	0.47	-0.74





Laboratory Code 01: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 02: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 03: The laboratory obtained a **QUESTIONABLE** result for the determination of yield strength in the **LM3308** batch. Furthermore, **SATISFACTORY** results were obtained for the remaining parameters.

Laboratory Code 04: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 05: The laboratory has not sent the results before the deadline.

Laboratory Code 06: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 07: The laboratory obtained a **QUESTIONABLE** result for the determination of yield strength in the **LM3308** batch. Furthermore, **SATISFACTORY** results were obtained for the remaining parameters.

Laboratory Code 08: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 09: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 10: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 11: The laboratory has not sent the results before the deadline.

Laboratory Code 12: The laboratory has not sent the results before the deadline.

Laboratory Code 13: The laboratory obtained an **UNSATISFACTORY** result for the determination of tensile strength in the **LM3538** batch and a **QUESTIONABLE** result for the same parameter in the **LM3308** batch. Furthermore, **SATISFACTORY** results were obtained for the remaining parameters.

Laboratory Code 14: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 15: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 16: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 17: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 18: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 19: The laboratory obtained a **QUESTIONABLE** result for the determination of tensile strength in the **LM3308** batch. Furthermore, **SATISFACTORY** results were obtained for the remaining parameters.

Laboratory Code 20: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 21: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 22: The laboratory has obtained **SATISFACTORY** results for all parameters.

Laboratory Code 23: The laboratory has not sent the results before the deadline.

Laboratory Code 24: The laboratory obtained an **UNSATISFACTORY** result for the determination of tensile strength in the **LM3308** batch. Furthermore, **SATISFACTORY** results were obtained for the remaining parameters.

GLOBAL PERFORMANCE - SUM OF ABSOLUTE Z SCORE

POSITION	LABORATORY CODE	z SCORE
1 st	20	3.05
2 nd	16	4.67
3 rd	08	4.81
4 th	06	4.86
5 th	02	4.91
6 th	14	5.52
7 th	22	5.67
8 th	17	6.08
9 th	15	6.11
10 th	18	6.13
11 th	10	7.07
12 th	01	7.19
13 th	04	7.20
14 th	21	7.34
15 th	07	7.45
16 th	19	7.55
17 th	09	8.11
18 th	24	8.82
19 th	03	9.46
20 th	13	10.31

12. CONCLUSIONS

The overall performance on this **SQO-M13 (Round 24)** program from the participating laboratories, based on expected results, is the following:

- Laboratory Codes **01, 02, 04, 06, 08, 09, 10, 14, 15, 16, 17, 18, 20, 21** and **22** have obtained a **SUFFICIENT** performance according to the expected results and should not take action;
- Laboratory Codes **03, 07,** and **19** have obtained an **ALMOST SUFFICIENT** performance according to the expected results and must evaluate if it is necessary to take corrective action.
- Laboratory Codes **13,** and **24** have obtained an **INSUFFICIENT** performance according to the expected results and must take corrective action (See Appendix B).

The criteria used for the evaluation of the overall performance are the following:

- **SUFFICIENT** performance: No unsatisfactory/questionable results 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

A1 - PARTICIPANT DATA

Company: **AFV BELTRAME**

Laboratory: **AFV Beltrame Lab**

Country: Italy

Client ID: E511

Contact person: Ing. Riccardo Rossato - Quality Assurance Coordinator
(r.rossato@beltrame-group.com)

A2 - PARTICIPANT RESULTS



**INSTRUCTIONS
&
RESULTS FORM**

PROGRAM:	Tension testing of metallic materials
CODE:	SQO-M13
ROUND:	24
STANDARD:	ISO 6892-1
COORDINATOR:	Eng. Alfredo Schmidt (aschmidt@ptsouthquality.com)

DSQ-012 - REV 05 - SQO-M13 R24 March 2026 1 of 5

1 - General

This document is intended to be filled with the results of the **SQO-M13** program, round 24.

Results must be typed, not handwritten.

2 - Standard

ISO 6892-1: 2019

3 - Participant

AFV BELTRAME AFV Beltrame Lab	CODE 20
Michele Andreani	"M.A."
Riccardo Rossato	"R.R."
Sergio Piasentin	"S.P."

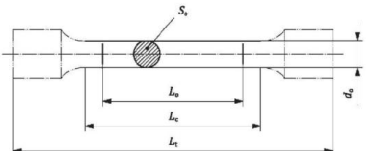
4 - Tests involved

TEST	SUBTEST
Tension testing of metallic material	- Yield Strength 0.2 Offset - Tensile Strength - Elongation at fracture - Reduction of area

5 - Samples

CODE	SAMPLE	QUANTITY
LM3308-A25 LM3308-B25 LM3308-C25 LM3308-D25 LM3308-E25 LM3308-F25	Steel sample - Ø10.9 x 200mm	6
LM3538-A25 LM3538-B25 LM3538-C25 LM3538-D25 LM3538-E25 LM3538-F25	Steel sample - Ø12.6 x 200mm	6

6 - Samples preparation

SAMPLE	DIMENSIONS
 According FIG. 13	$d_0 = 10 \pm 0.03\text{mm}$ $L_0 = 50\text{mm}$ $L_c = 55\text{mm}$

7 - Notes

- The deadline for the delivery of results is **May 9, 2026**.
- The tables in this document may be modified by the participant, if desired, to include data or observations.
- The samples must be kept until the end of the program, which concludes with the submission of the final report.
- The samples should be treated as a routine laboratory sample. All testing, recording and reporting must be performed in accordance with **ISO 6892-1**.
- To review the results, the submission of images of the tests is appreciated. These images can be attached at the end of this document or sent via email.
- Upon completion of this document, please convert it to a PDF file and send it to the program coordinator.

8 - Test results

Method:	According to standard
Testing rate:	Method B

Test date:	7/05/2026	Temperature:	23.5 °C
Equipment:	Test Control ZwickRoell	Date calibration:	23/09/2025
Resolution:	-	Resolution uncertainty:	Classe 0.5
Gripped ends - Type:	No screw type	Speed:	0.0067 1/s

SAMPLE	Operator	Yield strength 0.2 Offset (MPa)	Tensile strength (MPa)	Elongation at fracture (%)	Reduction of area (%)
LM3308-A25	M.A.	577	603	11.0	62.2
LM3308-B25	M.A.	570	598	16.4	64.4
LM3308-C25	R.R.	567	597	11.8	62.2
LM3308-D25	R.R.	564	593	14.0	61.1
LM3308-E25	S.P.	559	592	15.4	65.4
LM3308-F25	S.P.	565	603	16.2	57.2
AVG		567	597	14.13	62.0
U (±)		7	5	1.4	1.8

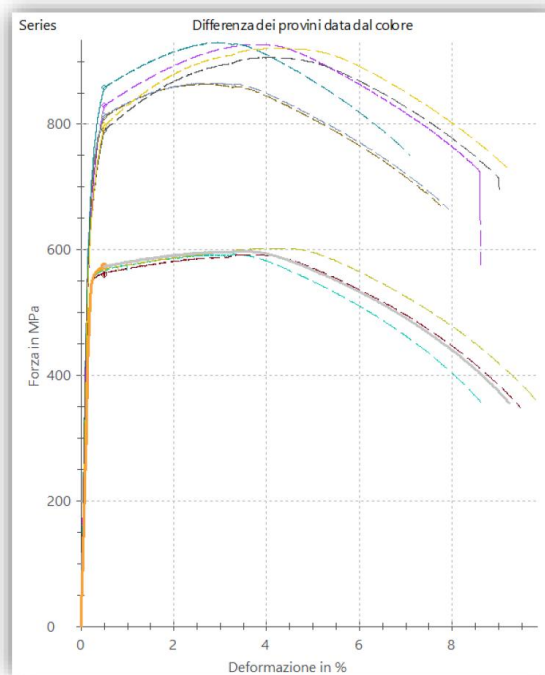
Test date:	7/05/2026	Temperature:	23.5 °C
Equipment:	Test Control ZwickRoell	Date calibration:	23/09/2025
Resolution:	-	Resolution uncertainty:	Classe 0.5
Gripped ends - Type:	No screw type	Speed:	0.0067 1/s

SAMPLE	Operator	Yield strength 0.2 Offset (MPa)	Tensile strength (MPa)	Elongation at fracture (%)	Reduction of area (%)
LM3538-A25	M.A.	801	927	11.7	44.3
LM3538-B25	M.A.	707	864	13.5	41.8
LM3538-C25	R.R.	714	866	12.7	41.8
LM3538-D25	R.R.	809	930	12.8	39.0
LM3538-E25	S.P.	742	906	13.8	41.0
LM3538-F25	S.P.	757	921	12.7	40.5
AVG		754	902	12.8	41.4
U (±)		7	5	1.4	1.8

OBSERVATIONS

The yield strength is not reliable, because of is an material characteristic (ReH).
 Only Yield strength 0.2 Offset is reported.

PHOTOGRAPHS



APPENDIX B

VOID

----- END OF REPORT -----