

ENGLISH

OPERATIVE MANUAL

ForceKAL

Release 3.3

Application software

for Material Testing Machines Calibration.

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AEP transducers s.r.l. holds the right to make any change, when necessary, without notice.

The data contained in this manual are just indicative and the manufacturer declines any responsibility for errors or discrepancies with respect to this manual.

WARNING

The program comes on a USB key in which resides the permanent protection of the program from any claims of piracy. The USB key must always be inserted into the PC.

System requirement

PC: Pentium III 300 MHz 128 MB RAM or upper

Windows XP (Professional o Home) Service Pack 3 and NET 3.5 installed

Windows 2000

Windows Vista

Windows 7

Windows 8

Windows 10

Windows: International options

For the proper functioning of the program, you must use (.) as the decimal point regardless of the conventions of the country where this program is used otherwise several settings can cause errors in calculation.

Modify or check your decimal separator setting in the Windows Control Panel

INTRODUCTION

The program is designed to perform the calibration of material testing equipment, machines force samples, test benches or other equipment using standard devices.

Evaluation of the uncertainty of calibration is performed according to the requirements of the UNI CEI ENV 13005 and the information given in Appendix D of ISO / DIS 7500-1.

To perform the calibration is necessary to generate a significant number of measures (5, 8 or 10) of increasing strength in two or three series to check the repeatability of the machine calibration.

After each cycle, increasingly, the machine must be reset to zero before performing the next measurement cycle.

After the test, the program calculates:

- a) Average readings
- b) Error reading%
- c)% expanded uncertainty associated with each point of measurement.

All certificates are then printed and stored in a database that keeps the historian of calibrations performed.

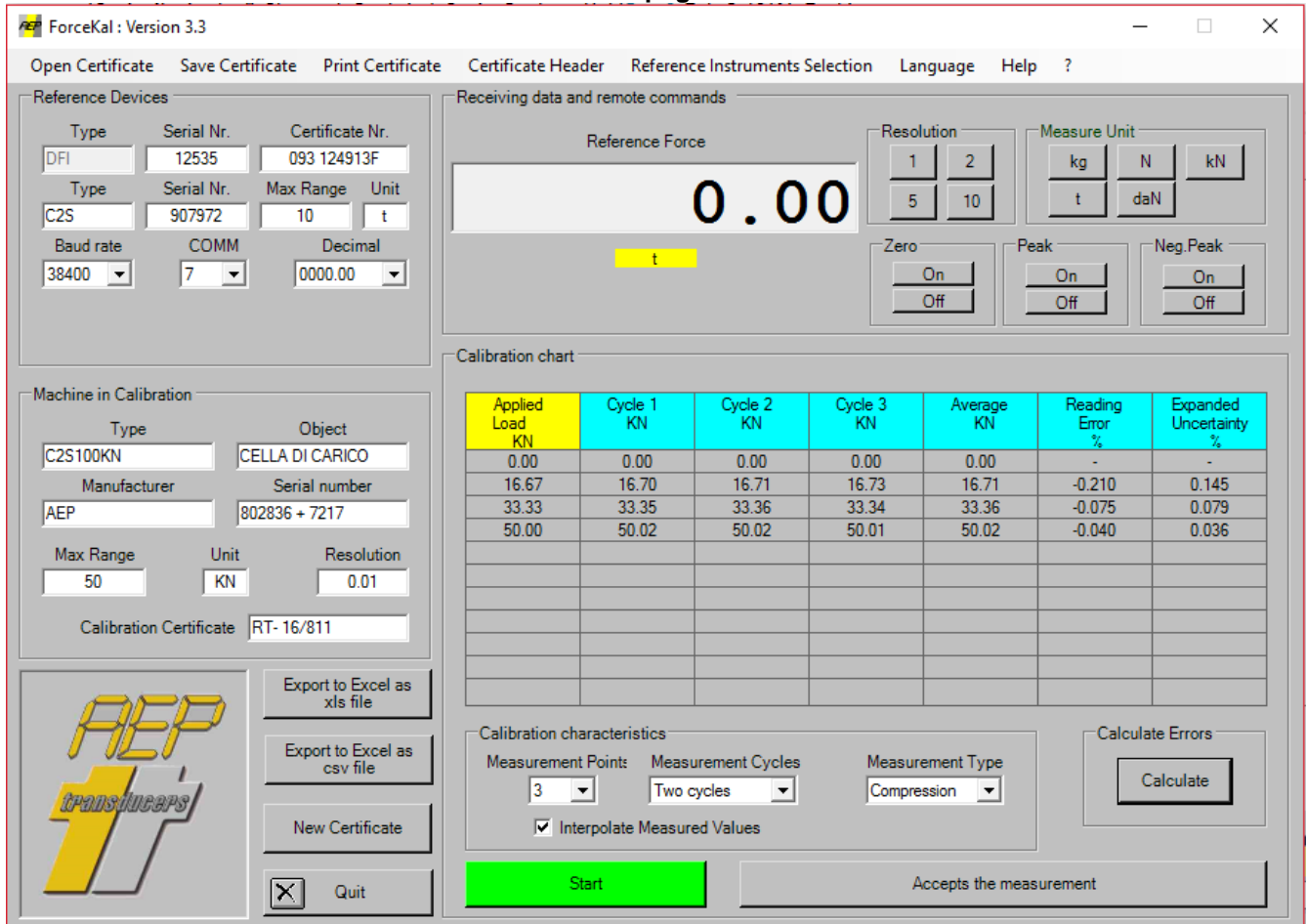
The program maintains a database of standard AEP instruments type TA2USB , TAUSB, MP10, DFI MP2E, MP2000A STAR, MP10Plus and MP6A connected to a PC via RS232 serial communication or USB to ensure the acquisition of instantaneous force measurement.

For each standard instrument is necessary to introduce all the identification data, SIT certificates or equivalent reference and for the different calibration points the computed uncertainties.

The program automatically advises the operator if the used reference instrument has a certificate date expired.

KEYS FUNCTION DESCRIPTION

Main page



The screenshot shows the ForceKal software interface with the following sections:

- Reference Devices:** Fields for Type (DFI), Serial Nr. (12535), Certificate Nr. (093 124913F), and another set for Type (C2S), Serial Nr. (907972), Max Range (10), and Unit (t). Baud rate is 38400, COMM is 7, and Decimal is 0000.00.
- Receiving data and remote commands:** Reference Force display shows 0.00 t. Resolution buttons (1, 2, 5, 10) and Measure Unit buttons (kg, N, kN, t, daN). Zero, Peak, and Neg Peak controls (On/Off).
- Machine in Calibration:** Type (C2S100KN), Object (CELLA DI CARICO), Manufacturer (AEP), Serial number (802836 + 7217), Max Range (50), Unit (KN), Resolution (0.01), and Calibration Certificate (RT-16/811).
- Calibration chart:** A table with columns: Applied Load KN, Cycle 1 KN, Cycle 2 KN, Cycle 3 KN, Average KN, Reading Error %, and Expanded Uncertainty %.
- Calibration characteristics:** Measurement Points (3), Measurement Cycles (Two cycles), Measurement Type (Compression), and an option for Interpolate Measured Values.
- Buttons:** Export to Excel as xls/csv file, New Certificate, Quit, Start, and Calculate.

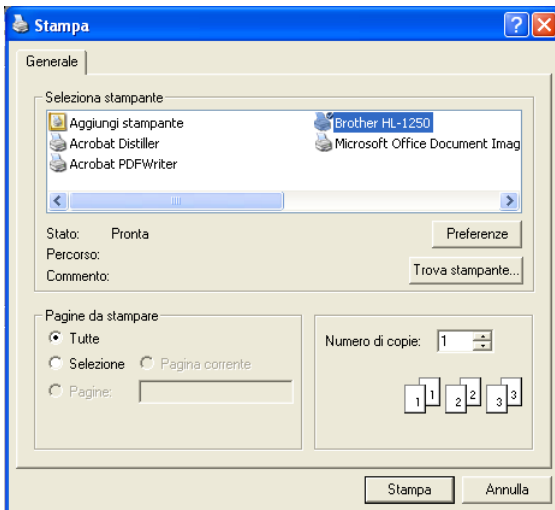
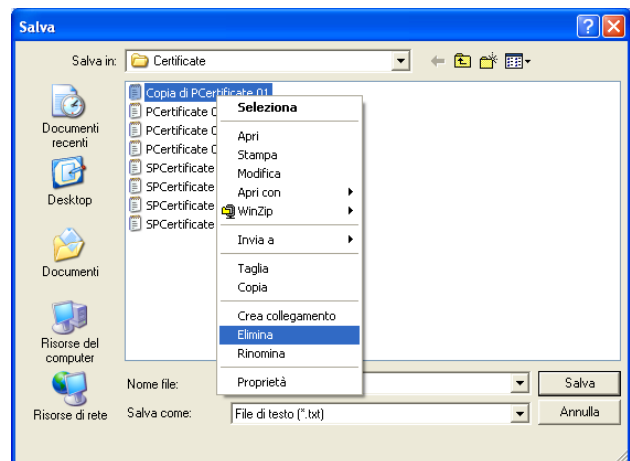
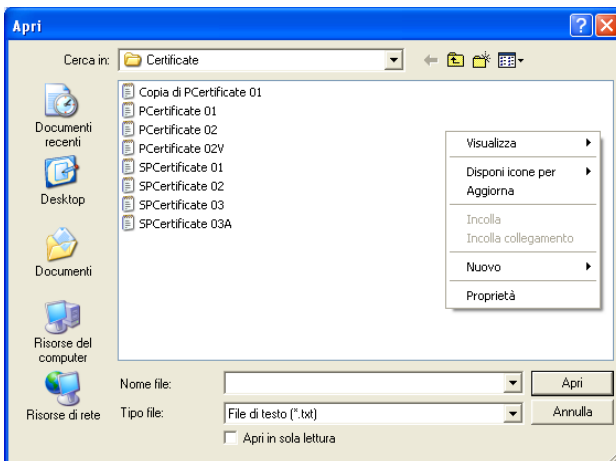
Applied Load KN	Cycle 1 KN	Cycle 2 KN	Cycle 3 KN	Average KN	Reading Error %	Expanded Uncertainty %
0.00	0.00	0.00	0.00	0.00	-	-
16.67	16.70	16.71	16.73	16.71	-0.210	0.145
33.33	33.35	33.36	33.34	33.36	-0.075	0.079
50.00	50.02	50.02	50.01	50.02	-0.040	0.036

In the main menu you can manage the following operational functions such as:

- **Open Certificate:** This button opens the dialog box to select and open a certificate from the archive.
- **Save Certificate:** This button saves the certificate on file with. The operator should select the path and the name of the certificate.
- **Print Certificate:** This button opens the dialog box for printing the certificate of calibration.
- **Header Certificate:** This button opens the page where you enter the header data of the certificate. Footer notes that may be entered too.
- **Select Reference Instrument:** This button opens the page where you have to enter the data and the uncertainties of your standard instrument. To properly use this program is necessary to fill all fields required.
- **Language:** This button opens a dialog where select the desired language. –
- **Help:** This button opens this file.
- **?:** This button provides information about the program.

To exit the program using the **Quit** button placed next to the logo AEP.

In the **Open Certificate** and **Save Certificate** dialog boxes, you can choose the path and folder where to open or save files your certificates. As usual using the right mouse button, you can access the menu with the standard Windows functions such as: Create a new folder, rename, copy, delete a file or folder, etc.



The **Print Certificate** dialog box allows you to print your certificate.

Serial communication

From the main menu you can select your Reference Instrument using the **Select Reference Instrument** selection.

For your comfort the main data of the selected Reference Instrument are replicated in the main Window.

To establish a proper serial communication between the PC and the instrument you have to set :

- **Baud rate** : same as the one selected on your instrument. For TA2USB and MP10Plus any selection is valid. For TAUSB is fixed to 38400
- **COM PORT** : (COM1, COM2 ...) if you don't know it please check in the Windows Control Panel
- **Decimal** : the point position for the acquired data .

If the PC does not have a serial input please use a RS232C➔USB adaptor.

Data receiving and remote commands

In the window **Receiving Data and Remote Commands** you can see the Force Value transmitted from the instrument in real Time.

It is possible to act on some commands (zero, resolution etc) to better operate on your instruments remotely.

In some kind of tests can be useful to use the peak function

Device in calibration

The window Device in Calibration allows you to set the main data of your instrument to in calibration.

All these information will be stored and printed in the report.

Objetc : Generic field normally used to define the machine type. (for example Testing Machine)

Type :

Serial Number:

Maker: Here you have to set the data of the machine in calibration (example "TMM350")

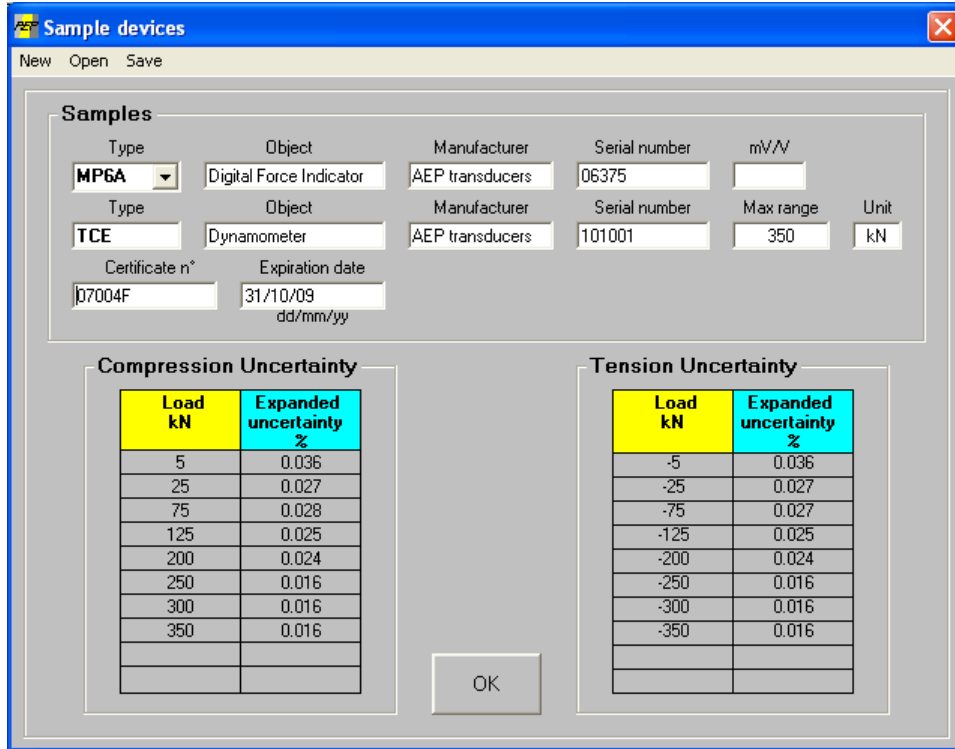
Max Force: This is the max Force allowed for the machine or ,if during calibration you want to reach a lower load, the maximum load during calibration.

Unit: The load unit used. Please controls that the reference instrument and the device in calibration are set with the same load unit.

Resolution: Set the best resolution you can obtain from the device in calibration.

Calibration Certificate: Set here the number assigned to the certificate. This is a free text field

Reference Devices



Load kN	Expanded uncertainty %
5	0.036
25	0.027
75	0.028
125	0.025
200	0.024
250	0.016
300	0.016
350	0.016

Load kN	Expanded uncertainty %
-5	0.036
-25	0.027
-75	0.027
-125	0.025
-200	0.024
-250	0.016
-300	0.016
-350	0.016

On this page are stored all data on standard instruments that can be used during the calibration.

For the proper functioning you should fill all the following fields easily recovered by a SIT calibration certificate or equivalent document

The function keys on this page allow you to perform the following steps:

New: This button clears all fields to a new data entry.

Open: This button opens a dialog box that lets you open a file with the data of a standard instrument previously saved.

Save: This button opens a dialog box that allows you to save files on the instrument data sample selected at that time.

The fields to be filled are:

- **Object** : Field of general use to indicate the type of instrument (eg "digital Indicator").
- **Type**: Select the name of the instrument (eg "MP6A").
- **Manufacturer**: Enter the manufacturer of the instrument (eg "AEP transducers")
- **Serial Number**: enter the serial number of the standard instrument.
- **Max Range**: indicate the maximum capacity of the load cell sample (eg "350" kN).
- **Certificate Number**: Indicate the number of the SIT certificate or equivalent instrument.
- **Expiration date** : Set the date (dd / mm / yy) the expiration of the standard instrument, the program will warn the operator of the expiration of the certificate.

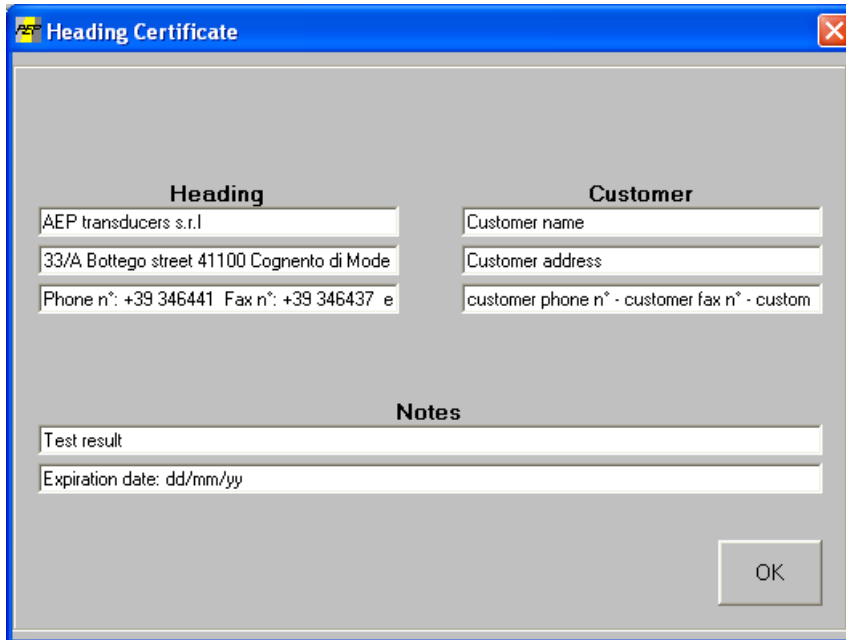


- **mV / V**: accessible only with the instrument TAUSB. Setting mandatory to calibrate the sensitivity of the instrument with the sensitivity of output of the load cell connected. Setting range: from 5000 (0.5mV) to 25000 (2.5mV), default value 2 (2mV). For instruments other than TAUSB this field will be empty.
- **Channel** : accessible only with the instrument TA2USB. It allows to set the channel of the TA2USB used during calibration
- **Uncertainty Compression**: In this table, the operator must introduce in the first column the calibration points on the certificate SIT in load unit, and in the column, the uncertainty associated with each point of strength in compression. The table can accept up to 10 different strengths, but if necessary the operator can set 5, 7 or more depending on the certificate in his possession.
- **Tensile Uncertainty** : In this table, the operator must introduce in the first column the calibration points on the certificate SIT in load unit, and in the column, the uncertainty associated with each point of strength in tension. The calibration points should be placed in tensile with a minus sign (-) (eg "-2.5"). The table can accept up to 10 different strengths, but if necessary the operator can set 5, 7 or more depending on the certificate in his possession.

WARNING:

The introduction of incorrect data affect the calculation of the uncertainty on the machines in calibration.

Certificate Header



Heading	Customer
AEP transducers s.r.l.	Customer name
33/A Bottego street 41100 Cognento di Mode	Customer address
Phone n°: +39 346441 Fax n°: +39 346437 e	customer phone n° - customer fax n° - custom

Notes

Test result

Expiration date: dd/mm/yy

OK

On this page you can enter some data of interest when the certificate will be printed.

Header: You can enter up to 3 lines of free text to indicate the company details that runs the certificates. This text is placed next to the logo.

Client: You can enter up to 3 lines of free text to indicate the details of the client company owns the device calibrated

Note: You can enter up to 2 lines of free text to show general information. (eg expiry of the certificate, if your machine is or is not within calibration specifications, operator name, etc. ...). This text is inserted in the footer of the certificate.

Folder Data : It allows to change the folder of the certificate

Custom logo:

By default on the report the AEP Instruments logo will be printed.

If you want to change the AEP logo with your own brand please substitute the file logo2.jpg in the ForceKal Installation folder.

This file should be a JPEG image (max size 80x22mm)

CALIBRATION procedure

The calibration is semi-automatically because the program sets and suggests the execution sequence, but is the operator that must perform properly the sequence. At the end of the sequence the program scan the data and calculates the average, the errors, the uncertainty of the measurements.

Calibration chart

Applied Load KN	Cycle 1 KN	Cycle 2 KN	Cycle 3 KN	Average KN	Reading Error %	Expanded Uncertainty %
0.00	0.00	0.00	0.0	0.00	-	-
16.67	16.70	16.71	16.72	16.71	-0.210	0.145
33.33	33.35	33.36	33.34	33.36	-0.075	0.079
50.00	50.02	50.02	50.01	50.02	-0.040	0.036

Calibration characteristics

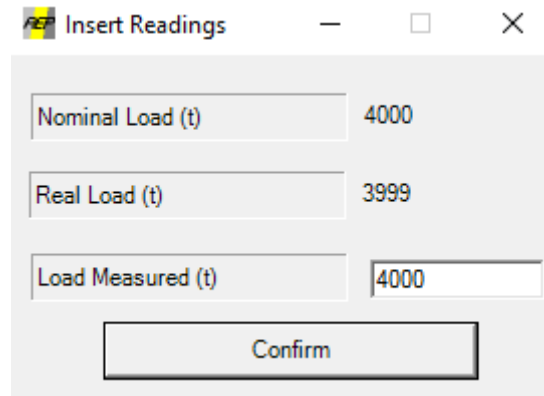
Measurement Point: Measurement Cycles: Measurement Type:

Interpolate Measured Values

Calculate Errors

"Calibration Characteristics " setting

- **Points of measurement:** set the number of points of measurement (eg "5" maximum "10").
- **Cycles of measurement:** set the number of cycles of measurement (eg "2" maximum "3").
- **Type of measure:** Set "Compression" if the calibration is performed with increasing positive set "Tensile" if the calibration is performed with increasing negative; calibration is possible only in tension with load cells bidirectional.
- **Interpolate Measured Values :** This selection allows you to interpolate the measurements performed on the instrument to be calibrated to the actual load that has been created. This situation is typical in testing machine where it is very difficult to achieve precise nominal load. Interpolate Measured Values



Nominal Load (t)	4000
Real Load (t)	3999
Load Measured (t)	4000

Confirm

For each measurement point, by pressing the "**Accept the measurement**" button the actual load generated is measured and prompts the operator to enter the load indicated by the machine under test. This value is related to the nominal load required for the measuring point

Before starting the procedure verify that the communication with the reference instrument is active and place the load cell on the device being calibrated, taking care to center it within $\pm 0.1\text{mm}$.

Press the **Start button** to begin calibration.

The program automatically calculates the strength to be controlled by dividing the maximum capacity of the device being calibrated by the number of steps to be performed.

Reset the force reading with the appropriate key "zero" and press the "Accept the measure" or press the spacebar on the keyboard. Generate the first point of power proposed by the program in the "applied load" (eg "2.5 kN) wait 30 seconds and press the " Accept the measure.

Perform the same way all the measurement points then after that the last strength of the measuring cycle, return the force to zero.

The program is placed on or next measurement cycle by proposing the first point of measurement to verify.

At the end of the sequence of measurement cycles, the program will automatically calculate the errors and uncertainties of the device being calibrated. You can stop the test at any time by pressing the **Stop** button highlighted in red and then start over the procedure by pressing **Start**.

At the end is possible to modify all the fields in the table manually-

Calibration simulation

It is possible to simulate a calibration table by filling in all the fields manually.

Program the calibration Characteristics as usual.

The simulation starts by pressing the **Start** button highlighted in green, the program automatically calculates the strength to be controlled by dividing the maximum capacity of the device being calibrated by the number of steps to be performed.

Press **Stop** Button

Insert manually the measured values in the table.

At the end press **Calculate** to calculate the errors and uncertainties .

ERRORS and UNCERTAINTIES CALCULATION

Average Reading (F_m): it is calculated for each measurement point:

$$F_m = ((\text{sum of the reading point in each series}) / (\text{n}^\circ \text{of series}))$$

Reading Error e_i : it is calculated for each measurement point:

$$e_i = \frac{F_i - F_m}{F_m} * 100$$

Expanded Uncertainty (U): it is calculated keep in count all the standard uncertainties for each measurement point : Resolution, Repeteability and Reference Instrument Uncertainty

$$U = k * \text{SQR}((U_{\text{res}})^2 + (U_{\text{rep}})^2 + (U_{\text{std}})^2)$$

where:

U_{res} = Uncertainty due to the relative resolution

U_{rep} = Uncertainty due to the repeatability

U_{std} = Uncertainty due to the reference instrument

where $k=2$ is adopted

Certificate example



AEP transducers s.r.l.

33/A Bottego street 41100 Cognento of Modena (Modena) Italy
Phone n°: +39 059 346441 Fax n°: +39 059 346437 email: aep@aep.it

Customer:
Customer name
Customer address
Customer phone n°, fax n°, email, internet

CERTIFICATE Nr.: CTF00001

Date: 30/10/2008
Hour: 10.40.32
Calibration type: Compression

SAMPLE DEVICES

Certificate n°: 07001F

Type:	DFI	Serial number:	06502
Object:	Digital Force Indicator	Manufacturer:	AEP transducers
Type:	KAL	Serial number:	13501
Object:	Dynamometer	Manufacturer:	AEP transducers
Maximum range:	25 kN		

DEVICE in TEST

Type:	Test Wheel Platform	Serial number:	WP25-0001
Object:	TWP25	Maximum range:	25 kN
Manufacturer:	DEF	Resolution:	0.1

FORCE MEASUREMENTS

Applied load kN	Cycle 1 kN	Cycle 2 kN	Cycle 3 kN	Average kN	Reading error %	Expanded Uncertainty %
0.000	0.000	0.000		0.0000	-	-
2.500	2.496	2.496		2.4960	1.1582	2.3164
5.000	4.996	4.997		4.9965	0.5811	1.1622
7.500	7.502	7.500		7.5010	0.3857	0.7714
10.000	9.996	9.995		9.9955	0.2897	0.5794
12.500	12.494	12.495		12.4945	0.2313	0.4626
15.000	14.994	14.993		14.9935	0.1928	0.3856
17.500	17.492	17.494		17.4930	0.1653	0.3306
20.000	19.994	19.994		19.9940	0.1447	0.2894
22.500	22.492	22.493		22.4925	0.1286	0.2572
25.000	24.993	24.992		24.9925	0.1158	0.2316

Notes

Test result
Expiration date: dd/mm/yy

Signature _____