Publication Date: 2021-04-19

Product Change Notification

Subject	Type of change:	Test process

PI offers various motion technologies. In the past, different metrology approaches came up, due to different requirements in the technologies. For a transparent description of the measurement standard, these different approaches are now unified to one measurement standard.
This new measurement standard is based on the ISO 230 standard but has some slight changes to it, to comply to former measurements done by PI.
This document describes the changes between the current measurement evaluation and the evaluation according to the unified measurement standard for piezo actuator-driven PI products.

The new measurement standard will apply from the 3rd of May 2021 on for the whole PI Group.

This is the announcement of a change to one or more products currently offered by Physik Instrumente (PI) GmbH & Co. KG. Find detailed information on this change as well as a list of affected products on the following pages.
This change will be implemented within 6 months of the publication date.
This notification has no influence on the life cycle of products that have already been discontinued.
If products are affected that have already been listed in previous change / discontinuation notifications, this notification has no suspensive effect with regard to the end of the product life cycle or the last possible order dates.
If you have any questions about this notification, please contact your sales representative.

Reasons for the Change

PI wants to give customers insight into our data acquisition procedure as well as the algorithms used for data evaluation.

For historical reasons PI has used two different software suites for data acquisition and data evaluation: One designed mainly for piezo applications, another one designed mainly for DC motors. However, both software solutions acquire the measurement data with a series of static measurements and work very similar.

In the future PI wants to use only one software for the following reasons:

- Technolgy: Over the last years hybrid systems, which contain both technologies, have become more and more important. The separation in two clear technology branches is therefore no longer possible.
- Transparency: The customer needs to be able to reproduce the data acquisition and evaluation. A unified measurement standard for data acquisition and evaluation is required for a transparent communication.
- Uniformity: The design of the test report as well as the measurement data it contains depends on the measurement software applied, because the two software suites use slightly different methods for data

Reasons for the Change
acquisition and evaluation. PI wants to provide reliable measurement values independent of the applied software.

Description of the Change

Data acquisition:

- No changes

Data evaluation:

- Data evaluation for measurements with 1 repetition (most cases): no changes
- Data evaluation for measurements with more than 1 repetition:
  With the same set of raw data the measurement value “Linearity” can vary slightly due to a more accurate evaluation algorithm.

Test report:

- The report's name changes from “FM 7.5-16 A4” to “FM 7.5-79_A1”.
- The new test report consists of one cover sheet with a summary of the metadata of the measurement setup. Each measurement domain with the measurement parameters and the measurement values is described on the following pages.
- Some measurands have not been shown quantitatively in the report before. With the new measurement standard, the following values are contained in the report:
  - Unidirectional repeatability
  - Stroke (measured travel range)
  - Linearity (absolute value)
  - Linearity (percentage)
- Some categories in the report will be sorted in a different manner:
  - “System Setup” is now “System” and does not include any product data contained in the datasheet (e.g. “nominal operating voltage”).
  - “Measurement Setup” divides into “Data Acquisition” and “Measurement Domain” and no longer includes the environmental data.
  - “Measurement Results” are not shown in a tabular style for each measurement point. The evaluated measurement values are listed in the report.
- Essential graphs are shown.
  - The graph “Displacement Curves” is no longer shown. The stroke of a piezo is listed as a measurement value.

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Description of the Change

- The graph “Linearity” for positioning measurement is now called “Positioning in X, minus end-point line”.
- The graph "Crosstalk" for parasitic motion is now called “Straightness” or “Angular Error Motion” respectively.
- The labels of the X-axis and Y-axis have changed slightly.

Find an example for the current / new test reports as an attachment at the end of this document.

Filenames:

The nomenclature of the measurement geometry has changed for all products. This nomenclature is part of the filenames of the test report and the measurement data file. In the current standard a measurement was described as:
for linear measurements: <moving direction>t<measuring direction>
for angular measurements: <moving direction>r<axis for the rotational direction>

In the new standard it is described as:
E_<measuring direction><moving direction>

The angular directions are described as A, B, C which corresponds to rotX, rotY, rotZ.

For example, the new description of measurements is now E_ZX instead of xtz or E_BX instead of xry.

Possible Impact on Fit, Form, Function, Quality and Reliability

Fit, Form, Function: The new measurement standard does not change the procedure of the data acquisition. The evaluation based on the new standard is almost the same as the evaluation based on the current standard. No changes are expected.

Quality: The new measurands are explained in detail in a whitepaper available on our website for a better understanding and transparency. The measurement values are listed quantitatively in the new test reports. This is an improvement to the current reports, which show considerably less explicit measurement values.

Changes to Product Identification as a Result of this Notification

No changes planned.

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Products Affected by this Notification (PI Item No.)				
F-712.HA1	P-545.3C8S	P-621.1UD	P-734.2CD	P-843.40V
F-712.HA2	P-545.3D8S	P-621.2CD	P-734.2CL	P-843.60
F-712.HU1	P-545.3R8S	P-621.2CL	P-736.ZR1S	P-843.60V
F-712.MA1	P-558.TCD	P-621.2VL	P-736.ZR2S	P-845.10
F-712.MA2	P-558.ZCD	P-621.ZCD	P-736.ZRN2S	P-845.10V
P-212.1S	P-558.ZCL	P-621.ZCL	P-737.1SL	P-845.20
P-212.2S	P-561.2DD	P-622.1CD	P-737.2SL	P-845.20V
P-212.2SV	P-561.3CD	P-622.1CL	P-737.5SL	P-845.30
P-212.4S	P-561.3CL	P-622.1U	P-750.20	P-845.30V
P-212.4SV	P-561.3DD	P-622.1UD	P-752.11C	P-845.40
P-212.8S	P-562.2CD	P-622.2CD	P-752.1CD	P-845.40V
P-216.1S	P-562.2CL	P-622.2CL	P-752.21C	P-845.60
P-216.2S	P-562.3CD	P-622.ZCD	P-752.2CD	P-845.60V
P-216.4S	P-562.3CL	P-622.ZCL	P-753.11C	P-871.112
P-216.8S	P-563.3CD	P-625.1CD	P-753.12C	P-871.122
P-216.8SV	P-563.3CL	P-625.1CL	P-753.1CD	P-871.127
P-216.9S	P-563.3UD	P-625.1VL	P-753.1UD	P-871.128
P-216.9SV	P-563.3VD	P-625.2CD	P-753.21C	P-871.140
P-225.1S	P-587.6CD	P-625.2CL	P-753.22C	PD72Z1CA0
P-225.2S	P-601.1S	P-625.2UD	P-753.2CD	PD72Z1CAA
P-225.4S	P-601.1SL	P-628.1CD	P-753.2UD	PD72Z1CAQ
P-225.8S	P-601.3S	P-628.1CL	P-753.31C	PD72Z1SA0
P-235.1S	P-601.3SL	P-628.2CD	P-753.32C	PD72Z1SAA
P-235.2S	P-601.4S	P-628.2CL	P-753.3CD	PD72Z1SAQ
P-235.4S	P-601.4SL	P-629.1CD	P-753.3UD	PD72Z2CA0
P-235.4SV	P-602.1L8	P-629.1CL	P-821.10	PD72Z2CAA
P-235.8S	P-602.1S0	P-629.2CD	P-821.1B	PD72Z2CAQ
P-235.8SV	P-602.1S8	P-629.2CL	P-821.20	PD72Z4CA0
P-235.9S	P-602.1SL	P-630.XCD	P-821.2B	PD72Z4CAA
P-363.2CD	P-602.3L8	P-631.XCD	P-821.3B	PD72Z4CAQ
P-363.2CL	P-602.3S0	P-721.CDA	P-841.10	PD73Z2COW
P-363.3CD	P-602.3S8	P-721.CDQ	P-841.10V	PD73Z2ROW
P-363.3CL	P-602.3SL	P-721.CLQ	P-841.1B	S-303.CD
P-517.2CD	P-602.5L8	P-721.SDA	P-841.1BV	S-303.CDI
P-517.2CL	P-602.5S0	P-721.SL2	P-841.20	S-316.10
P-517.3CD	P-602.5S8	P-722.00	P-841.20L	S-316.10H
P-517.3CL	P-602.5SL	P-723.00	P-841.20V	S-316.20
P-517.6CD	P-602.8S0	P-723.07	P-841.2B	S-325.3SD
P-517.RCD	P-602.8SL	P-723.10	P-841.2BL	S-325.3SL
P-518.TCD	P-603.1S1	P-725.1CA	P-841.2BV	S-330.2SD

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Products Affected by this Notification (PI Item No.)				
P-518.ZCD	P-603.1S2	P-725.1CD	P-841.30	S-330.2SH
P-518.ZCL	P-603.3S1	P-725.1CDE2	P-841.30L	S-330.2SL
P-527.2CD	P-603.3S2	P-725.1CL	P-841.30V	S-330.40L
P-527.2CL	P-603.5S1	P-725.1SL	P-841.3B	S-330.4SD
P-527.3CD	P-603.5S2	P-725.2CA	P-841.3BL	S-330.4SH
P-527.3CL	P-611.1S	P-725.2CD	P-841.3BV	S-330.4SL
P-527.RCD	P-611.2S	P-725.2CL	P-841.40	S-330.80L
P-528.TCD	P-611.3S	P-725.2SL	P-841.40L	S-330.8SD
P-528.ZCD	P-611.3SF	P-725.4CA	P-841.40V	S-330.8SH
P-528.ZCL	P-611.XZS	P-725.4CD	P-841.4B	S-330.8SL
P-541.2CD	P-611.ZS	P-725.4CL	P-841.4BL	S-331.2SH
P-541.2CL	P-612.2SL	P-725.4SL	P-841.4BV	S-331.2SL
P-541.2DD	P-612.ZSL	P-725.CDD	P-841.60	S-331.5SH
P-541.2SL	P-616.3C	P-725.SDD	P-841.60L	S-331.5SL
P-541.3CD	P-620.1CD	P-726.1CD	P-841.60V	S-335.2SH
P-541.TCD	P-620.1CL	P-733.2CD	P-841.6B	S-335.2SHM1
P-541.TSL	P-620.2CD	P-733.2CL	P-841.6BL	S-335.2SHM2
P-541.ZCD	P-620.2CL	P-733.2DD	P-841.6BV	S-340.ASD
P-541.ZCL	P-620.2VL	P-733.2UD	P-843.10	S-340.ASL
P-541.ZSL	P-620.ZCD	P-733.3CD	P-843.10V	S-340.ISD
P-542.2CD	P-620.ZCL	P-733.3CL	P-843.20	S-340.ISL
P-542.2CL	P-620.ZVL	P-733.3DD	P-843.20V	S-340.SSD
P-542.2SL	P-621.1CD	P-733.3VD	P-843.30	S-340.SSL
P-545.2C8S	P-621.1CL	P-733.ZCD	P-843.30V	S-340.TSD
P-545.2R8S	P-621.1U	P-733.ZCL	P-843.40	S-340.TSL

In addition:

- All related customized products delivered with a test report

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Attachments: Current / New Test Report

Current test report:

Page 1/1:

Performance Test Protocol
P-900 - Linearity

Piezo · Nano · Positioning

File: 123456789_linearity_z_5Wdh.cal
Protocol No.: FM 7.5-16 A4 17:29 2020-10-20

Order Info

Customer	
Customer Ref No.	
PI Order No.	

System Setup

Stage	P-900
Ser. No.	123456789
Commanded Axis	Z
Measured Axis	Z
Feedback Sensor	Linear Scale Encoder
Sensor Bandwidth	Standard
Design	Standard
Nominal Oper. Voltage	-30 ... +120V
Nominal Expansion	+/- 20µm
Controller	E-712 #123456789
Calibration Type	Standard, via analog control input

Measurement Setup

Measurement Device	Others
Meas. Device Type	Laser Interferometer
Temperature	20.1 °C
Air Pressure	981.0 mbar
Humidity	31.0 %
Measurement Date	14:06:19, 2020-07-07
Meas. Program	PZTCalib 7.8.0.0
Examiner	abc
Min. Ctrl Input	-20.0 µm
Max. Ctrl Input	20.0 µm
Step Size	2.0 µm
Time Delay	0.5 s
Number of repetitions	5

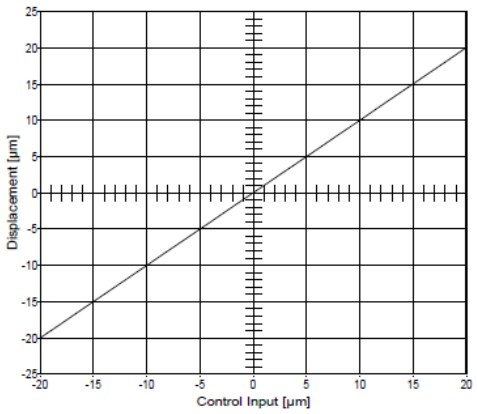
Measurement Results

Ctrl In [µm]	Output + [µm]	nonlin [µm]	nonlin [%]
-20.0000	-20.0000	0.0000	0.0000
-18.0000	-17.9987	0.0001	0.0002
-16.0000	-15.9954	0.0022	0.0054
-14.0000	-14.0021	-0.0057	-0.0142
-12.0000	-11.9943	0.0009	0.0023
-10.0000	-9.9968	-0.0028	-0.0071
-8.0000	-7.9964	-0.0036	-0.0089
-6.0000	-6.0083	-0.0167	-0.0418
-4.0000	-3.9982	-0.0078	-0.0194
-2.0000	-1.9957	-0.0065	-0.0163
0.0000	0.0122	0.0002	0.0005
2.0000	2.0037	-0.0095	-0.0238
4.0000	4.0113	-0.0031	-0.0078
6.0000	6.0114	-0.0042	-0.0106
8.0000	8.0170	0.0002	0.0006
10.0000	10.0061	-0.0119	-0.0298
12.0000	12.0174	-0.0018	-0.0045
14.0000	14.0221	0.0017	0.0041
16.0000	16.0260	0.0044	0.0109
18.0000	18.0179	-0.0049	-0.0122
20.0000	20.0240	0.0000	0.0000

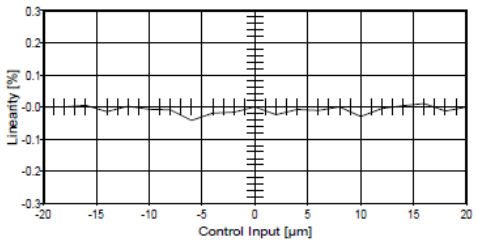
Mean sigma = 0.0055 µm
Sigma sigma = 0.0019 µm

Control Function:
Expansion = 1.000600*Ctrl_In + 0.0120 µm

Displacement Curves



Linearity



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Publication Date: 2021-04-19

New test report:

Page 1/2:

Test Report for Linear Stage P-900.123

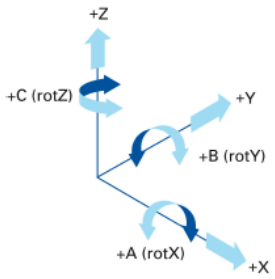
File: 123456789_linearity_z.pdf
Protocol no.: FM 7.5-79_A2
2021-03-22 15:09:20, Script version: 1.22.2.0, Signed on 2021-03-18 11:56:15 for Framework 1.22.2.0

System	
Stage type	P-900.123
Stage serial number	123456789
Controller type	E-712
Controller serial number	123456789
Controller firmware version	not available

Data Acquisition	
Date, time	2020-07-07, 14:06:19
Examiner	ABC
Measurement program	PZTCalib 7.8.0.0
Data analysis program	HummingBird 1.22.2.0
Measurement devices	Interferometer
Moving direction	Z
Measuring direction	Z

Measurement Domain 1	
Min. commanded position / um	-20.0
Max. commanded position / um	20.0

Comment
Measurements based on ISO 230



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MOTION I POSITIONING

Publication Date: 2021-04-19

New test report:

Page 2/2:

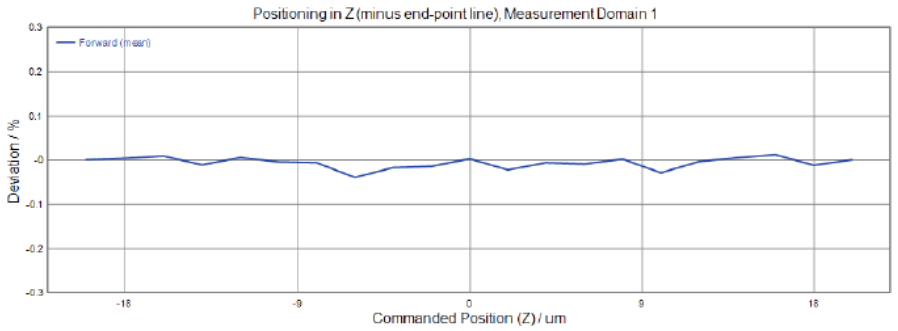
Test Report for Linear Stage P-900.123

File: 123456789_linearity_z.pdf
Protocol no.: FM 7.5-79_A2
2021-03-22 15:09:20, Script version: 1.22.2.0, Signed on 2021-03-18 11:56:15 for Framework 1.22.2.0

System	
Stage type	P-900.123
Stage serial number	123456789

Measurement Domain 1	
Moving direction	Z
Measuring direction	Z
Min. commanded position / um	-20.0
Max. commanded position / um	20.0
Measuring range / um	40.0
Bidirectional measuring range / um	36.0
Step size / um	2.0
Waiting time / s	0.5
Number of repetitions	5
Data correction	Thermal drift correction is applied to the measurement data

Positioning in Z (minus end-point line), Measurement Domain 1			
R_fbm	Unidirectional repeatability (mean)	+/-6.3	nm
S	Stroke	40.025	µm
L	Linearity	15.8	nm
L_p	Linearity (percentage)	0.0396	%



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