OWSG GENERAL MEETING

June 14, 2022

8:30 am CDT Start Time

Jonathan Lightfoot

Sub-Committee Chair

AGENDA

- OWSG Mission & Anti-Trust
- API RP-78 Update
- Wellbore Quality Metrics – The Precision Placement Value Proposition
- IOGP P7 Adoption
- MWD Sensor Calibration & Lab Standards
- Open Discussion Session

Introductions

- Name
- Company Affiliation
- Favorite Holiday Destination

OWSG Mission

To promote practices that provide confidence that reported wellbore positions are within their stated uncertainty.

OWSG Anti-Trust

We are meeting to help develop and promote good practices in wellbore surveying necessary to support oil and gas operations which enhance safety and competition.

The meeting will be conducted in compliance with all laws including the antitrust laws, both state and federal. We will not discuss prices paid to suppliers or charged to customers nor will we endorse or disparage vendors or goods or services, divide markets, or discuss with whom we will or will not do business, nor other specific commercial terms, because these are matters for each company or individual to independently evaluate and determine. We are meeting to help develop and promote good practices in wellbore surveying necessary to support wellbore construction operations which enhance safety and competition.

API RP-78

- PROPOSAL SELECTED
- FUNDING APPROVED
- WORK STARTING SOON

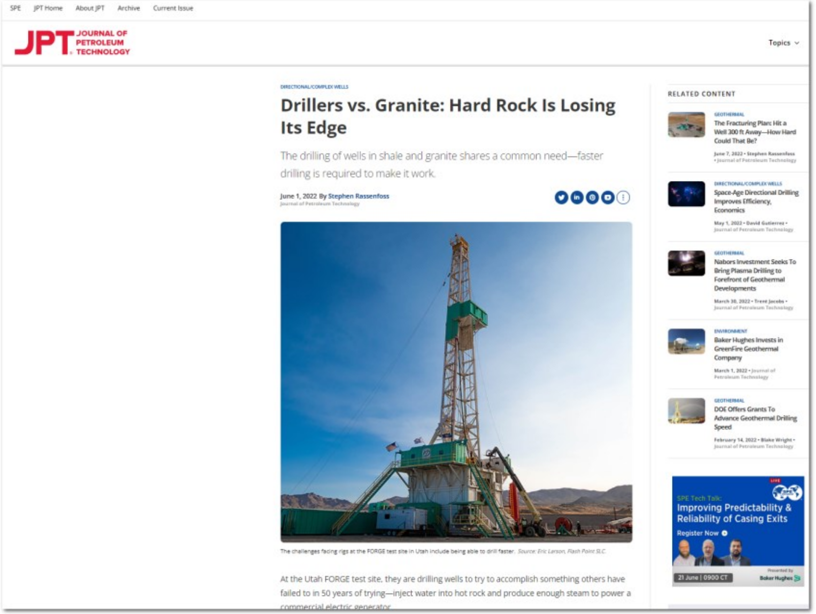
- A PART-TIME TECHNICAL WRITER SELECTED
    - 15hrs a WEEK (MAX)
    - 90 – 100 hrs Estimated
    - 3-4 MONTH ESTIMATE

Wellbore Quality Metrics

- PRECISION PLACEMENT - VALUE STATEMENT
- LOOKING BEYOND “MAX DOGLEG”
- DOES WELL PLACEMENT QUALITY MATTER?
    - SAFE SEPARATION
    - DRILLING EFFICIENCY
    - DOWNHOLE EQUIPMENT RELIABILITY
    - CEMENTING
    - COMPLETIONS & STIMULATION
    - PRODUCTION
    - WELL SERVICING

Industry Collaboration Opportunity

Geothermal – JPT Article: Trajectory Example



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JPT JOURNAL OF PETROLEUM TECHNOLOGY

Topics

DIRECTIONAL/COMPLEX WELLS

Drillers vs. Granite: Hard Rock Is Losing Its Edge

The drilling of wells in shale and granite shares a common need—faster drilling is required to make it work.

June 1, 2022 By Stephen Rassenfoss

The challenges facing rigs at the FORGE test site in Utah include being able to drill faster. *Source: Eric Larson, Flash Point SLC.*

At the Utah FORGE test site, they are drilling wells to try to accomplish something others have failed to in 50 years of trying—inject water into hot rock and produce enough steam to power a commercial electric generator.

RELATED CONTENT

GEOTHERMAL
The Fracturing Plan: Hit a Well 300 ft Away—How Hard Could That Be?
June 7, 2022 • Stephen Rassenfoss • Journal of Petroleum Technology

DIRECTIONAL/COMPLEX WELLS
Space-Age Directional Drilling Improves Efficiency, Economics
May 1, 2022 • David Gutierrez • Journal of Petroleum Technology

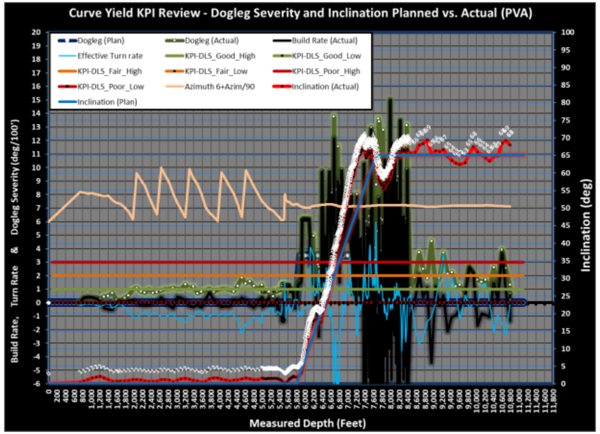
GEOTHERMAL
Nabors Investment Seeks To Bring Plasma Drilling to Forefront of Geothermal Developments
March 30, 2022 • Trent Jacobs • Journal of Petroleum Technology

ENVIRONMENT
Baker Hughes Invests in GreenFire Geothermal Company
March 1, 2022 • Journal of Petroleum Technology

GEOTHERMAL
DOE Offers Grants To Advance Geothermal Drilling Speed
February 14, 2022 • Blake Wright • Journal of Petroleum Technology

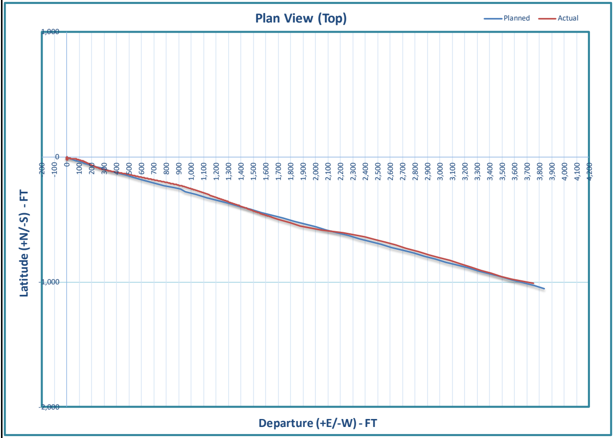
Fig. 1—The three wells marked on the map were part of a test that halved the time required to drill geothermal wells in really hard rock. *Source: SPE 208798.*

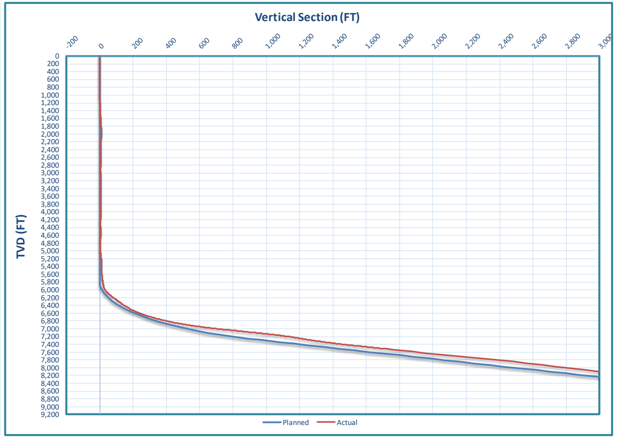
Well Trajectory Analysis



DIRECTIONAL DRILLING STEERING QUALITY
KPI WELL PLACEMENT SCORECARD

BU: UTAH FORGE	WELL: 16A	AREA: UTAH	DD/MWD COMPANY: Scout Downhole	FIELD: FORGE

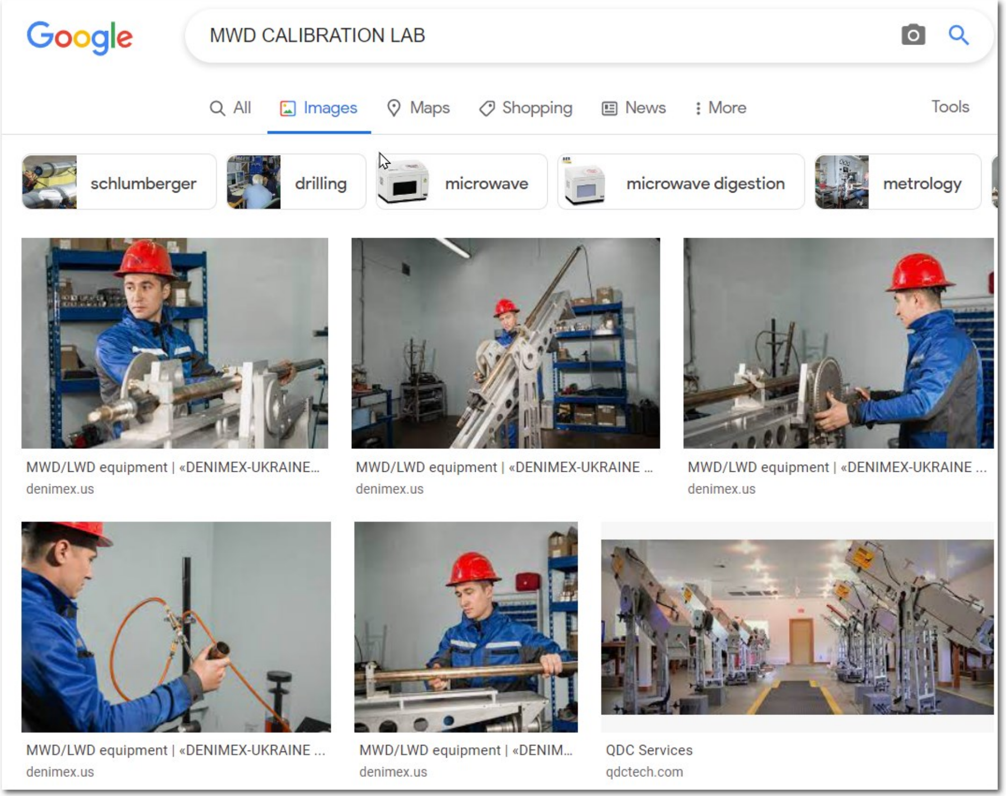




IOGP P7 DISCUSSION – PETE CLARK

[P7/17 Wellbore Positioning Data Exchange Format (and User Guide) | IOGP Publications library]

IOGP Report 483-7 & 483-7u



Seeking Information from Industry Experts

Industry Standards
NIST / API / ISO / Others?

Sensor Types?

SENSOR CALIBRATION PRESENTATION – MEMS vs. FLUXGATE

Sensor Calibration Process

MEMS vs. Fluxgate Mag Calibration, presented by Chad Hanak

March 2019

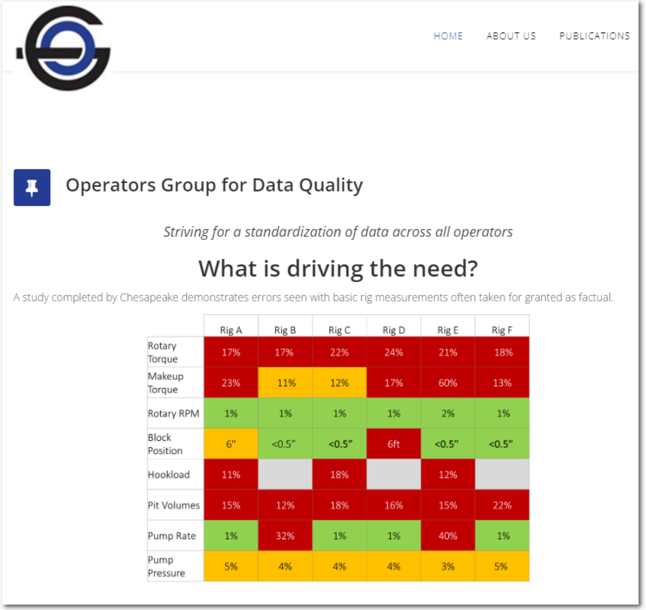
Source: https://tolteq.com/?p=5859

https://www.nov.com/Segments/Wellbore_Technologies/ReedHycalog/Directional_Measurment_and_Steerable_Technologies/Directional_Systems/Tolteq_iSeries_MWD_Solutions/Tolteq_Repair_and_Maintenance/Tolteq_Service_and_Support/Tolteq_Service_and_Support.aspx

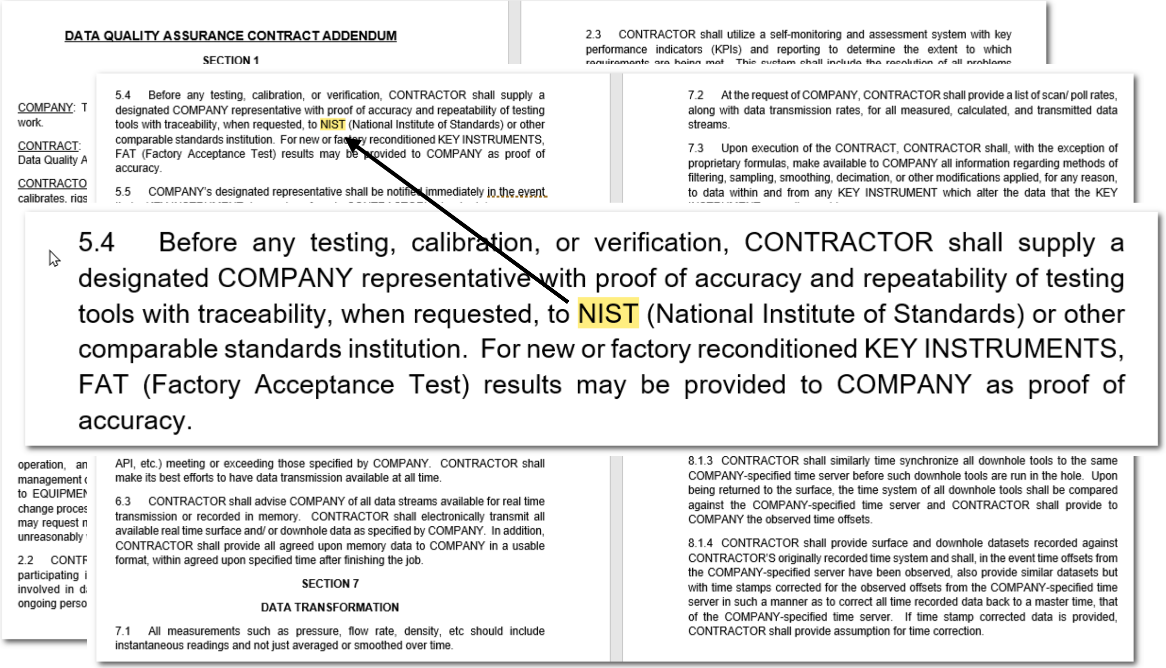
Steps

1. Solve for coefficient table at one temperature using total field calibration or some other technique
2. Repeat Step 1 at multiple other temperatures to calculate temperature-based polynomials for each coefficient
3. Write the coefficient table to the tool and perform a verification run

ISCWSA



	Rig A	Rig B	Rig C	Rig D	Rig E	Rig F
Rotary Torque	17%	17%	22%	24%	21%	18%
Makeup Torque	23%	11%	12%	17%	60%	13%
Rotary RPM	1%	1%	1%	1%	2%	1%
Block Position	6"	<0.5"	<0.5"	6ft	<0.5"	<0.5"
Hookload	11%		18%		12%	
Pit Volumes	15%	12%	18%	16%	15%	22%
Pump Rate	1%	32%	1%	1%	40%	1%
Pump Pressure	5%	4%	4%	4%	3%	5%



DATA QUALITY ASSURANCE CONTRACT ADDENDUM

SECTION 1

5.4 Before any testing, calibration, or verification, CONTRACTOR shall supply a designated COMPANY representative with proof of accuracy and repeatability of testing tools with traceability, when requested, to NIST (National Institute of Standards) or other comparable standards institution. For new or factory reconditioned KEY INSTRUMENTS, FAT (Factory Acceptance Test) results may be provided to COMPANY as proof of accuracy.

7.2 At the request of COMPANY, CONTRACTOR shall provide a list of scan/ poll rates, along with data transmission rates, for all measured, calculated, and transmitted data streams.

API, etc.) meeting or exceeding those specified by COMPANY. CONTRACTOR shall make its best efforts to have data transmission available at all time.

6.3 CONTRACTOR shall advise COMPANY of all data streams available for real time transmission or recorded in memory. CONTRACTOR shall electronically transmit all available real time surface and/ or downhole data as specified by COMPANY. In addition, CONTRACTOR shall provide all agreed upon memory data to COMPANY in a usable format, within agreed upon specified time after finishing the job.

SECTION 7

DATA TRANSFORMATION

7.1 All measurements such as pressure, flow rate, density, etc should include instantaneous readings and not just averaged or smoothed over time.

8.1.3 CONTRACTOR shall similarly time synchronize all downhole tools to the same COMPANY-specified time server before such downhole tools are run in the hole. Upon being returned to the surface, the time system of all downhole tools shall be compared against the COMPANY-specified time server and CONTRACTOR shall provide to COMPANY the observed time offsets.

8.1.4 CONTRACTOR shall provide surface and downhole datasets recorded against CONTRACTOR'S originally recorded time system and shall, in the event time offsets from the COMPANY-specified server have been observed, also provide similar datasets but with time stamps corrected for the observed offsets from the COMPANY-specified time server in such a manner as to correct all time recorded data back to a master time, that of the COMPANY-specified time server. If time stamp corrected data is provided, CONTRACTOR shall provide assumption for time correction.

Data quality assurance contract addendum (ogdq.org)

NIST

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PUBLICATIONS

Magnetometer Calibration Services

Published: July 1, 1995

Author(s)
Edwin R. Williams, D. W. Matson

Proceedings Title: Proc. 1995National Conference of Standards Laboratories Workshop and Symposium (NCSL)

Conference Dates: July 16-20, 1995

Conference Location: Dallas, TX

Pub Type: Conferences

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Electrical / electromagnetic metrology

Edwin R. Williams
National Institute of Standards and Technology
Gaithersburg, MD 20899, USA

Abstract—A new facility to calibrate magnetometers in San Diego has recently been completed as a cooperative effort between the Naval Primary Standards Laboratory and the National Institute of Standards and Technology. All measurements are NIST traceable through a nuclear magnetic resonance-based measurement. Magnetic fields from the 0.1 µT to 1.4 T can be calibrated by comparisons with fields generated by a series of coils or an electromagnet.

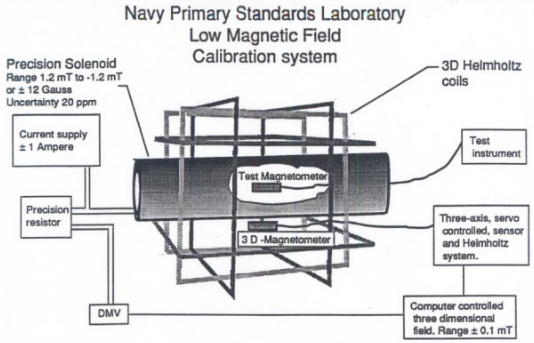


Figure 1. Low Magnetic Field Calibration System.

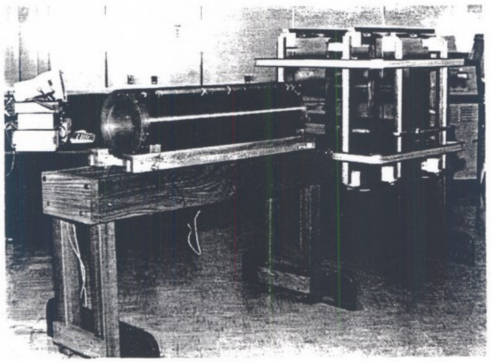
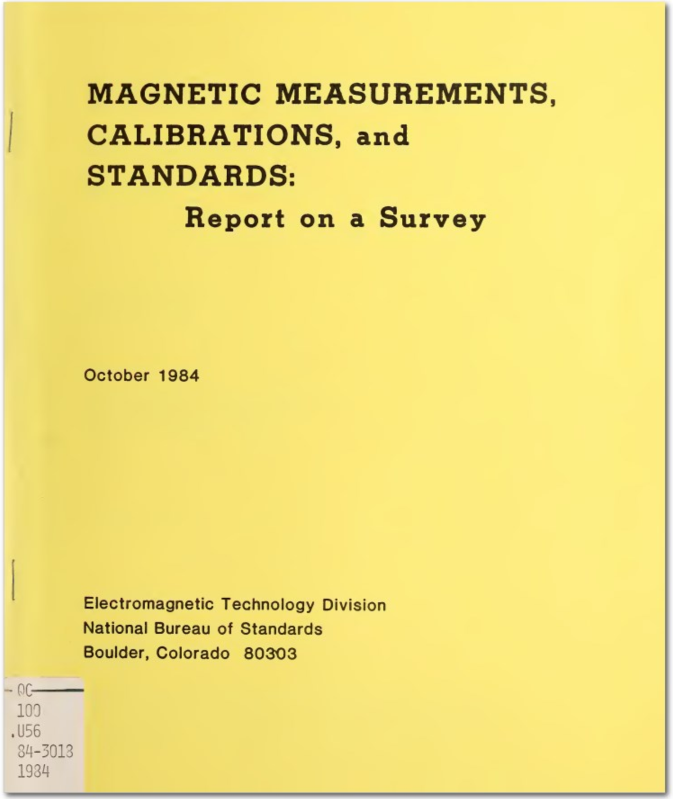


Figure 2. Photograph of Low Field System.

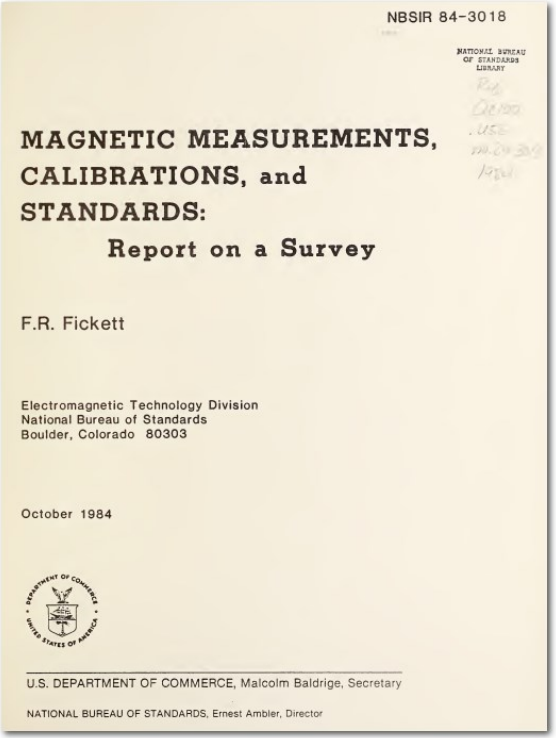
1995 NCSL Workshop & Symposium

Session 6B


MAGNETIC MEASUREMENTS,
CALIBRATIONS, and
STANDARDS:
Report on a Survey

October 1984

Electromagnetic Technology Division
National Bureau of Standards
Boulder, Colorado 80303


NBSIR 84-3018

MAGNETIC MEASUREMENTS,
CALIBRATIONS, and
STANDARDS:
Report on a Survey

F.R. Fickett

Electromagnetic Technology Division
National Bureau of Standards
Boulder, Colorado 80303

October 1984

U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, Secretary

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

1984 Report
on a Survey

National
Bureau of
Standards

[Magnetic measurements, calibrations, and standards: report on a survey (govinfo.gov)]

Magnetic Signature Collection & Methodology Standard

Range Commanders Council

STANDARD 808-03

SIGNATURE MEASUREMENT STANDARDS GROUP

MAGNETIC SIGNATURE COLLECTION & METHODOLOGY STANDARD

WHITE SANDS MISSILE RANGE
REAGAN TEST SITE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ABERDEEN TEST CENTER
NATIONAL TRAINING CENTER
ELECTRONIC PROVING GROUND

NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT
PACIFIC MISSILE RANGE FACILITY
NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT
NAVAL STRIKE AND AIRWARFARE CENTER

30TH SPACE WING
45TH SPACE WING
AIR FORCE FLIGHT TEST CENTER
AIR ARMAMENT CENTER
AIR WARFARE CENTER
ARNOLD ENGINEERING DEVELOPMENT CENTER
BARRY M. GOLDWATER RANGE
UTAH TEST AND TRAINING RANGE

NATIONAL NUCLEAR SECURITY ADMINISTRATION (NEVADA)

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3.6 Scientific Grade Magnetometers

The magnetometers used must be of scientific quality and have an annual calibration traceable to NIST. Although the manufacturers calibrate single-axis and 3-axis magnetometers, such calibrations are only valid for a finite period of time. Annual calibration of the magnetometer is mandatory by the manufacturer or by other means.

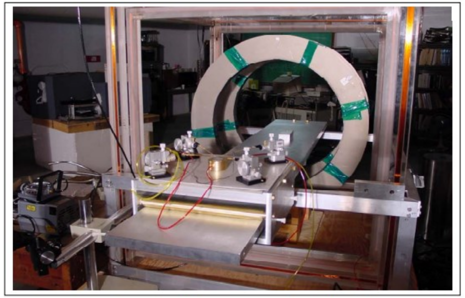
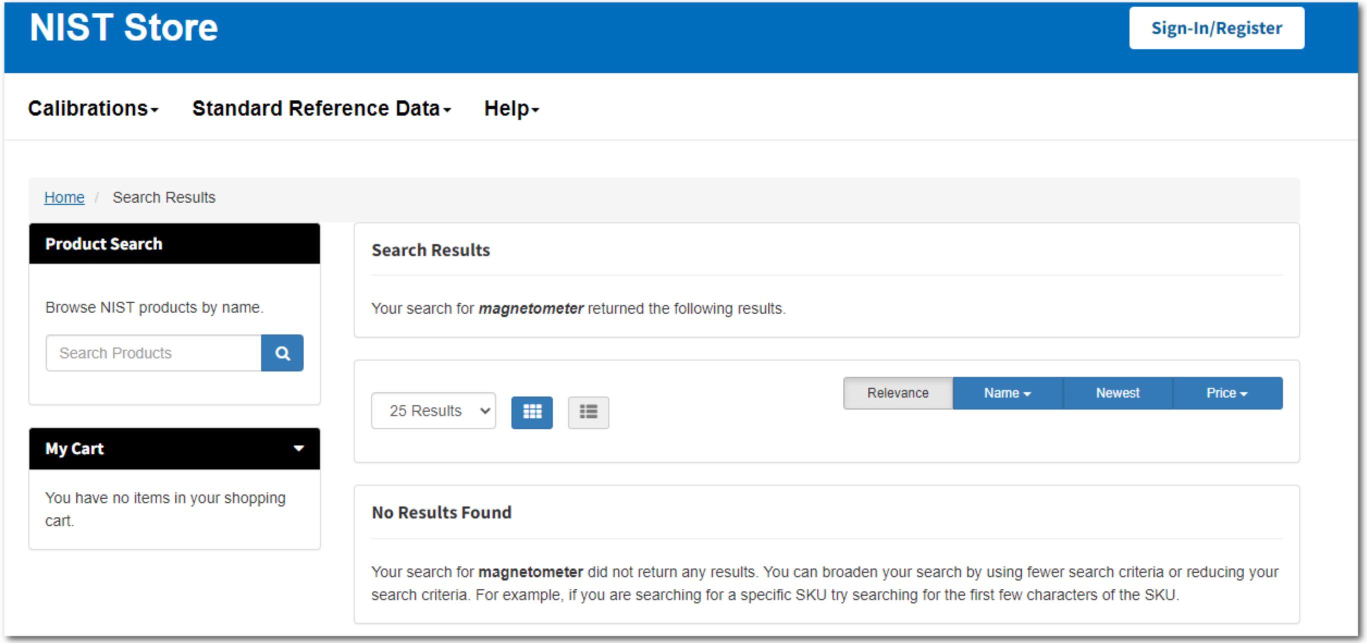
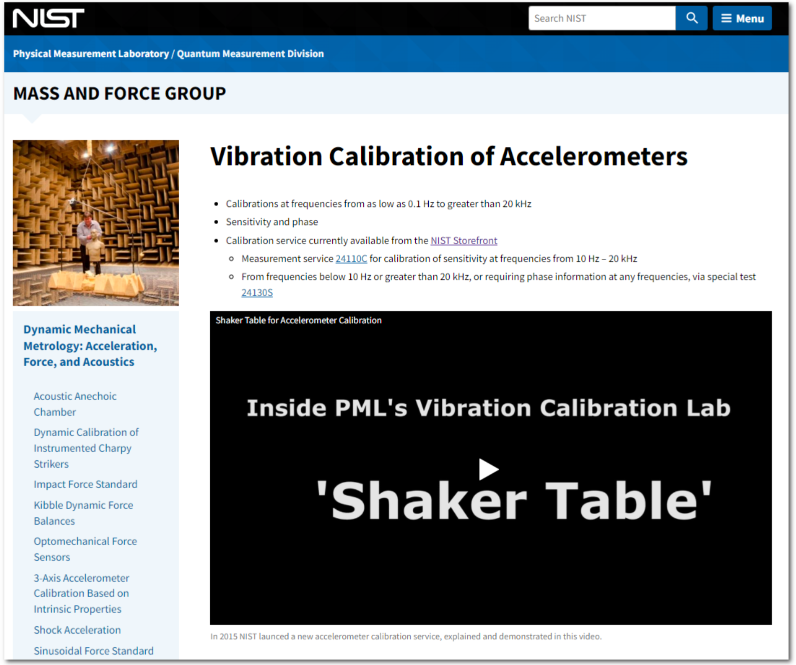


Figure 3-1. 3-axis Helmholtz coil system with a higher field single-axis Helmholtz coil system mounted inside.

FLUX-GATE MAGNETOMETER



Vibration Calibration of Accelerometers | NIST



NIST

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Physical Measurement Laboratory / Quantum Measurement Division

MASS AND FORCE GROUP

Vibration Calibration of Accelerometers

- Calibrations at frequencies from as low as 0.1 Hz to greater than 20 kHz
- Sensitivity and phase
- Calibration service currently available from the NIST Storefront
  - Measurement service 24110C for calibration of sensitivity at frequencies from 10 Hz – 20 kHz
  - From frequencies below 10 Hz or greater than 20 kHz, or requiring phase information at any frequencies, via special test 24130S

Shaker Table for Accelerometer Calibration

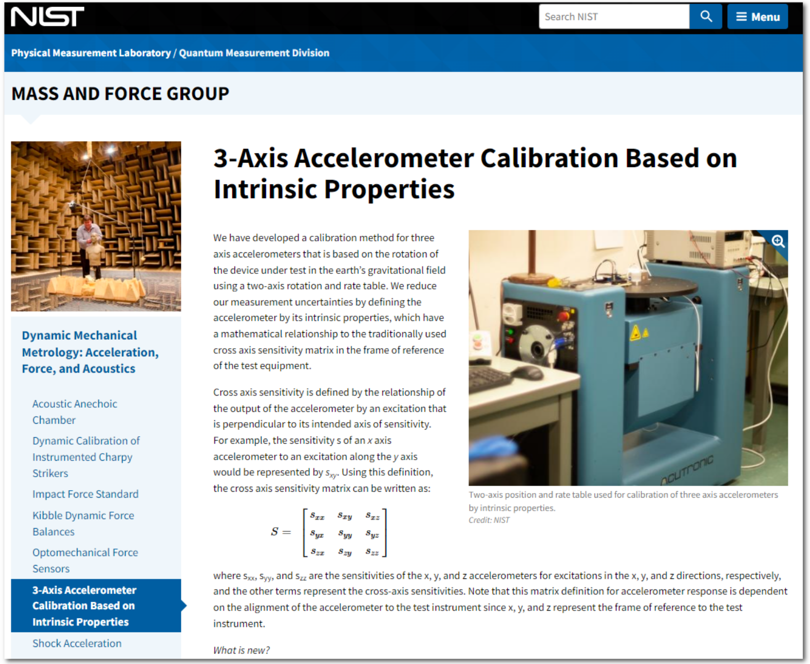
Inside PML's Vibration Calibration Lab

'Shaker Table'

In 2015 NIST launced a new accelerometer calibration service, explained and demonstrated in this video.

Dynamic Mechanical Metrology: Acceleration, Force, and Acoustics

- Acoustic Anechoic Chamber
- Dynamic Calibration of Instrumented Charpy Strikers
- Impact Force Standard
- Kibble Dynamic Force Balances
- Optomechanical Force Sensors
- 3-Axis Accelerometer Calibration Based on Intrinsic Properties
- Shock Acceleration
- Sinusoidal Force Standard



NIST

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Physical Measurement Laboratory / Quantum Measurement Division

MASS AND FORCE GROUP

3-Axis Accelerometer Calibration Based on Intrinsic Properties

We have developed a calibration method for three axis accelerometers that is based on the rotation of the device under test in the earth's gravitational field using a two-axis rotation and rate table. We reduce our measurement uncertainties by defining the accelerometer by its intrinsic properties, which have a mathematical relationship to the traditionally used cross axis sensitivity matrix in the frame of reference of the test equipment.

Cross axis sensitivity is defined by the relationship of the output of the accelerometer by an excitation that is perpendicular to its intended axis of sensitivity. For example, the sensitivity s of an *x* axis accelerometer to an excitation along the *y* axis would be represented by s_{xy}. Using this definition, the cross axis sensitivity matrix can be written as:

$$S = \begin{bmatrix} s_{xx} & s_{xy} & s_{xz} \\ s_{yx} & s_{yy} & s_{yz} \\ s_{zx} & s_{zy} & s_{zz} \end{bmatrix}$$

Two-axis position and rate table used for calibration of three axis accelerometers by intrinsic properties.
Credit: NIST

where s_{xx}, s_{yy}, and s_{zz} are the sensitivities of the x, y, and z accelerometers for excitations in the x, y, and z directions, respectively, and the other terms represent the cross-axis sensitivities. Note that this matrix definition for accelerometer response is dependent on the alignment of the accelerometer to the test instrument since x, y, and z represent the frame of reference to the test instrument.

What is new?

Dynamic Mechanical Metrology: Acceleration, Force, and Acoustics

- Acoustic Anechoic Chamber
- Dynamic Calibration of Instrumented Charpy Strikers
- Impact Force Standard
- Kibble Dynamic Force Balances
- Optomechanical Force Sensors
- **3-Axis Accelerometer Calibration Based on Intrinsic Properties**
- Shock Acceleration

MWD CALIBRATION LABS

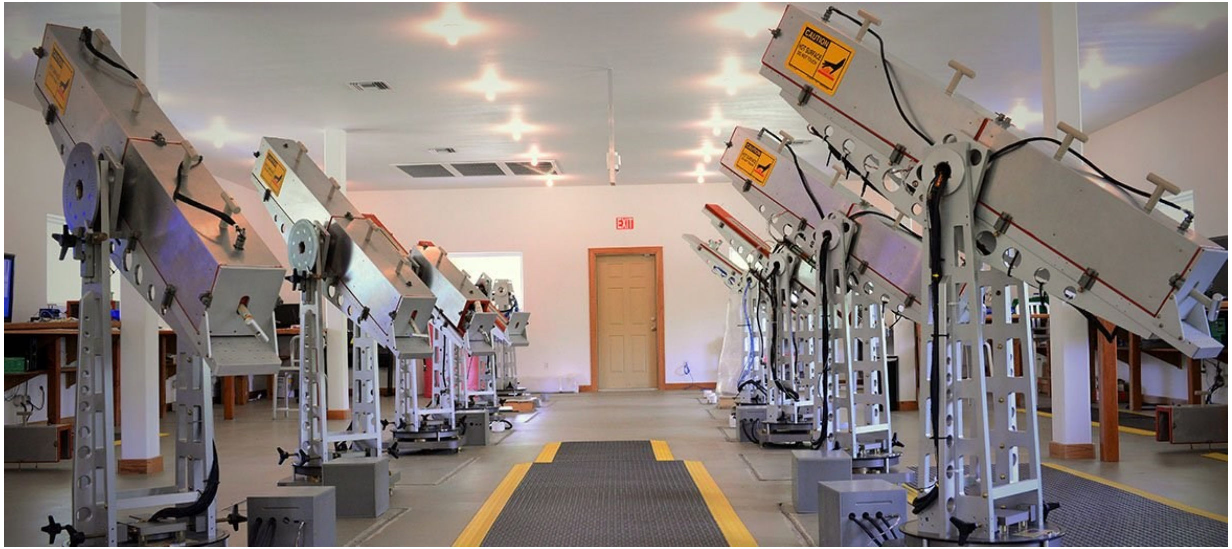

Image Downloaded from www.qdctech.com
QDC Services (qdctech.com)

Calibration Facility | MicroTesla
Magnetic Field Effects

Open Discussion

Questions?

Thank you for attending this meeting

Thank you

Questions?