

REPORT No 11986

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Status: FINAL REPORT

ISO 12106

METALLIC MATERIALS - FATIGUE TESTING

AXIAL-STRAIN-CONTROLLED METHOD

Program: SQ-0129.V2

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Prepared by:	Reviewed by:	Approved by:
Sergio Andrada Assistant Technician	Eng. Alfredo Schmidt Metallurgical expert	Eng. Emiliano Medina Quality Assurance Lead

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1. FOREWORD

This report summarizes the results of the **SQ-0129.V2** proficiency testing program on the evaluation of laboratory performance in strain-controlled low cycle fatigue testing of metallic materials. This program is conducted in a bilateral format, following the “split-sample” design described in clause A.4.2 of ISO/IEC 17043: 2023 (Alternative interlaboratory comparisons).

South Quality conducted the testing program in July 2026 with the aim of assessing the laboratory's ability to competently perform the designated 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 evaluate laboratory performance in strain-controlled low cycle fatigue testing of metallic materials in accordance with the following standard:

Standard
ISO 12106: 2017

To verify this, batches of steel samples have been selected.

Participants in this program have not been previously informed about the expected values or value ranges of the samples they receive.

4. PARTICIPANT

Company: **Materials Center Leoben Forschung GmbH**
 Laboratory: **Department Materials & Services**
 Country: Austria
 Client ID: E554
 Contact person: Joachim Haberl
 Senior Engineer Accreditation
joachim.haberl@mcl.at

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: **50 units**

Tested samples from each batch: **20 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES (25±3°C, TRIANGULAR WAVE, 0.5 Hz, RE=-1, $\Delta \epsilon T/2=0.8\%$)		
	BATCH: LM2793	BATCH: LM2794	BATCH: LM2795
Number of cycles to failure	YES	NO	YES
Stabilized stress amplitude at half-life	YES	NO	YES

Samples for this program are taken from the selected batch identified as **LM2793**.

For the indicated batch, 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.

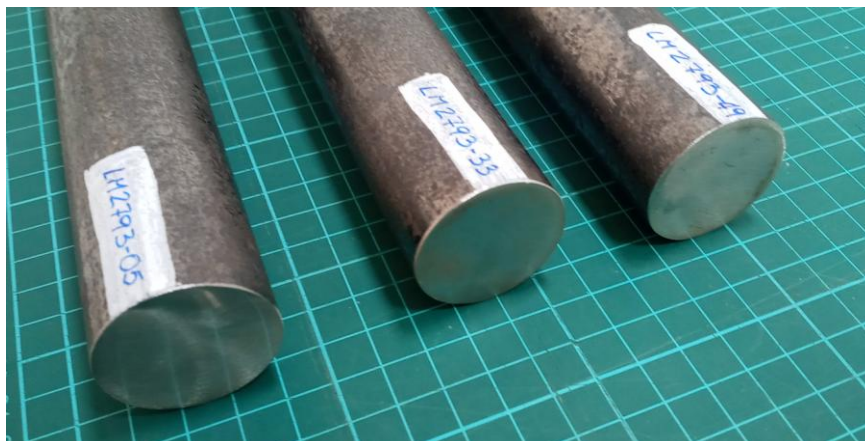
6. SAMPLE INFORMATION

The following samples were sent for testing:

Batch:	LM2793
Sample ID:	05 + 33 + 49
Characteristics:	Medium carbon steel (SAE 4140) - Ø34.9 x 200 mm

7. IMAGES

SAMPLES



8. ASSIGNED VALUES

BATCH	NUMBER OF CYCLES TO FAILURE		STABILIZED STRESS AMPLITUDE AT HALF-LIFE	
	AVG	SD	AVG (MPa)	SD
LM2793	1165	26.8	610	2.4

9. PARTICIPANT RESULTS (SEE APPENDIX B)

BATCH	NUMBER OF CYCLES TO FAILURE (AVG)	STABILIZED STRESS AMPLITUDE AT HALF-LIFE - AVG (MPa)
LM2793	1214	614

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

BATCH	CONDITIONS	AVERAGE		z score	PERFORMANCE RESULT
		PARTICIPANT RESULT	ASSIGNED VALUE		
LM2793	NUMBER OF CYCLES TO FAILURE	1214	1165	1.83	SATISFACTORY
	STABILIZED STRESS AMPLITUDE AT HALF-LIFE (MPa)	614	610	1.67	SATISFACTORY

12. CONCLUSIONS

The overall performance of this **SQ-0129.V2** program from the participant laboratory **Materials Center Leoben Forschung GmbH - Department Materials & Services**, 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:	Metallic materials - Fatigue testing Axial-strain-controlled method
CODE:	SQ-0129
VERSION:	2
STANDARD:	ISO 12106
COORDINATOR:	Eng. Alfredo Schmidt (aschmidt@ptsouthquality.com)

1 - General

This document serves as a guide for managing the results of the **SQ-0129.V2** program.

2 - Standard

ISO 12106: 2017

3 - Tests involved

TEST	PARAMETERS TO DETERMINE
Evaluation of laboratory performance in strain-controlled low cycle fatigue testing of metallic materials	- Number of cycles to failure - Stabilized stress amplitude at half-life

4 - Samples

CODE	SAMPLE	QUANTITY
LM2793-XX	Medium carbon steel - Ø34.9 x 200 mm	3

5 - Notes

- Being a bilateral program, there is no deadline for submitting results.
- The participant must submit the results using the usual report employed by their laboratory.
- The samples are to be handled as routine lab samples, with all testing, documentation, and reporting adhering to **ISO 12106**.
- Samples must be retained until the end of the program, which concludes with the submission of the final report.
- To review the results, test images would be appreciated. Images can be attached at the end of this document or sent by email.

6 - Test conditions

CODE	TEST CONDITIONS
LM2793-XX	25°C ± 3°C Waveform: Triangular Frequency/Strain rate: 0.5 Hz Strain ratio (R_e): -1 Total strain amplitude ($\Delta\epsilon/2$): 0.8% Dimensions: According to Fig. 3 Gauge diameter: 6 or 8 mm

PHOTOGRAPHS

DSQ-012 - REV 06 -

SQ-0129.V2

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APPENDIX B

PARTICIPANT RESULTS (TR #190/26-EB-AFS16179)

Materials Center Leoben Forschung GmbH

Roseggerstraße 12, A-8700 Leoben, Tel: +43 3842 45922, Email: mclburo@mcl.at



Report No.: 190/26-EB-AFS16179

Investigation report

Strain controlled fatigue tests according to ISO 12106 for participation in the proficiency testing program SQ-0129 of South Quality Proficiency Testing Provider

Client: South Quality Proficiency Testing Provider

Report to: Eng. Alfredo Schmidt

Tel.: -

Email: aschmidt@ptsouthquality.com

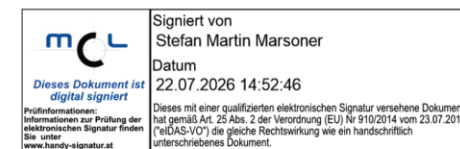
Quotation-No.: --

Order-No.: PBK23141 (internal)

Author: Dr. J. Haberl

Checked by: Dr. S. Marsoner

Date: 2026-07-10



Approval: Dr. Stefan Marsoner
(Head of Department Services)

This report comprises 8 pages / 2 tables / 4 images / 0 annexes

Scope of investigation



Introduction

Materials Center Leoben Forschung GmbH (MCL) participated in following Proficiency Testing Program of South Quality Proficiency Testing Provider:

- Metallic materials - Fatigue testing - Axial-strain-controlled method according ISO 12106; SQ-0129

Three samples, made of medium carbon steel ($\varnothing 34.9 \times 200$ mm) were delivered to MCL by mail on May 12th 2026.

The results in this report refer only to the tested specimens.

Performed investigations

- Machining of 3 testing samples from delivered materials with gauge diameter of 8 mm.
- Fatigue tests at room temperature ($25^{\circ}\text{C} \pm 3^{\circ}\text{C}$) acc. to ISO 12106 with strain ratio (R_{ϵ}) of -1, triangular waveform, frequency of 0,5 Hz and strain amplitudes ($\Delta\epsilon/2$) of 0.8%.
- The aim of the test is to determine the number of cycles to failure [-] and the stabilized stress amplitude at half-life [MPa] of each of the three specimens.

Documentation of samples after machining and geometry according ISO 12106

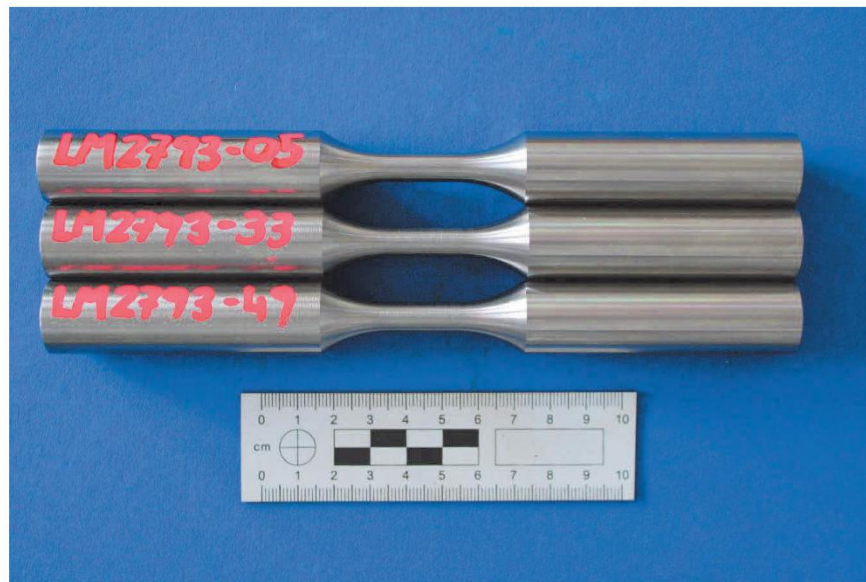


Figure 1: Documentation of the 3 samples after machining

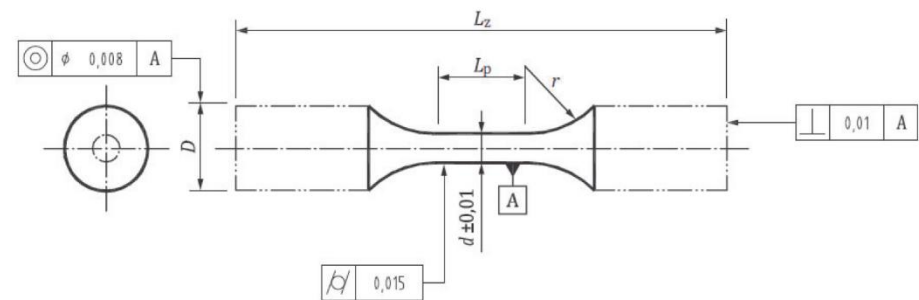


Figure 2: Geometrical dimensions according ISO 12106, Figure 3

Drawing of the MCL geometry according ISO 12106

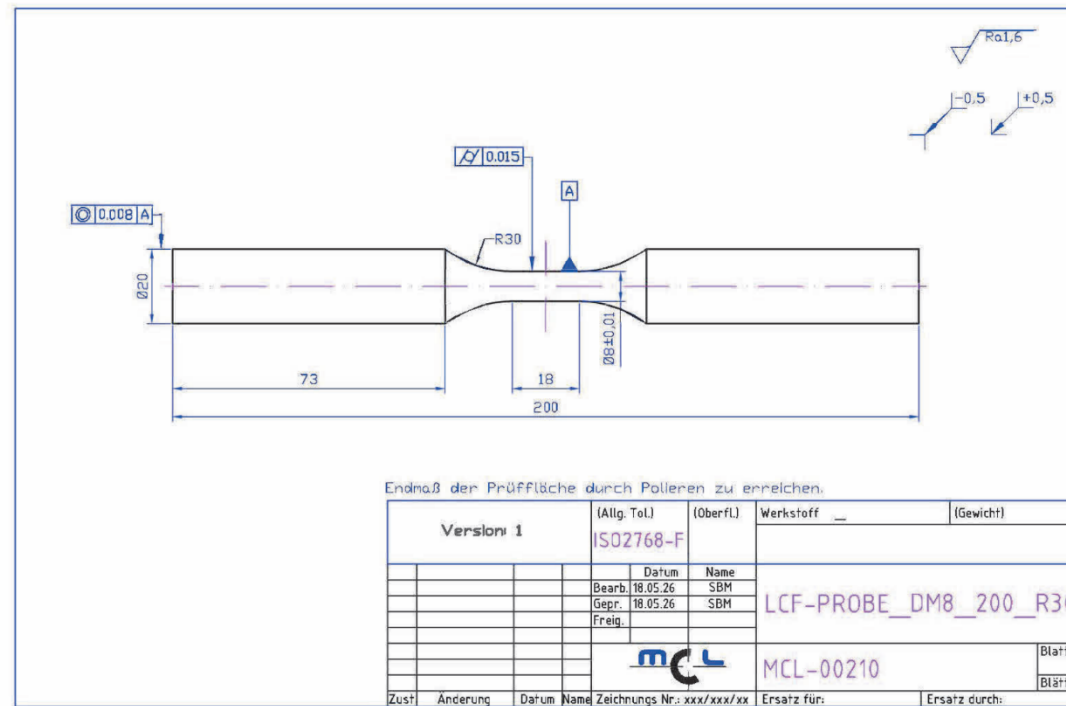


Figure 3: Drawing of the specimens machined at MCL

Strain controlled fatigue tests according ISO 12106

Testing parameters



Testing equipment	<u>Type of machine:</u> Servo Hydraulic, digital controlled: Instron 8854 / 8854MTL7102		<u>Load cell:</u> 250kN/2000Nm / Nr A2211K-1003/124339. (Fa. Instron)	<u>Extensometer:</u> Fiedler Laser extensometer P50, PS-E50-0266-AP, gauge length: 12-40 mm, operating range: ± 10 mm, Last calibration: 21.06.2026	
Test	<u>Date:</u>	09.06. – 10.06.2026		<u>Name of tester:</u>	Stefan Baumgartner-Steinleitner
Specimens	<u>Type:</u>	Cylindrical acc. ISO 12106, Fig. 3		<u>Dimensions:</u>	d ₀ = 8 mm, D = 20 mm, L _p = 18 mm, R = 30 mm
Material	<u>Material:</u>	Medium carbon steel		<u>Position of samples</u>	Cylindrical from cyl. bar
Testing parameters	<u>Strain amplitude ($\Delta\epsilon/2$):</u>		0,8 %		
	<u>Strain ratio (R_ϵ) :</u>		-1		
	<u>Stop criteria:</u>		Fracture		
	<u>Testing temperature:</u>		Room temperature		
	<u>Waveform:</u>		Triangular		
	<u>Frequency:</u>		0,5 Hz		
Temperature	<u>Room temperature:</u>		22,8°C		
Remarks	-				

Strain controlled fatigue tests according ISO 12106

Testing Machine

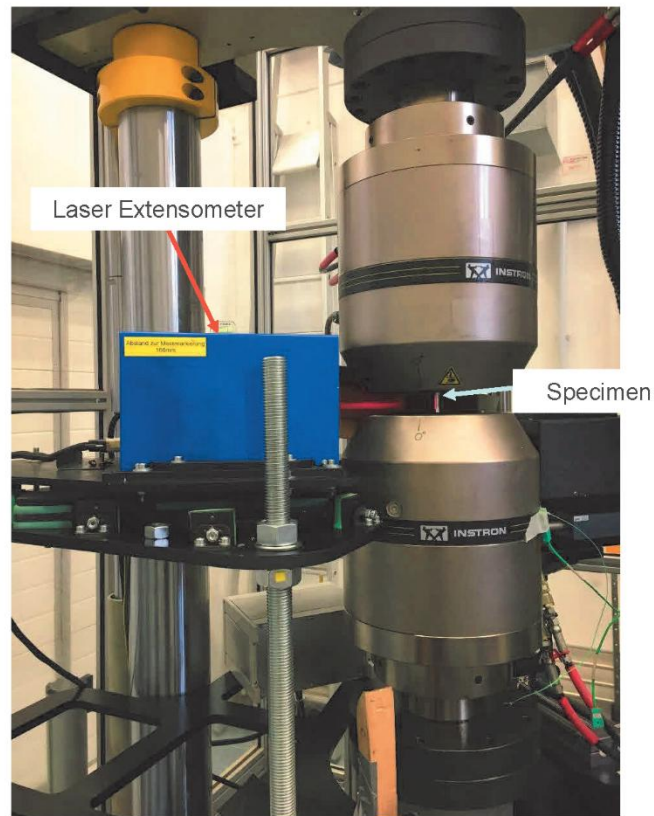


Figure 3: Overview of the testing machine and its hydraulic clamping jaws

Strain controlled fatigue tests according ISO 12106

Results



Table 1 is showing an overview of the testing parameters and results. Following results were determined:

1. Number of cycles to failure [-]:

LM2793-05: 1179

LM2793-33: 1345

LM2793-49: 1117

2. Stabilized stress amplitude at half-life [MPa]:

LM2793-05: 612

LM2793-33: 612

LM2793-49: 618

Testing Parameters and Results														
Material [-]	Specimen Id. [-]	Ambient Temp. [°C]	Humidity [%]	d ₀₁	d ₀₂	d _m [mm]	A [mm²]	e _a [%]	Strain Ratio R [-]	Frequency [Hz]	Stop Criteria [-]	S _a (N _f /2) [MPa]	N _f /2	N _f [-]
Medium carbon Steel	LM2793-05	22,8	58,1	8,00	8,00	8,00	50,30	0,80	-1,0	0,5	Till fracture	612	590	1179
	LM2793-33	22,8	57,5	8,01	8,01	8,01	50,35	0,80	-1,0	0,5	Till fracture	612	673	1345
	LM2793-49	22,7	59,1	8,01	8,00	8,00	50,32	0,80	-1,0	0,5	Till fracture	618	559	1117

Table 1: Overview of testing parameters and results



Sample retention periods:

Please take back the test objects. Residual materials will be kept for 6 months, test items and specimens for 3 years and metallographic specimens for 10 years. Return or longer storage only possible by arrangement.

Reports:

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End of report

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