Asia Pacific Laboratory Accreditation Cooperation

APLAC T052 Proficiency Testing Program
Tensile Test for Metallic Materials

INSTRUCTIONS TO PARTICIPATING LABORATORIES

To ensure that results from this program can be analyzed properly, participants are asked to adhere carefully to the following instructions.

1. SAMPLE

The participating laboratory will obtain two round bars of metallic materials. These are numbered A and B for preparing standard 12.5mm round tensile test specimens. The capacity of testing machine had better over 150 kN.

On receipt, unpack the artifacts and inspect them for any defects. Please contact with your accreditation body if there is damaged.

2. TESTS TO BE PERFORMED

Sample Information: The two samples are Φ20mm × 250mm blank. Laboratory must machine tensile round specimen from the center of each blank. The standard round specimen has a 50mm gage length and 12.5mm in diameter of reduced section. Please refer to the part of Standard Specimen in ASTM E8M-04 FIG. 8.

Testing Period: Test should be finished **within one week** after receiving the samples.

Test Method: The method of tensile test at ambient temperature is according to **ASTM E8M-04**. In testing procedure, the preparation of test pieces and the speed of the testing shall also conform to **ASTM E8M-04** requirements**.**

The following mechanical properties of results must be obtained for each specimen:

1. Diameter and Gauge Length before Testing
2. Yield Strength (0.2% offset)
3. Tensile Strength
4. Percentage Elongation (%, on Gauge Length＝4 times the Diameter)

For reducing the factors of variances and easy discussing the bias of the test, we suggest that complete the test in the same time interval, and the same operator and the testing apparatus are recommended.

Where possible, uncertainties should be calculated using the method in the ISO Guide to the Expression of Uncertainty in Measurements.

3. DOCUMENTS TO BE SUBMITTED

Within one week of the completion of the tests, participating laboratories are required to send the Result Sheet to their accreditation body.

No other documents are required. Laboratories should make a copy of all documents and worksheets for their own records and keep these on file for an adequate period of time (at least until a final report has been issued).

A final report will be issued at the end of the program with each laboratory only identified by a **confidential** code number.

4. CONFIDENTIALITY

For this program your laboratory has been allocated the code number shown on the results sheet. All reference to your laboratory in reports associated with this program will be with this code number, thus ensuring confidentiality of results.

5. GENERAL INFORMATION

For general queries, please contact your accreditation body.

Additional information may be obtained from:

Taiwan Accreditation Foundation (TAF)

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Asia Pacific Laboratory Accreditation Cooperation

APLAC T052 Proficiency Testing Program
Tensile Test for Metallic Materials
Result Sheet

Lab Code: ☐

Testing Data	Sample A No.____	Sample B No.____
Ambient Temperature (℃)		
Diameter (0.01mm) before Testing		
Gauge Length (0.01mm) before Testing		
Yield Strength (0.2% Offset, 1MPa)		
Tensile Strength (1MPa)		
Percentage Elongation after Fracture (1%)		
Speed of Testing		
Before Yield (min^{-1})		
After Yield ($min^{-1)}$		

If other methods are used, please kindly specify.

Type of Testing Machine: ☐ hydraulic ☐ ball screw ☐ others:________________________

Manufacture/Model of Machine: ____

Type of Grips: ☐ V groove ☐ plate ☐ others:______________________________

Class of Extensometer: ____

Type of Testing Speed Control:

☐ servo control ☐ strain rate indicator ☐ maximum strain rate control ☐ others:________

Additional Information: ____

____

Date: ________________________ Signature: ______________

Measurement Uncertainty Budget

Items	Factors of Uncertainty x_i	Type A / Type B	Probability Distribution	Standard Uncertainty $u(x_i)$	Coverage Factor(κ)
Combined Standard Uncertainty $u_c(Y)$:					
Expanded Uncertainty (95% confidence interval) $U_{exp} = \kappa \times u_c(y)$:					

Note：Please participating laboratories provide test original data (curve diagrams) e-mail or fax to TAF

Date: ________________________ Signature: _______________

INSTRUCTIONS – MEASUREMENT UNCERTAINTY

Part (1) Background information & justification for this change

ISO/IEC 17025 requires that, except under specified conditions, the uncertainty of measurement associated with the results of tests and measurements must be estimated.

What is uncertainty of measurement?

Uncertainty of measurement is defined as a "parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (the measurand is the particular quantity subject to measurement).

The result of a test or measurement is our best estimate of the true value of the measurand. The result is imperfect. The true value of the measurand is contained within a range of values about the measurement result and the "uncertainty of measurement" is an estimate of the magnitude of that range expressed at a given level of confidence (confidence interval). Uncertainty of measurement is usually given as a 95% confidence interval and would normally be expressed in the appropriate SI units (ie. mm, °C, g/l, MPa etc).

For example, the result of a measurement might be 5.1 mg/l with an uncertainty of ±0.2 mg/l at a 95% level of confidence. This means that there is an estimated 95% probability that the true value is in the range 4.9 mg/l to 5.3 mg/l. The 95% probability means that there is an estimated one in twenty chance that the true value is outside that range.

Uncertainty of measurement may also be expressed as a percentage where appropriate.

To assist laboratories to comply with the requirements of ISO/IEC 17025 for estimating uncertainty and to promote a uniform methodology in its estimation, information packages for APLAC PT testing program participants now include general guidance relating to estimating uncertainties for the specific testing involved, and final program reports will now include relevant worked examples. All program participants are required to report their estimates of uncertainty to their accreditation bodies along with their results unless the Technical Adviser to the program specifically waives any requirement to estimate uncertainties. The estimates of uncertainty provided by participants will be incorporated into the final program reports enabling direct comparison of uncertainty estimates across the program participants. The uncertainty estimates will not be used in the evaluation of the results on the primary samples.

How is uncertainty of measurement to be estimated?

APLAC expects that program participants' uncertainties of measurement would be estimated in accordance with the requirements of the respective member accreditation bodies. There are different approaches and methodologies available. Worked examples provided in APLAC PT program reports will generally be based on ISO GUM but will recognise other methodologies in accordance with 5.4.6.3 NOTE 3 in ISO 17025.

Estimates of uncertainty of measurement provided by program participants are required to be given at the 95% level of confidence.

ISO GUM methodology

An estimate of uncertainty of measurement would usually be based on the combination of a number of influencing parameters (components of uncertainty) such as errors in reference values, instrument errors, repeatability, thermal effects, weighing errors, inhomogeneity etc. ISO GUM methodology requires that the influence of each component of uncertainty on the measurement result be quantified and expressed numerically as a standard deviation. These values are then combined according to the rules of the propagation of uncertainty to produce a combined standard deviation (combined standard uncertainty) and the combined standard uncertainty is multiplied by a coverage factor to produce an expanded uncertainty at the required level of confidence. Detailed descriptions and information on the implementation of this methodology have been published by ISO2, UKAS3 and Eurachem/CITAC4 and made available over the internet[7].

Uncertainty of measurement is best estimated within the individual laboratory environment. All factors which will have a significant influence on the test or measurement result must be included in the estimation process. There must be suitable programs utilising reference standards, instruments and materials to ensure on-going and adequate quality control and repeatability and reproducibility of methods and equipment over time. In many instances, it will be possible to utilise quality control data in assessing uncertainty components such as precision. Where these data are not available, it may be necessary to carry out precision studies or to rely on published information about the method or portions of it until the laboratory can obtain its own estimates.

APLAC is aware of the general need for better estimates of uncertainty, and estimates that are obtained under similar conditions in all laboratories. PT programs are useful mechanisms for spreading awareness of uncertainty of measurement and the effects of different ways of estimating it. We anticipate that the information made available through PT programs will help focus discussions on uncertainty of measurement.

APLAC Technical Committees will interpret the information and report on current practices. They will also make recommendations for improving the collection of uncertainty data, the estimation of uncertainties and incorporating data and information on uncertainty of measurement into PT program reports. Therefore we anticipate an evolution in the mechanisms for collecting and reporting uncertainty data and associated information over the next few years.

Participation in APLAC PT programs should assist laboratories to develop appropriate estimates of uncertainty, help to guide accreditation bodies to adopting common and consistent approaches leading to enhanced understanding and international comparability of measurements among the member nations.

APLAC will consider the use of estimates of uncertainty of measurement in the evaluation of its PT testing program results after it is satisfied that participating laboratories are estimating uncertainties of measurement in an appropriate and consistent manner.

Here are a few important terms:

Standard uncertainty (*u(xi)*) is an input component of uncertainty *xi* expressed as a standard deviation. It should be expressed in the units of the influencing parameter, but may be expressed as a percentage where convenient.

Type A evaluation estimates of standard uncertainty are evaluated by applying statistical techniques to a series of repeatability or curve fitting data. For example, a standard uncertainty estimated from the repeatability of measurements on replicate samples is a Type A evaluation.

Type B evaluation estimates of standard uncertainty are based on assumed probability distributions, experience, laboratory records, or other information. For example, a standard uncertainty estimated using data provided on a calibration certificate is a Type B evaluation.

Sensitivity coefficient (*ci*) is the mathematical relationship between an influencing parameter and its effect on the result of a measurement. In many instances it is unity. That is, there is a one to one relationship between the value of the influence and its effect on the measurement result. For example, when weighing a sample of material, any uncertainty due to errors in the balance reading will have a one to one effect on the measurement result. On the other hand, if we are considering the influence of temperature on the length of a metal bar then the sensitivity coefficient is equal to the coefficient of linear thermal expansion for the metal bar multiplied by the length of the bar. It is important to note that a sensitivity coefficient has units. It is also important to note that the calculation methodology used by Eurachem/CITAC4 incorporates sensitivity coefficients in a manner that does not require their specific evaluation.

Combined standard uncertainty (*uc(y)*) is the final estimate of uncertainty for the test or measurement result *y* expressed as a standard deviation. It is calculated by multiplying the standard uncertainty *u(xi)* for each input component *(xi)* with its respective sensitivity coefficient *ci* to produce *ciu(xi)* and then combining those values by taking the square root of the sum of their squares. Note that the products *ciu(xi)* must each be expressed in the same units as those required for expressing the combined estimate *uc(y)*.

Expanded uncertainty (*U*) is the final result of our estimate of uncertainty expressed as a confidence interval. It is calculated by multiplying the combined standard uncertainty by a coverage factor to produce the desired level of confidence (usually 95%).

Coverage factor (*k*) is a multiplier used to expand the combined standard uncertainty *uc(y)* to an interval that is estimated to contain the true value of the measurand at a given level of confidence ($U = k.uc(y)$). The coverage factor then represents the number of standard deviations in the expanded uncertainty and is determined according to the Student-t distribution. A coverage factor of 2 is commonly used to approximate the expanded uncertainty to the 95% confidence level.

References

1. ISO-IEC 17025:1999. General requirements for the competence of testing and calibration laboratories. ISO, Geneva (1999)

2. Guide to the Expression of Uncertainty in Measurement. ISO, Geneva (1993)

3. UKAS LAB 12: The Expression of Uncertainty in Testing. UKAS, London (2000)

4. Eurachem / CITAC Guide QUAM: 2000.P1. Quantifying Uncertainty in Analytical Measurement, 2nd Edition (2000)

5. ISO/DTS 21748:2002 Guide for the use of repeatability, reproducibility, and trueness estimates in measurement uncertainty estimation.

6. APLAC TC 005, Interpretation and Guidance on the Estimation of Uncertainty of Measurement in Testing

7. www.A2LA.org / (for A2LA policies, links to guidance documents, including the UKAS Guide, and the Eurachem/CITAC Guide, at no cost), www.measurementuncertainty.org / (Eurachem/CITAC Guide), www.fasor.com/iso25 / (general information, links, and discussion of ISO-IEC 17025)