Product Updates

Presented by:
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Operations Director

TELEDYNE LECROY TEST SERVICES
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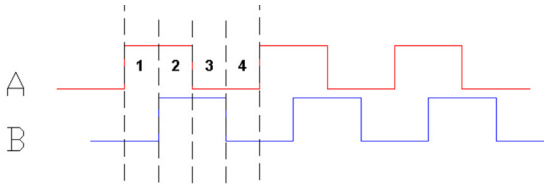
Product Updates

TOPICS

- **Calibration Improvements – Digital Channels**
- **QL3-FS Analog Accuracy Upgrade**
- **Displacement Sensor Accuracy Upgrade**
- **RoHS**
- **Spring Pack Measurement Device (SPMD), Sensitivity Polarity Change**
- **SPMD and Spring Pack Cal Stand Combined Accuracy**

Calibration Improvements – Digital Cal Capability

- Channel 15 & 16 Digital Inputs
- Digital Capability added to CalQL software and QL3-FS Calibration Interface
- Interface now becomes M&TE
- 2 Year calibration Interval



+ CalQL Software

Calibration Improvements – Zero Offset Issue

- **Customer Service Bulletin #2016-01**
- **Discovered zero offsets – microvolt level**
- **Small impact on strain gage channels**
  - ➢ **IF CHANNEL NOT ZEROED BY TESTER**
- **Issue related to noise generated during calibration – channels interconnected**
- **Solved with mod to Calibration Interface**
- **Investigation lead to discovery that we can greatly improve system stated accuracy**

+ CalQL Software

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CUSTOMER SERVICE BULLETIN

CSB No. : 2016-01
Title : QL3/FS Calibration Interface – Offset Noise
Affected Products : All QL3 Diagnostic Systems (Including FS models)
All QL3 Calibration Interface Module (CIM)

Specific Models/s/n's : 160200, 160600 & 160600E (s/n QL3-0001 to 0108)
: 160257 (s/n 16780 through 17581)

Issue Description:

An Out of Tolerance (OOT) condition was discovered on some QL3 diagnostic systems. The condition is caused by a ground loop that can generate noise when the analog channels are interconnected during the calibration process. The noise can cause a zero offset which leads to the OOT (>+/-1% reading), as indicated on the CalQL calibration report for readings at the low end of the very lowest range (1mV or 0.1mV/V measurements).

Review of data from OOT channels confirms that the accuracy of the affected units remains well within the +/-1% of reading specification *if* the data from the channel is "zeroed" per procedure during post-test analysis. Given that the mV range on QL3 channels is used only for strain gage devices where the data is normally "zeroed", the actual accuracy of channels with the OOT condition is typically better than +/-0.1% of reading. Therefore this is not an issue for actual QUIKLOOK-FS measurements taken in the field where the data is zeroed. Machines that have been used for DP testing where the data may not have been zeroed may require additional action if a pre DP static test was not conducted.

Reconciliation:

A modification is required to all TTS Calibration Interface Modules (p/n 160257) to eliminate the noise and will be performed by TTS at no charge. Following the modification, we recommend that "As-Found" calibrations be performed on all QL3 systems to re-set the internal zero offsets on their next scheduled calibration cycle. In some cases it may be necessary to perform grounding modifications to the QL3 itself. TTS will perform the re-set and any required grounding modifications at no additional charge at the time of the next scheduled calibration.

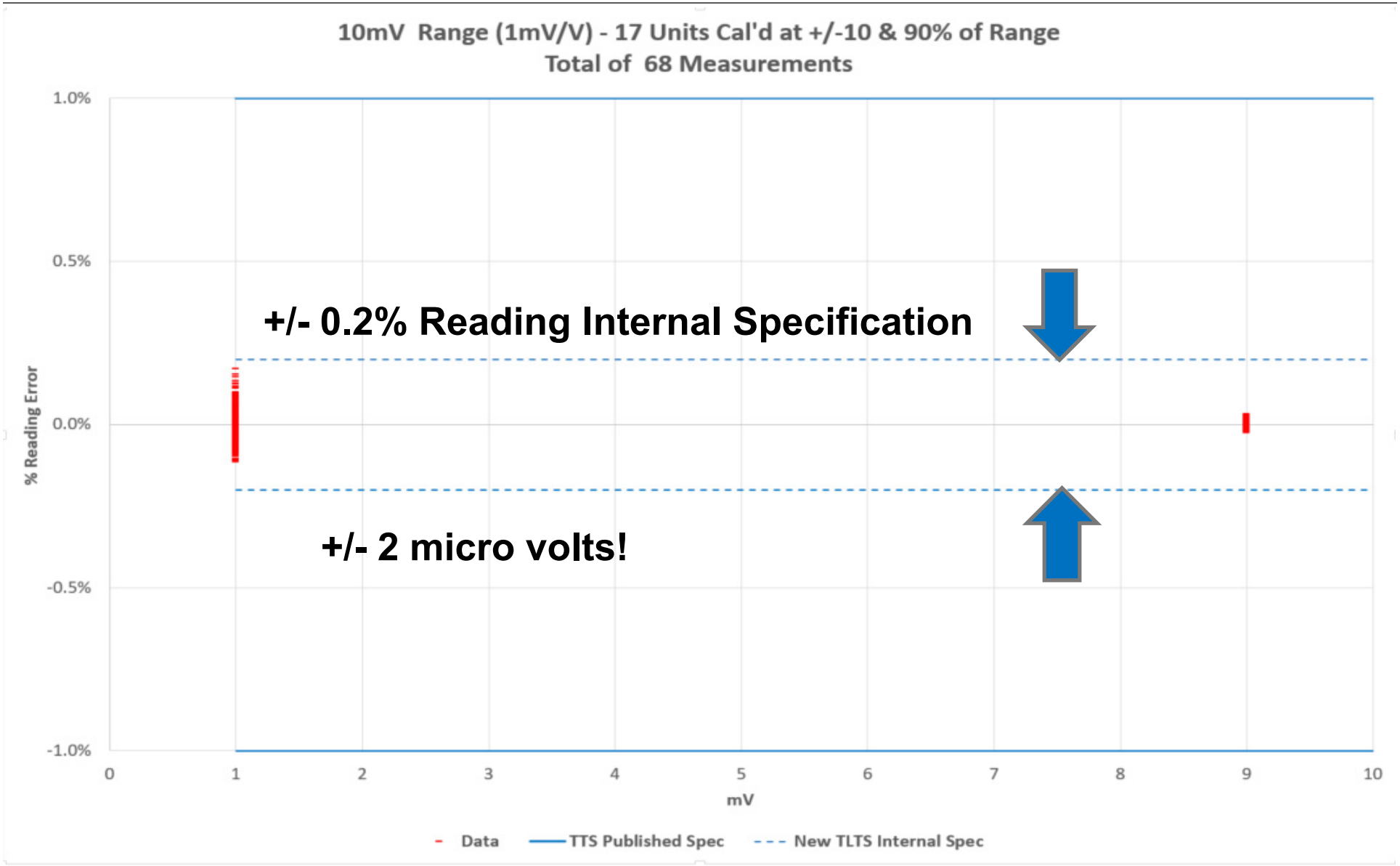
Customer Action Required:

Customer action required is dependent on who calibrates the QL3 units and whether or not any tests were conducted with strain gage devices in which the data for those channels was not zeroed.

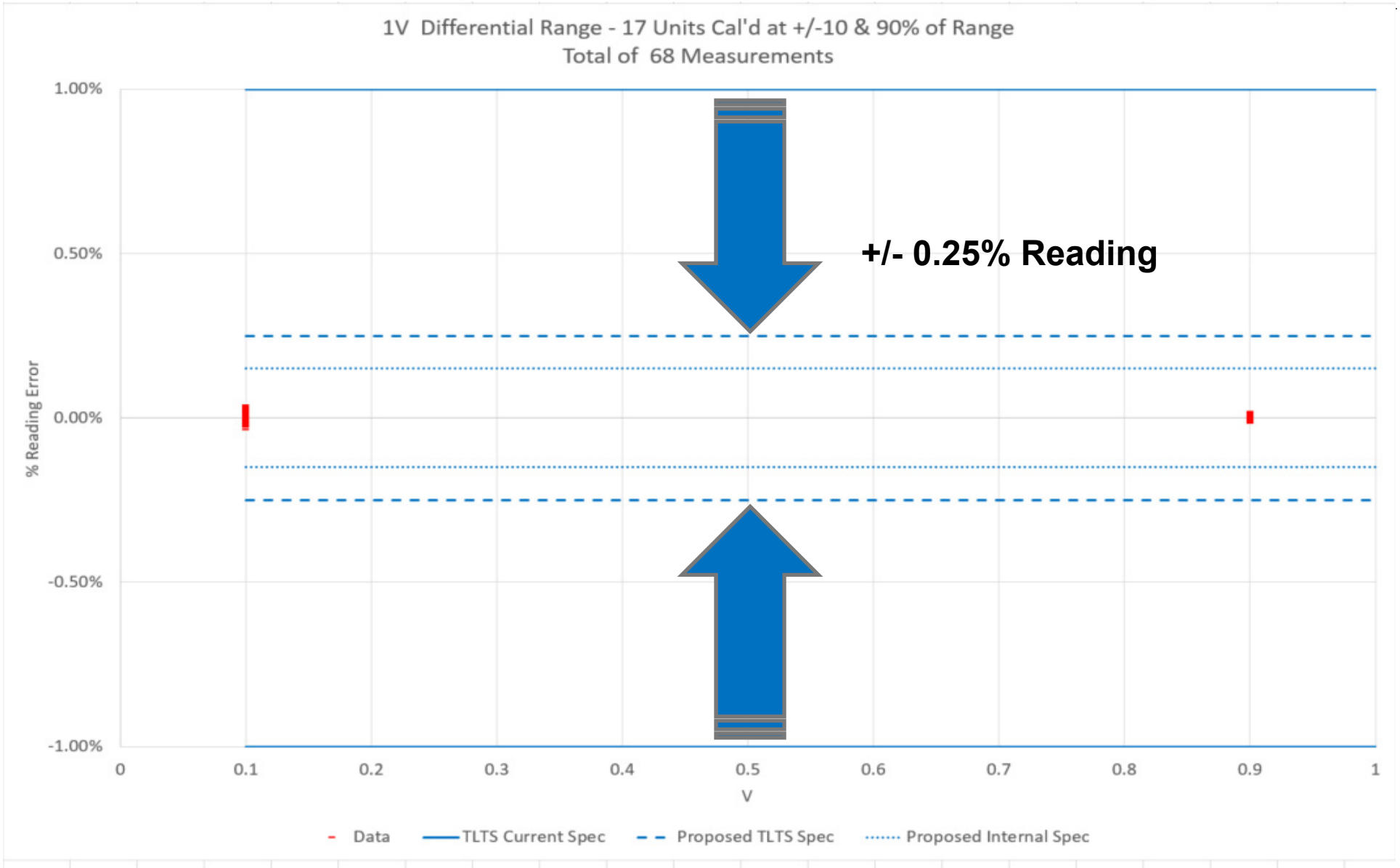
Calibrations Performed By	All Zeroed Tests	Some Tests Not Zeroed
TTS	Send QL3 units to TTS on regular calibration cycle	Send QL3 to TTS ASAP
Customer/3rd Party	Send Calibration Interface to TTS for updates and perform AF cals per TTS Procedure on normal calibration cycle.	Send Calibration Interface to TTS for updates and perform AF cals per TTS Procedure ASAP or prior to DP Testing.

1 of 1

Calibration Improvements – Zero Offset Issue



Calibration Improvements – Zero Offset Issue

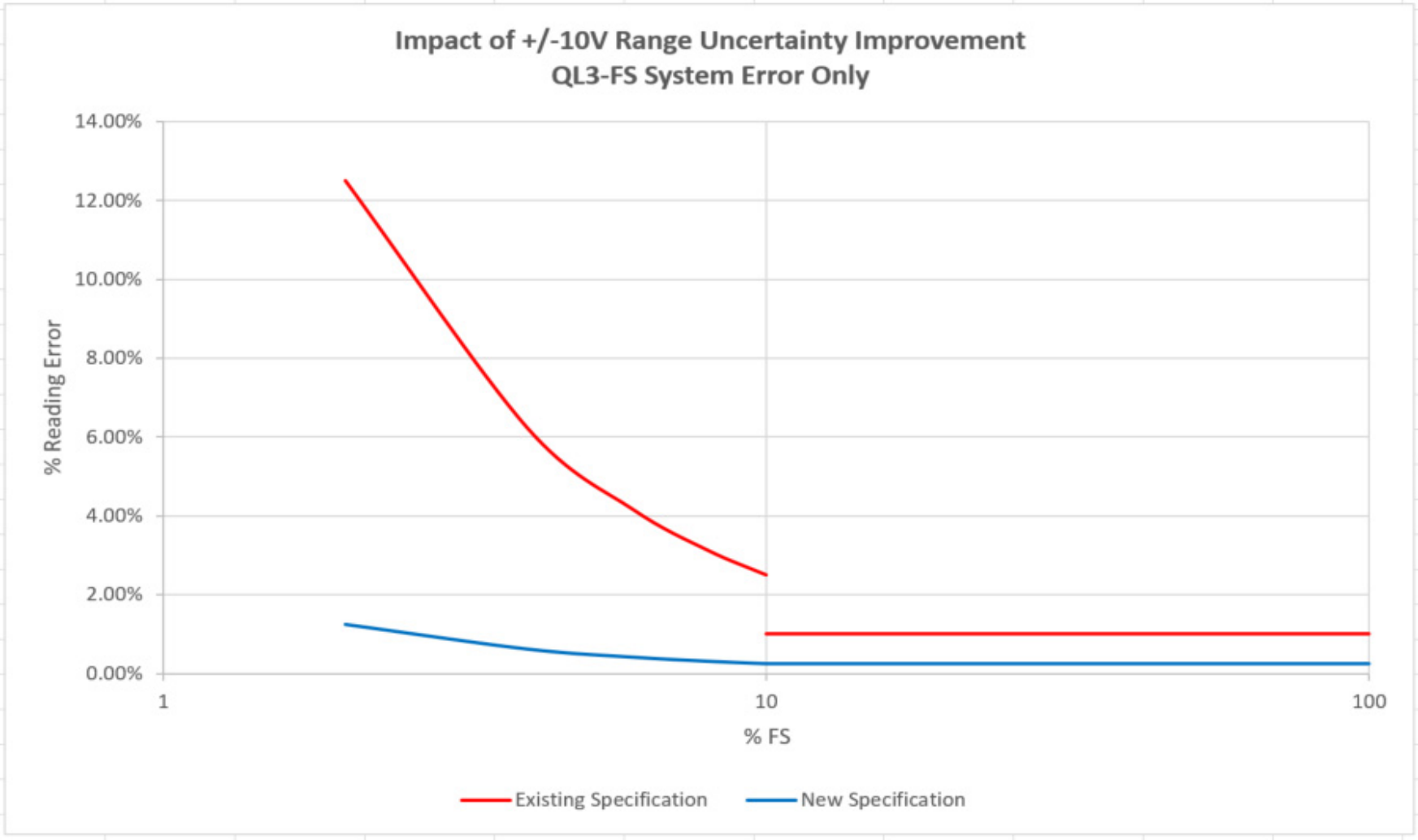


Accuracy Improvements – Analog Channels

- Analog Channels 1-14 currently 1% of reading (0.25% FS <10% reading)
- CSB #2016-1 investigation lead to better understanding of system capability
- Proposed 0.25% Reading for 1V, 3V & 10V range
- Improvement under 10% range to 0.10% FS (mV ranges)
  0.025% FS (V ranges)
- Will apply to all existing QL3 & QL3-FS systems w/TLTS Recal

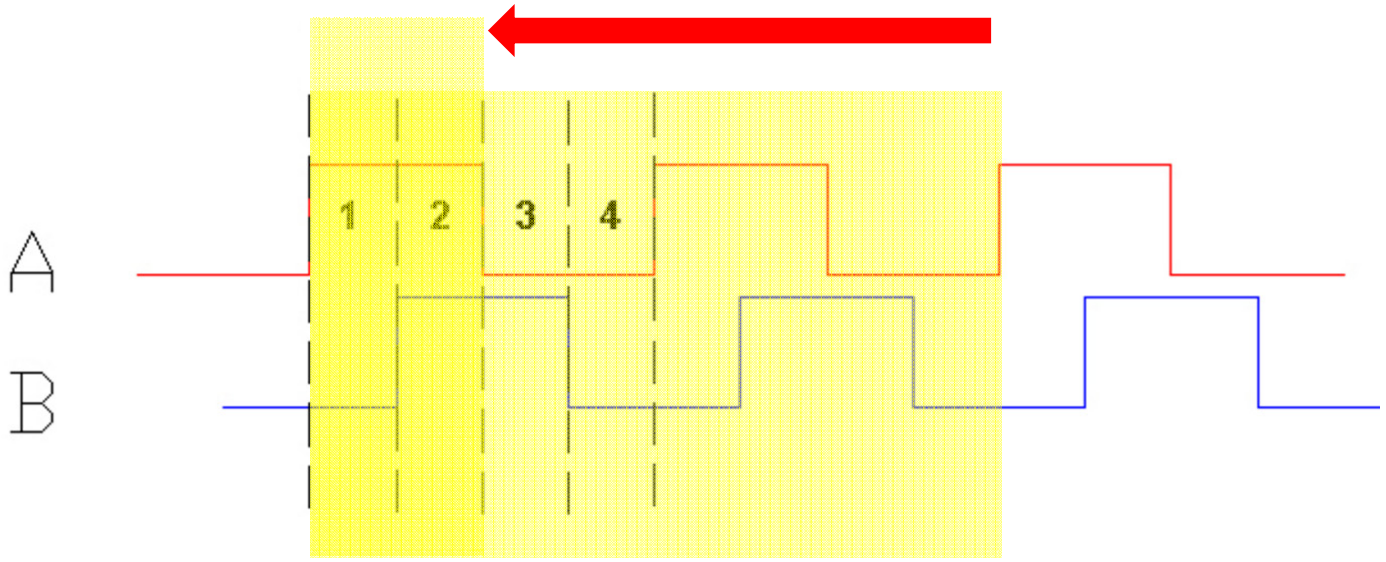
Range (+/-)		Existing		Proposed	
		% of Range		% of Range	
		0-10	10-100	0-10	10-100
10mV	1mV/V	0.25% FS	1% Reading	0.10% FS	1% Reading
30mV	3mV/V				
100mV	10mV/V				
300mV	30mV/V				
1V				0.025% FS	0.25% Reading
3V					
10V					

Accuracy Improvements – Analog Channels



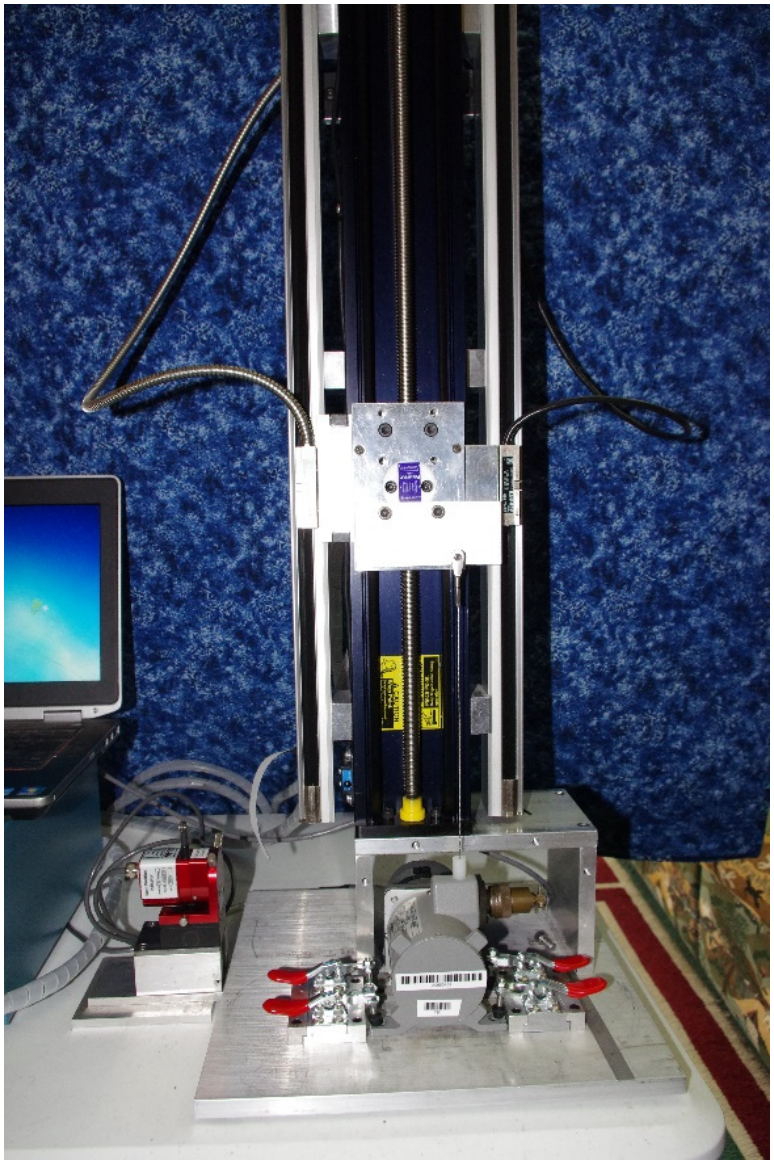
Accuracy Improvements – Digital Channels

- **Present stated uncertainty is +/-2 counts (8 quadrature counts)**
- **1 count = 4 quadrature counts**
- **Improve spec to +/- 0.5 counts (2 quadrature counts)**



Calibration Improvements – Displacement Calibration

- Developed new “Travel Cal” standard for displacement encoders.
- Up to 50” displacement, fully automatic operation
- 0.1” increments with micro-inch resolution
- Available for sale to our partners who perform in-house calibration



Accuracy Improvements – Digital Encoder

- **Original Analog Version 0.25% FS**
  0.075 in for 30 in version
- **Initial Digital Version 0.12% FS**
  0.037 in for 30 in version
- **Now 0.04% FS**
  0.012 in for 30 in Version

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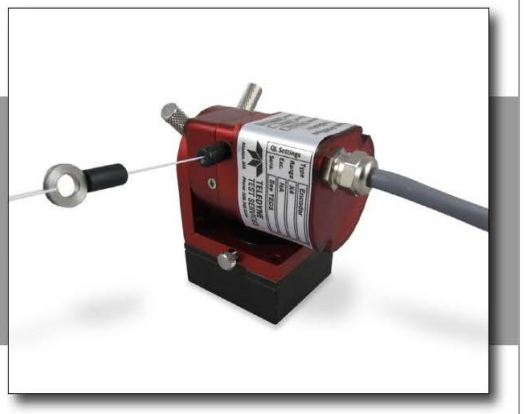
Digital Stem Position Encoder (SPE)



Features

- Ruggedized design
- Magnetic base for easy setup and attachment
- Adjustable orientation angle to allow proper alignment with stem travel
- 30 & 50 inch travel lengths standard
- Accuracy: ±0.04% Full Scale
- TEDS Sensor Recognition (QUIKLOOK 3-FS ONLY)

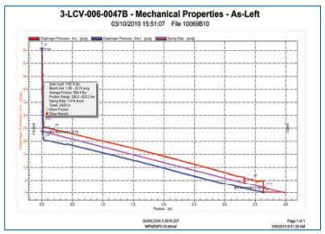
Optional Rotary Shaft Adapter shown

The Stem Position Encoder (SPE) provides the valve tester with a convenient means to accurately measure valve stem position. This custom "string pot" has a magnetic base and a variable orientation to allow the user to properly adapt to a variety of valve bodies and actuators including MSIVs, AOVs and MOVs. The SPE provides a calibrated signal for input to the QUIKLOOK Data Acquisition Systems.

The optional Rotary Shaft Adapter is a clamp-on split sheave used to provide a calibrated cable wrap diameter for conversion of rotary shaft motion to linear SPE cable motion. It includes the conversion factor for SPE output in degrees / volt.

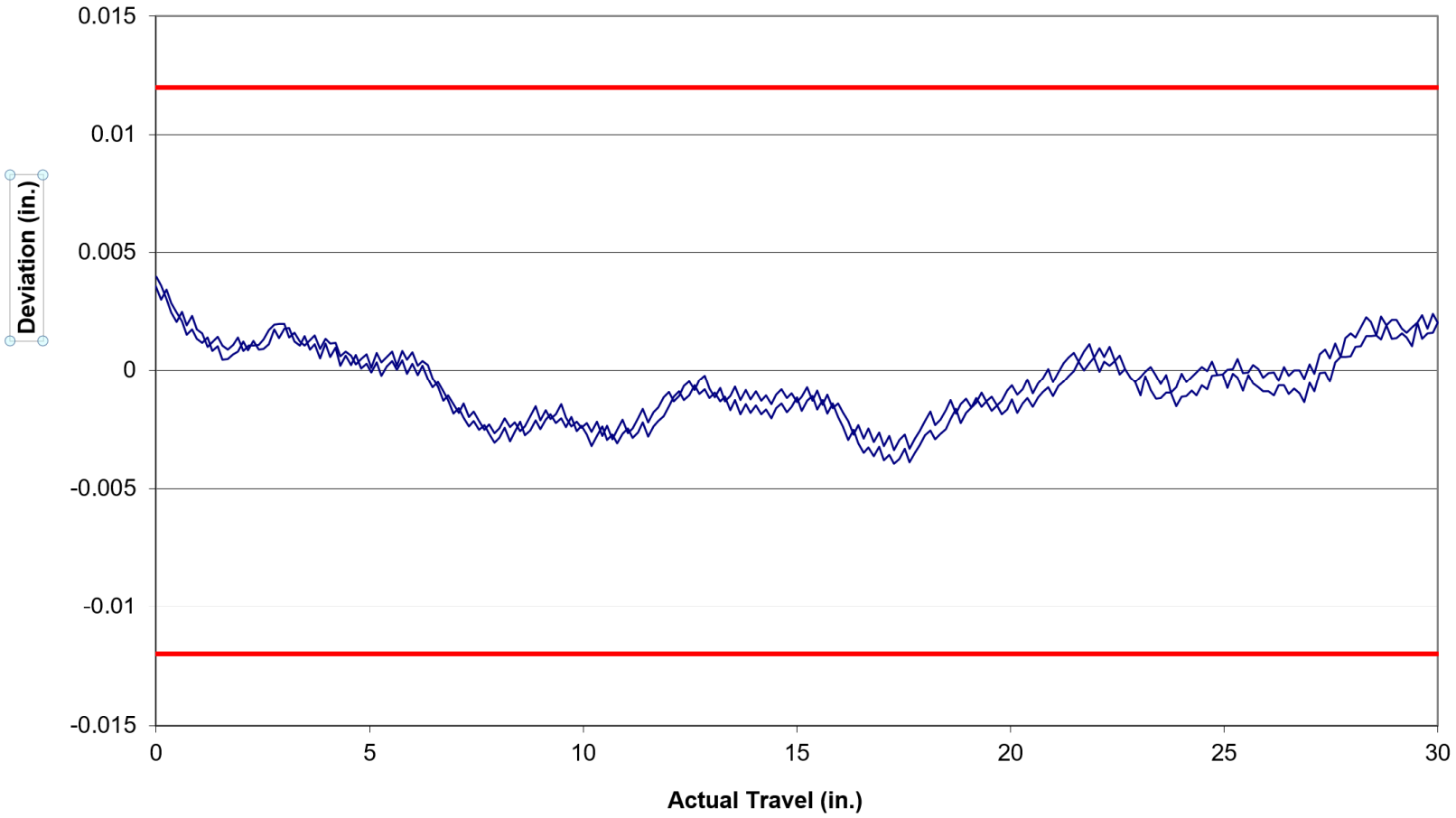
P/N	System	Travel Distance
160564	QL3-FS	30 inch
160643		50 inch

It is available for shaft diameters from 0.375 to 1.875 inches in three ranges.



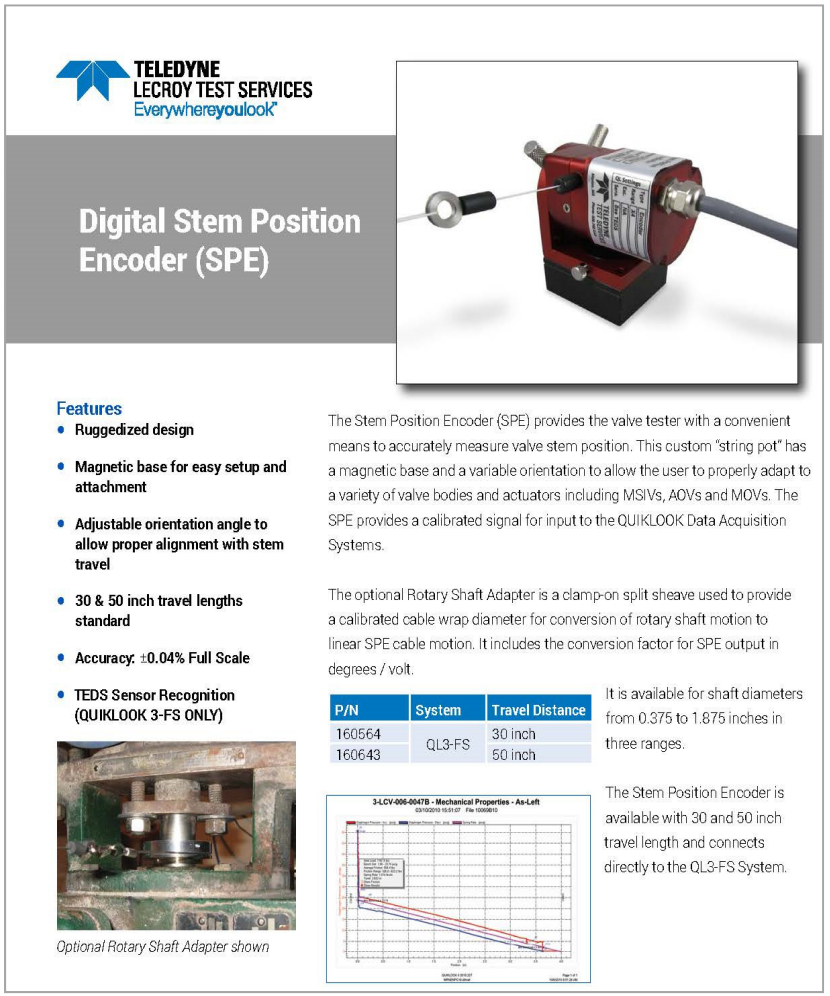
The Stem Position Encoder is available with 30 and 50 inch travel length and connects directly to the QL3-FS System.

Accuracy Improvements – Digital Encoder



Accuracy Improvements – Digital Encoder

- **New Spec for 0-2 inch displacement**
  0.004 in/in
- **Digital channel accuracy +/-0.5 counts,**
  not 1% reading!
- **315.XX/counts per inch = .003 in/count**
- **0.5 counts = 0.0008 channel error**
- **Total error <0.005 in/in (<2 inches)**



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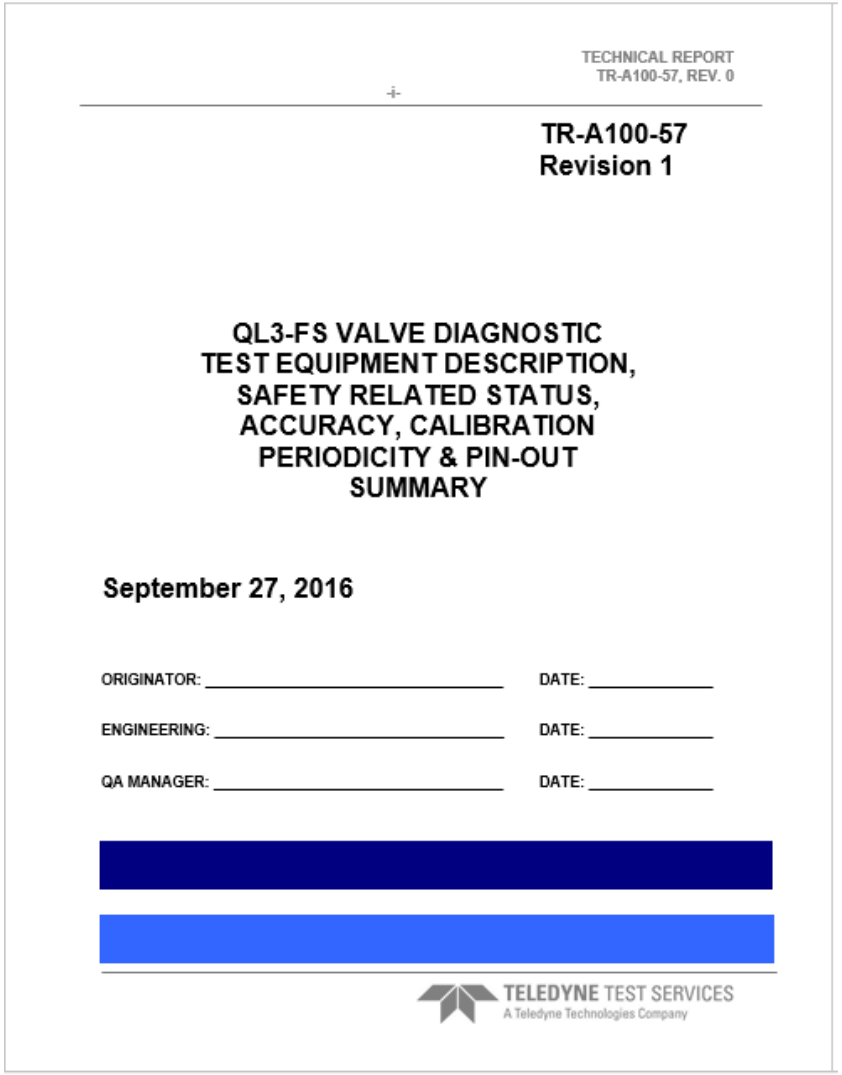
Accuracy Improvements

- **TR-A100-57 Rev 1 – AUG/MUG**



TECHNICAL REPORT
TR-A100-57, REV. 0

TR-A100-57
Revision 1

QL3-FS VALVE DIAGNOSTIC
TEST EQUIPMENT DESCRIPTION,
SAFETY RELATED STATUS,
ACCURACY, CALIBRATION
PERIODICITY & PIN-OUT
SUMMARY

September 27, 2016

ORIGINATOR: _____ DATE: _____

ENGINEERING: _____ DATE: _____

QA MANAGER: _____ DATE: _____

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SPMD and Spring Pack Cal Stand Combined Accuracy

Need to enhance current uncertainty statements for these products to add clarity

- **Better explanation of measurement uncertainty**
- **Better error analysis of individual SP spring rate characterizations**
- **Need for more precise SP moment arm dimensioning**
- **Clearly separate actual moment arm dimensions and uncertainty/conservancy factors**
- **Revise QUIKLOOK FS and MIDAS/TEST accordingly**

Better explanation of measurement uncertainty

- Presently state uncertainty of the SP Calibration Stand as 1.25% of reading
- Based on combined uncertainty of the;
  - Load Cell (0.5% Reading)
  - LVDT (0.5% Reading)
  - QL3-FS (1% Reading)
- Actually closer to 1.5% using conservative approach to the use of (2) QL3-FS channels.
- This only speaks to the calibration uncertainty of the system, not the accuracy of the SP as a measurement instrument.
- 5+% is a reasonable SP Spring Rate uncertainty

Better explanation of measurement uncertainty

- SPMD accuracy was 2% FS until we released the new version in 2013
- FS = 1 inch
- Typical SPMD measurement is 0.2 inches
- 2% FS becomes 10% reading
- Latest version of the SPMD (QL2 and QL3-FS) has 0.5% FS accuracy
- Same measurement >>> 2.5% of reading

SPMD and Spring Pack Cal Stand Combined Accuracy

Better error analysis of individual SP spring rate characterizations

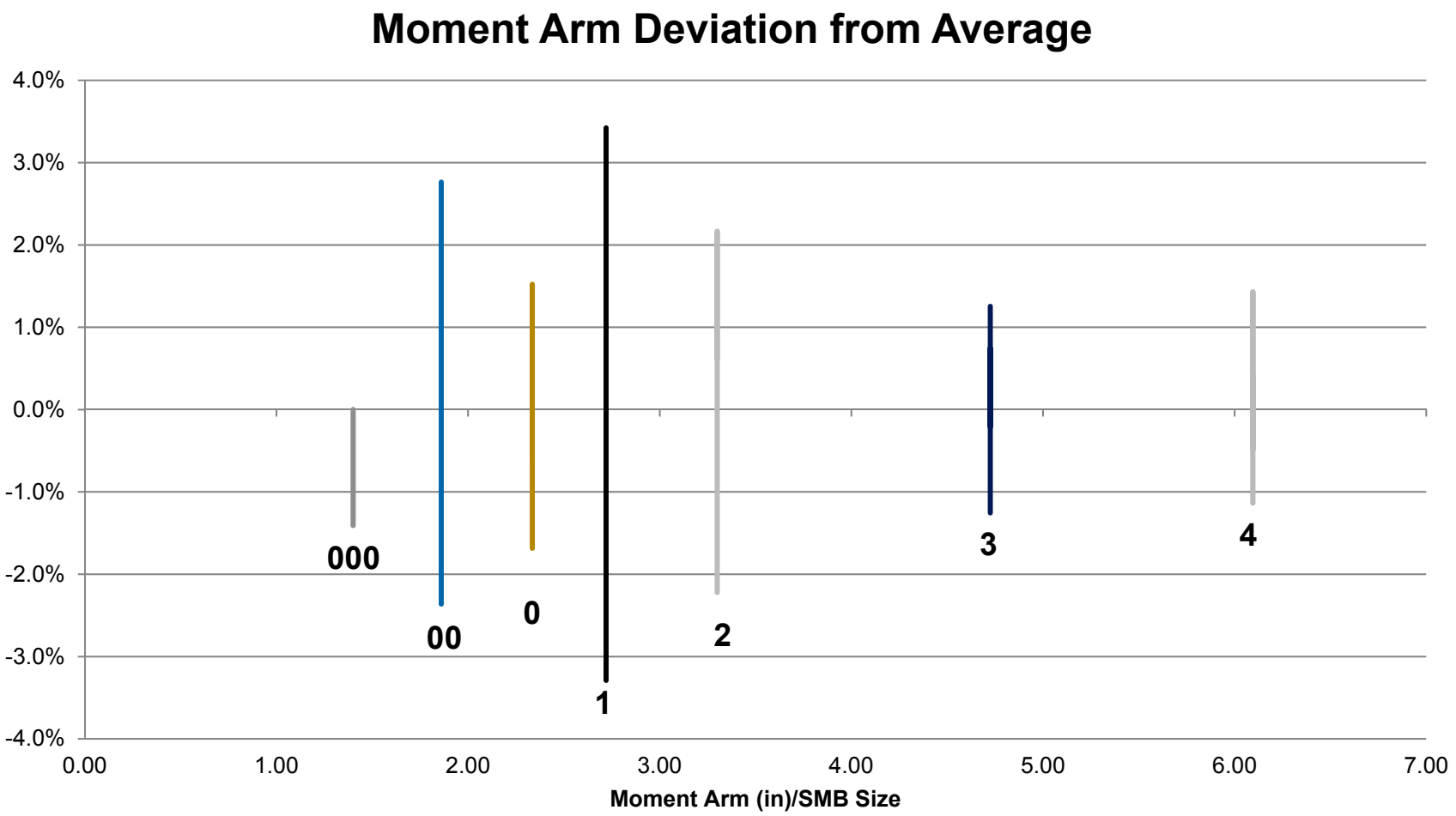
- **Presently QUIKLOOK FS Spring Pack Calibration software module "crushes" a spring pack 3 times and averages these runs**
- **Presents the user with an average 1st , 2nd or 3rd order polynomial curve to characterize the data points.**
- **We will soon provide the user with a error analysis of this best fit line against the actual data points**

SPMD and Spring Pack Cal Stand Combined Accuracy

- **Need for more precise SP moment arm dimensioning**
- **Moment arm data widely used in the industry is only an average for each SMB size…**

Unit Size	Worm Ratio		WG Pitch Radius or Moment Arm (in)	Average Moment Arm used	Error due to use of Average
SMB-000	18.67	1	1.40	1.40	0.00%
	50	1	1.40		0.00%
	68	1	1.42		-1.41%
SMB-00	19	1	1.81	1.86	2.76%
	45	1	1.88		-0.80%
	76	1	1.91		-2.36%
SMB-0	15.67	1	2.35	2.34	-0.64%
	37	1	2.31		1.08%
	58	1	2.30		1.52%
	95	1	2.38		-1.68%
SMB-1	14.5	1	2.63	2.72	3.42%
	34	1	2.69		1.30%
	66	1	2.75		-1.09%
	90	1	2.81		-3.29%
SMB-2	13.33	1	3.28	3.30	0.61%
	33.3	1	3.23		2.17%
	60	1	3.32		-0.45%
	85	1	3.38		-2.22%
SMB-3	10.33	1	4.67	4.73	1.25%
	16	1	4.74		-0.21%
	41	1	4.69		0.75%
	57	1	4.75		-0.53%
	80	1	4.79		-1.25%
SMB-4	12.67	1	6.12	6.10	-0.33%
	19	1	6.07		0.41%
	49	1	6.13		-0.49%
	58	1	6.01		1.43%
	86	1	6.17		-1.14%

SPMD and Spring Pack Cal Stand Combined Accuracy



SPMD and Spring Pack Cal Stand Combined Accuracy

- **Clearly separate actual moment arm dimensions and uncertainty/conservancy factors**
  - **Presently QUIKLOOK FS Spring Pack Module and MIDAS contain the widely used industry moment arm data.**
  - **SP displacement X moment arm = actuator torque**
  - **These moment arm dimensions include a 10% increase to inject conservancy into the resultant**
  - **Teledyne will provide for user input of moment arm data and uncertainty.**
  - **User obtains moment arm data from Limitorque**

SPMD and Spring Pack Cal Stand Combined Accuracy

- **Revise QUIKLOOK FS and MIDAS/TEST accordingly**
  - **QUIKLOOK FS update for MUG/AUG**
  - **MIDAS/Test update as requested**

Any Questions?

THANK YOU

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