

28. testXpo Internationale Fachmesse für Prüftechnik

Metal Tensile Test: Recent findings out of Round Robin tests – How important is the strain rate for Tensile Strength?

Ulm

Thursday, 17th October 2019

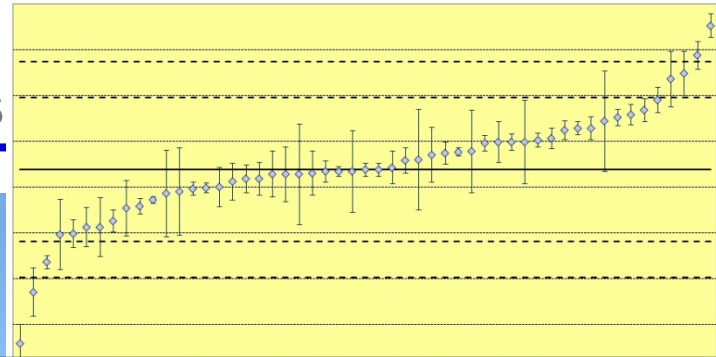
Dipl.-Ing. Christian Weißmüller

Christoph Sieg

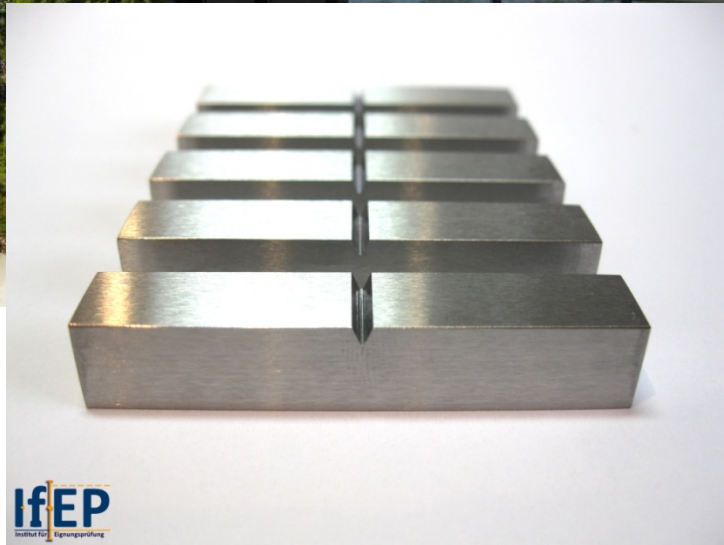


Since 2004

Eignungs



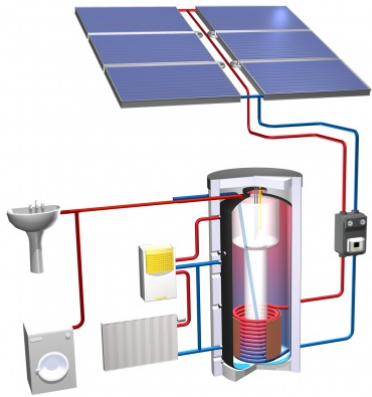
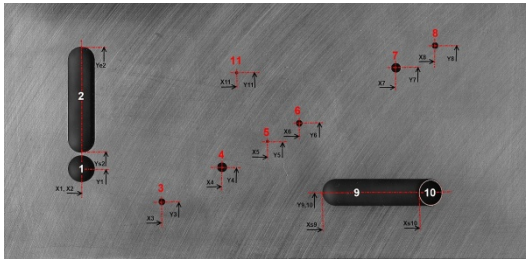
Since 2000; accredited 2005



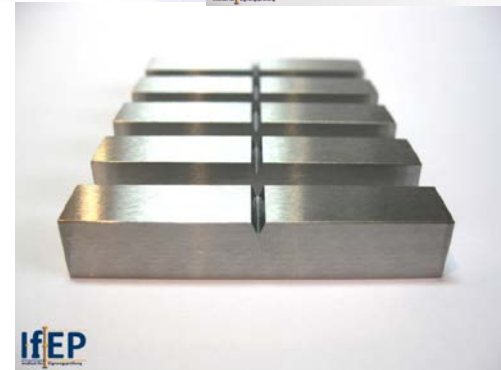
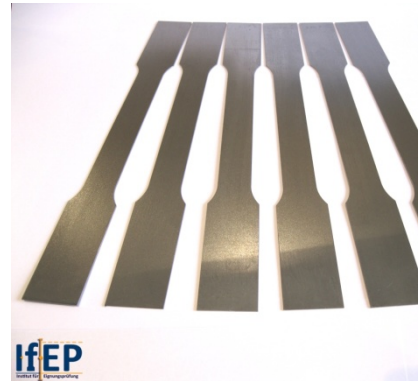
Since 2008; accredited 2009

IfEP – Program

Proficiency tests



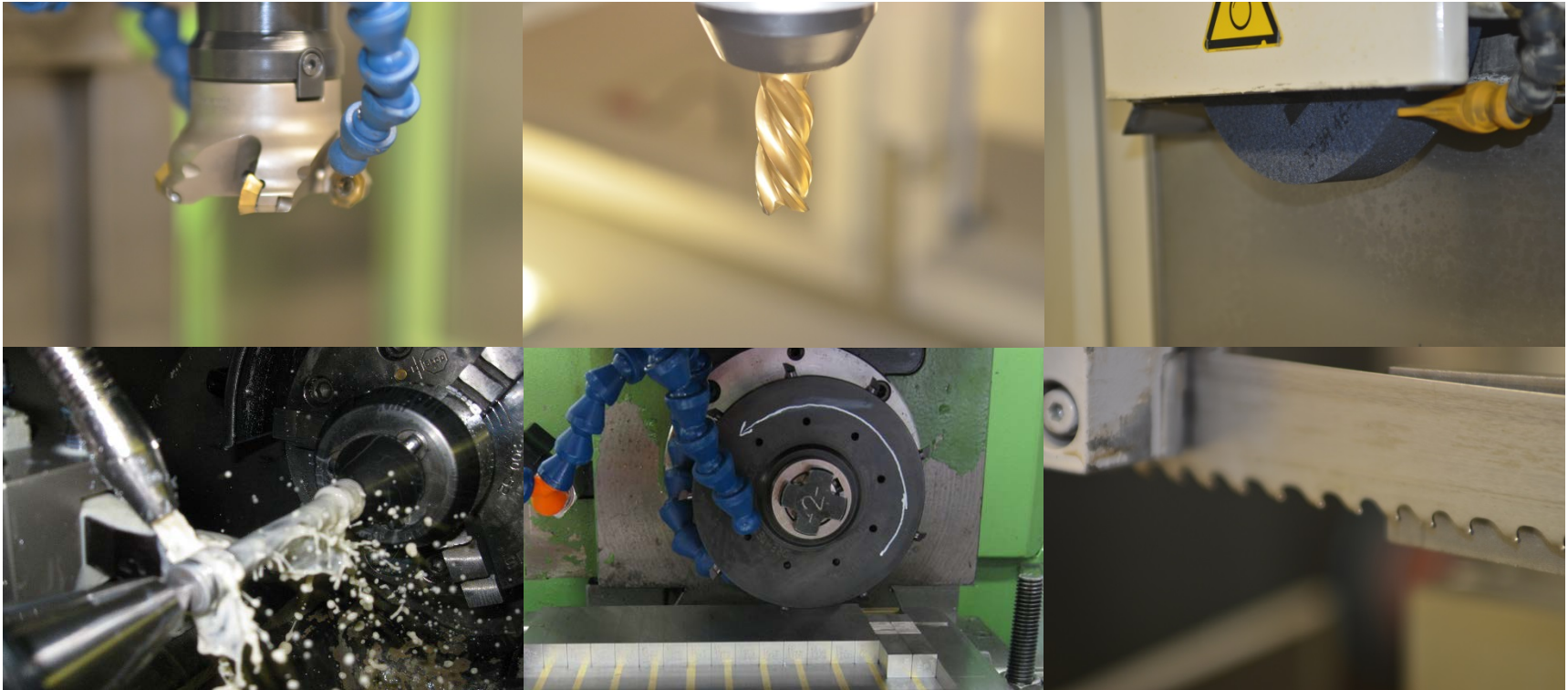
Reference material



+ 2.600 participations of 650
labs from 40 Ländern

app. 8.000 sets á 5/6 Proben

Specimen production



Precise machining of all requested specimen geometry

Basics to proficiency testing

ISO 17043: Proficiency testing

„... evaluation of participant performance against pre-established criteria by means of interlaboratory comparisons.“

Interlaboratory comparison

„... organization, performance and evaluation of measurements or tests on the same or similar items by two or more laboratories in accordance with predetermined conditions.“



Use of proficiency testing in accreditation



71 SD 0 010 | Revision: 1.2 | 14. April 2016



Scope:

This rule conduces to the implementation of international requirements and the summarization of the national requirements for the use of proficiency testing in the accreditation process of testing and calibration laboratories, medical laboratories (in the following described as laboratories) and also inspection bodies¹. It describes the requirements for participation in proficiency test at accredi-

Proficiency testing – general rules

Availability of proficiency tests

Proficiency tests are available, if they are offered by proficiency test providers and the required documents are provided in the **national language** of the participating body or in English.

Technical adequacy of proficiency tests

A proficiency test is regarded as technically adequate, if its scope similar to the daily practice in the participating body. In case of specific measurement techniques, for which no exact consistent proficiency test is available, it may be adequate to choose a proficiency test, which is similar to the scope or which covers an important partial aspect of the task.

Economical adequacy of proficiency tests

Proficiency test are regarded as economical adequate, if the entire costs of proficiency test have no considerable influence on the price of the test **or calibration**. In this instance the costs of the proficiency tests plus the costs which would be charged to a third party for this test of such a sample on the market, should be calculated. If for a test normally no prices are obtained (e.g. public CAB) so the internal efforts (staff and material costs) need to be considered.

PT 1810 UM

Tensile test flat specimens

Field of participants

Austria	3	Great Britain	1	Poland	1
Belgium	1	Greece	1	Portugal	1
Brazil	1	Hungary	1	Romania	1
Croatia	1	Italy	4	Serbia	1
Finland	1	Mexico	1	Spain	5
France	3	Netherlands	2	Sweden	3
Germany	28	P.R. China	2		

- 71 Labs
- 20 countries
- 44 accredited

Material

	$R_{p0,2}$	R_m	A
Total mean \bar{x}	288 MPa	663 MPa	52,6 %
Standard deviation between results s_s	0,5 %	0,5 %	0,9 %

- 1.4301 („V2A“)
- 19 specimens in final test
- Very sufficient, as standard deviation is clearly under 1 %

Assessment limits

$$nIQR = 0,7413 (Q3-Q1)$$

$$Z = \frac{MW_{LAB} - X}{\hat{\sigma}}$$

- $|Z| \leq 2$ satisfactory participation
- $|Z| \geq 3$ unsatisfactory participation
- $2 < |Z| < 3$ result questionable.

Limits depend on:

- Quality of material
- Variation of participants:
 - Anticipation: very narrow, as very good material

Summary:

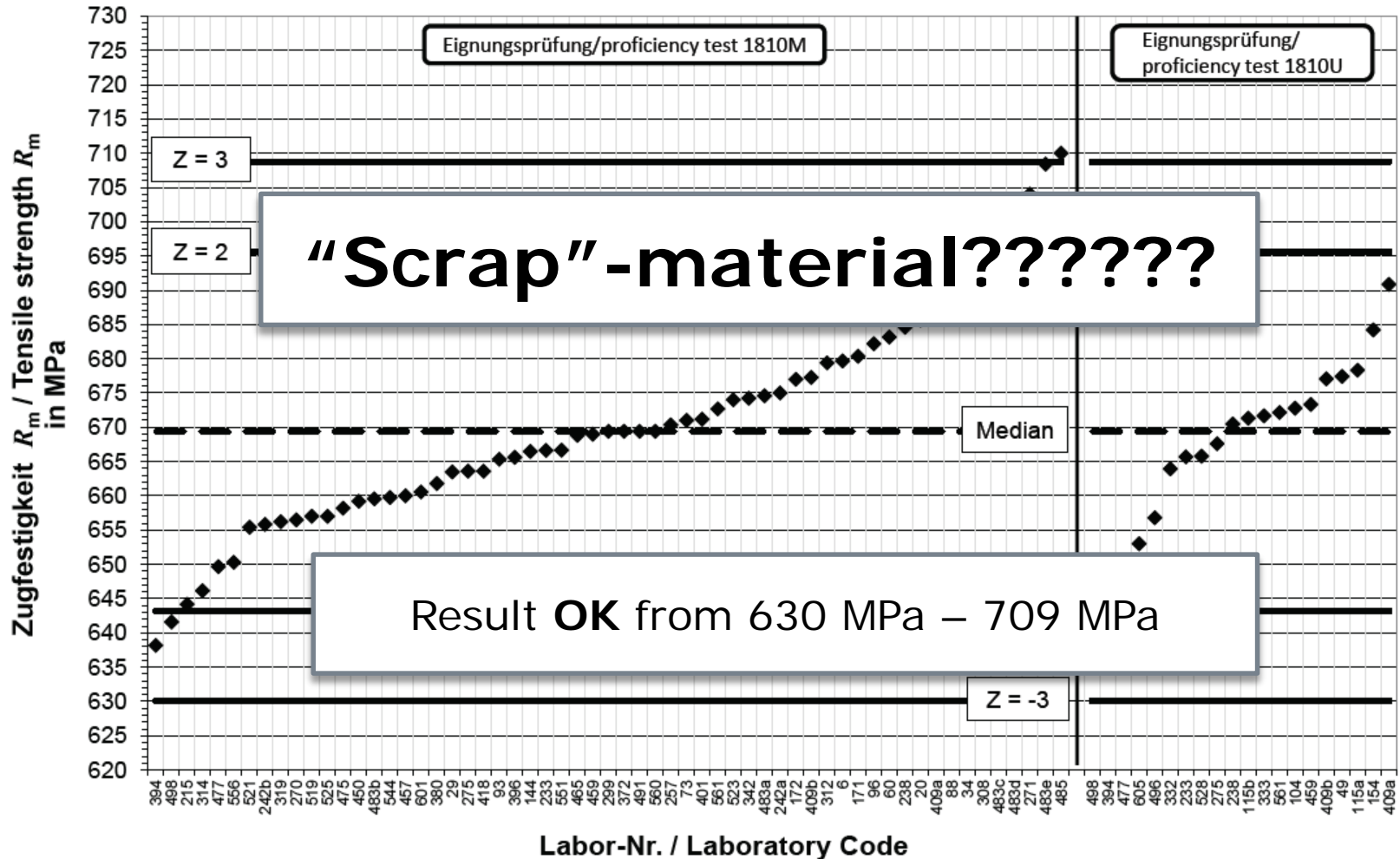
- S Rp: 2,6 %, N.OK.: +/- 8 %
- S Rm: 2,0 %, N.OK.: +/- 6 %
 - Limits Rm much higher than expected

Assessment limits

Specific values	$R_{p0,2}$ in MPa	R_m in MPa	A_{manually} in %	$A_{\text{extensometer}}$ in %
\bar{X}	296,6	669,4	53,1	53,3
$\hat{\sigma}$	8,0	13,1	1,6	2,2
$u_x, k = 1, p = 68 \%$	1,1	1,8	0,2	0,4
$Z = -3$	272,6	630,1	48,4	46,7
$Z = -2$	280,6	643,2	50,0	48,9
$Z = 2$	312,6	695,6	56,2	57,6
$Z = 3$	320,6	708,7	57,8	59,8

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Tensile strength



Analysis of results

Instructions for participants:

- **R_p:**
30 MPa/s, method B,
Explanation for the big variation of the outcome: resulting testing speed is commonly unknown in testing labs (became obvious in former publications and systematic comparisons between method A and B)
- **R_m:**
strain rate up to max. 0,006/s
Even at speed sensitive materials (DC 06) up to now no big influence, not in the focus at all
- Statement of the labs mostly (75 %) at "0,006/s", different statements,
no correlation.

Analysis of results, a few steps back

Homogeneity study:

- Clearly more the 19 specimens (summarized in the final report) were tested in the frame work of the homogeneity study. Every plate was tested at defined positions (prior production start)
- **Questions:**
 - All plates from one batch?
 - No effects of rolling, middle to the edges?
- If ok, a number of specimens is tested extracted from running production = homogeneity test, speed sensible material: statement of a value of testing speed (no area), usually 30 MPa/s
- **Very good material** (when tested under **reproducible** conditions)

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forward

R_m

-
-

/s und 0,008/s at 30 MPa/s

- R_m (0,002/s): 674 MPa
- R_m (0,008/s): 658 MPa
- 16 MPa range, in PT: 70 MPa range
- **Assumption:** testing speed after R_p is ABSOLUTELY unnoticed
- One part of the labs seem to test very slowly, and the other very fast, most probable outside max. permissible of the standard.
- Statements mainly at 0,006/s, no correlation

Summary

- The testing speed (although defined), leads to a high variation between the lab results in terms of R_p
- The speed control after R_p was not in the focus until now. With given materials one can notice a very high influence of the speed in terms of tensile strength.
- Future proficiency test (2020) will examine this influence in a more detailed way.



IfEP GmbH
Daimlerstraße 8
45770 Marl
Germany
Tel. +49 209 00 09
ifep@online.de



the international database for
certified reference materials

