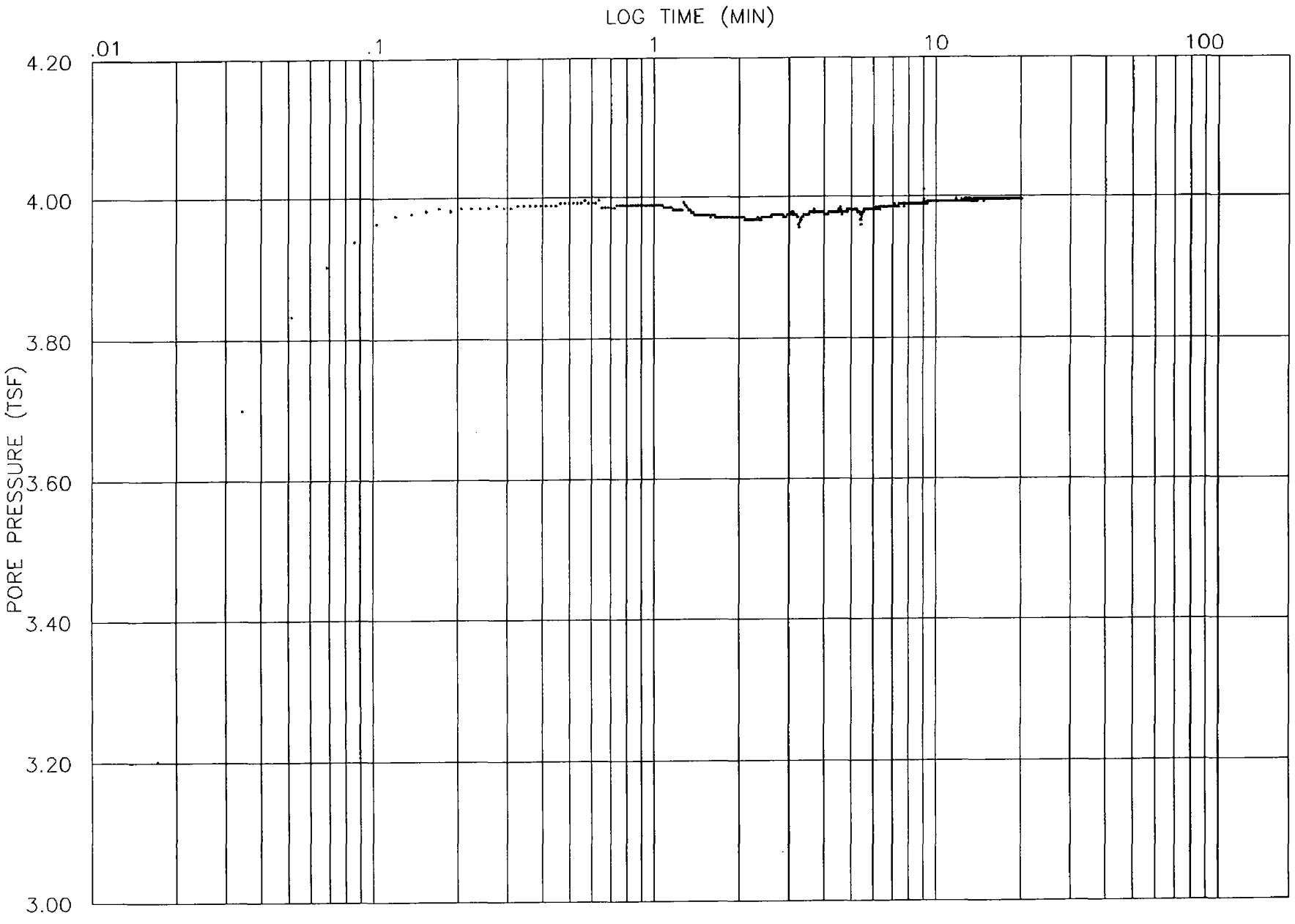
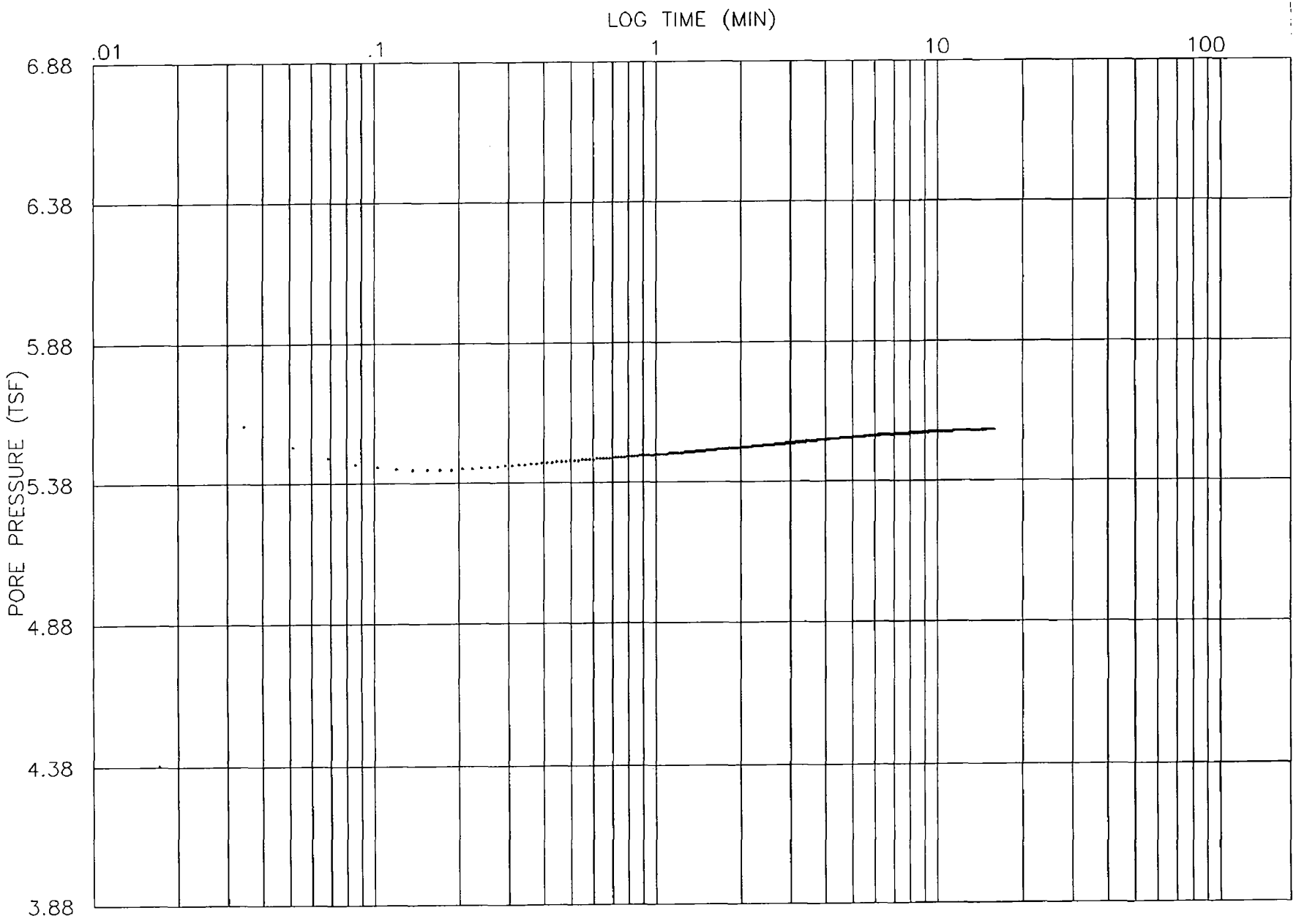
# DISSIPATION PLOTS




CPT NUMBER: C-601
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 125.9 FEET
DATE: 15-May-2008

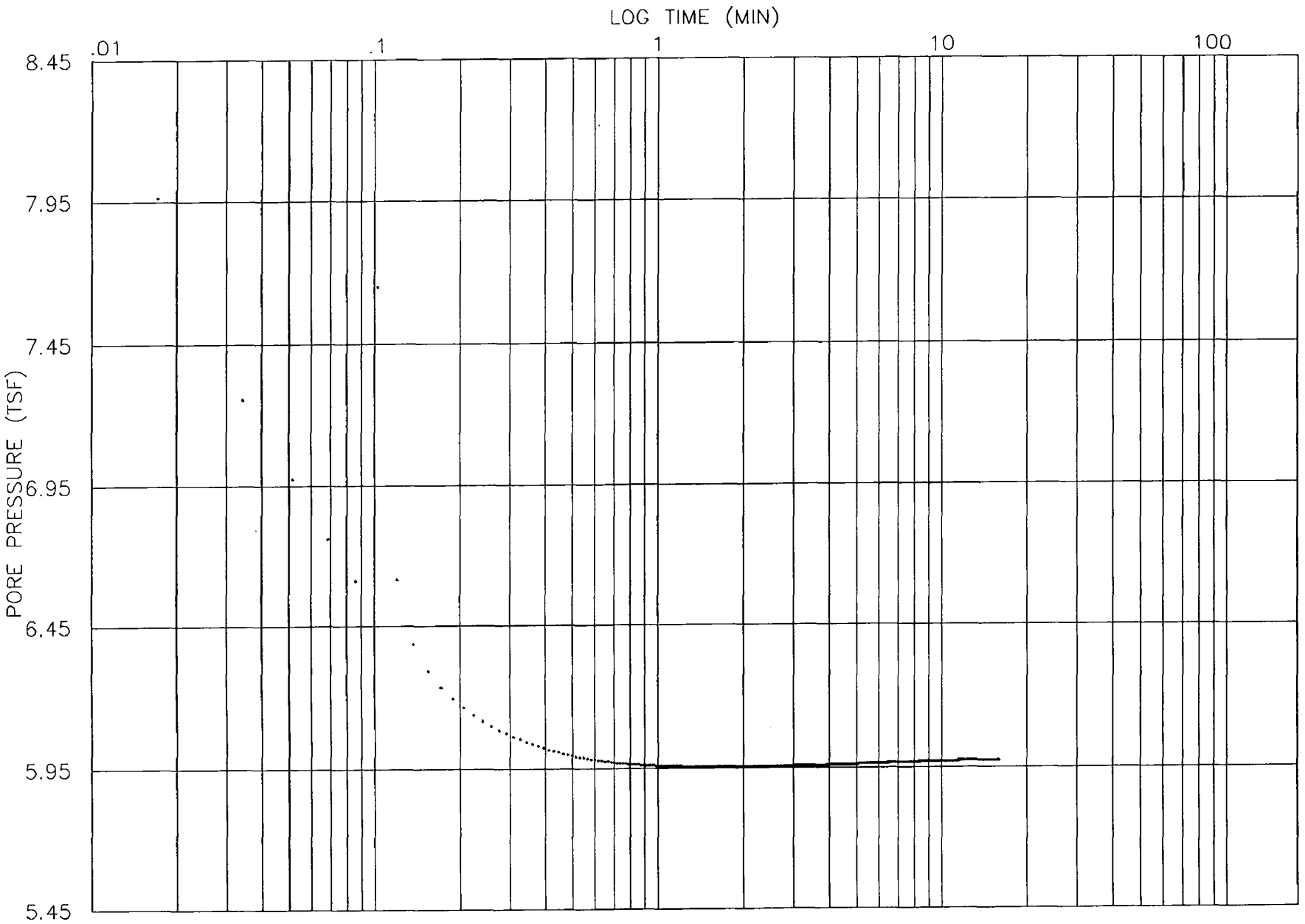



CPT NUMBER: C-601
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 175.1 FEET
DATE: 15-May-2008


FUGRO CONSULTANTS, INC.



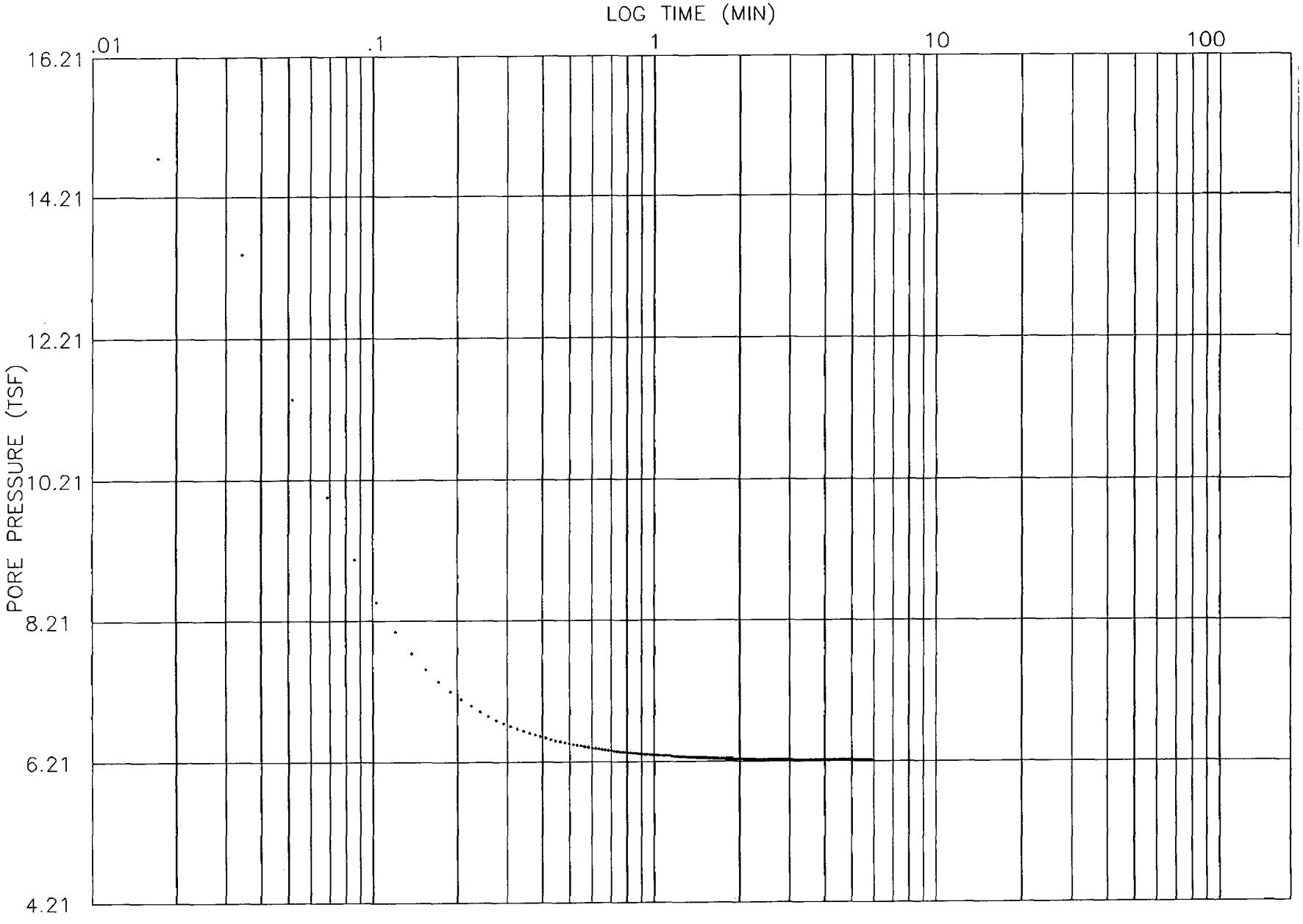

CPT NUMBER: C-601

JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 187.7 FEET

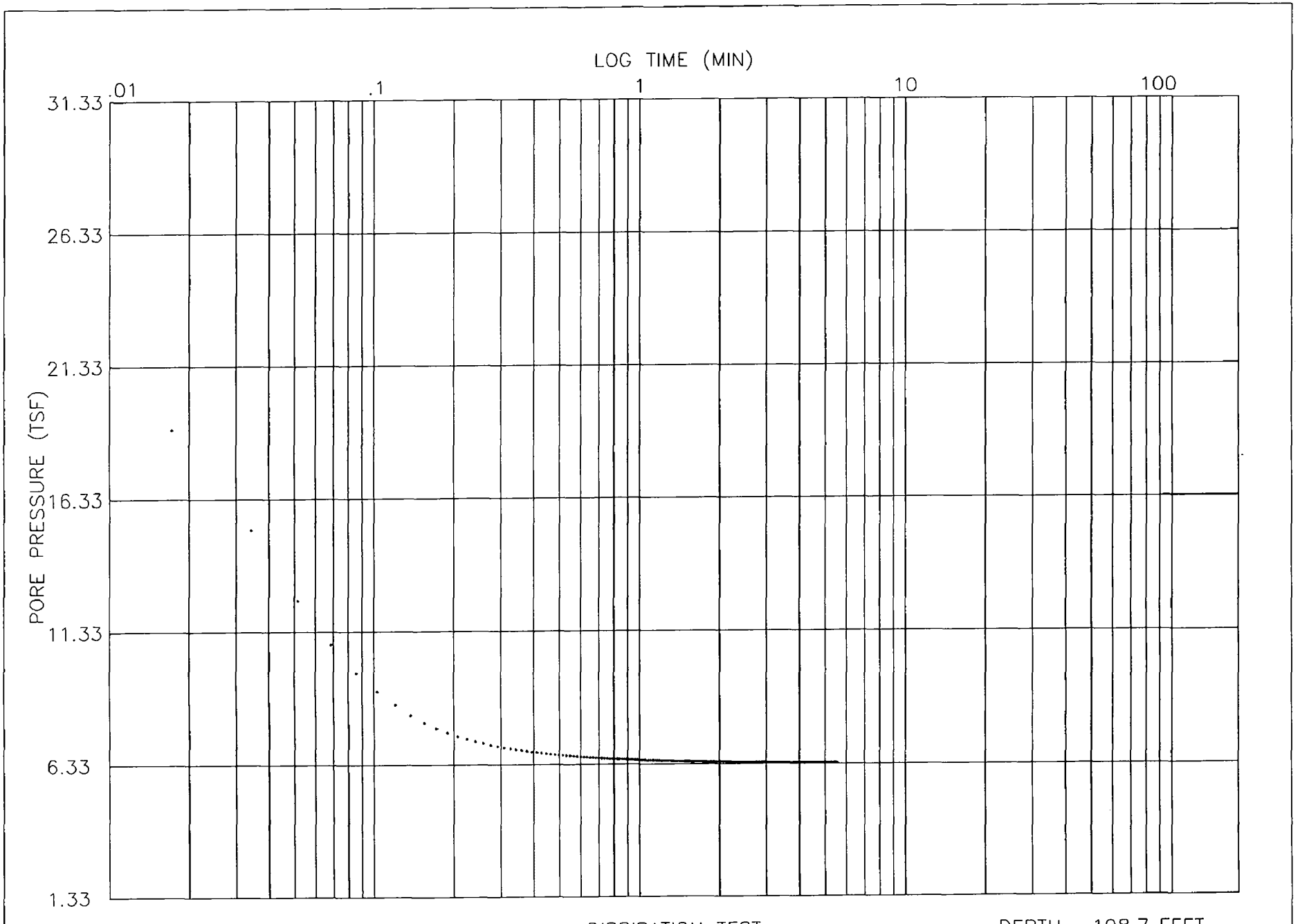
DATE: 15-May-2008




CPT NUMBER: C-601
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

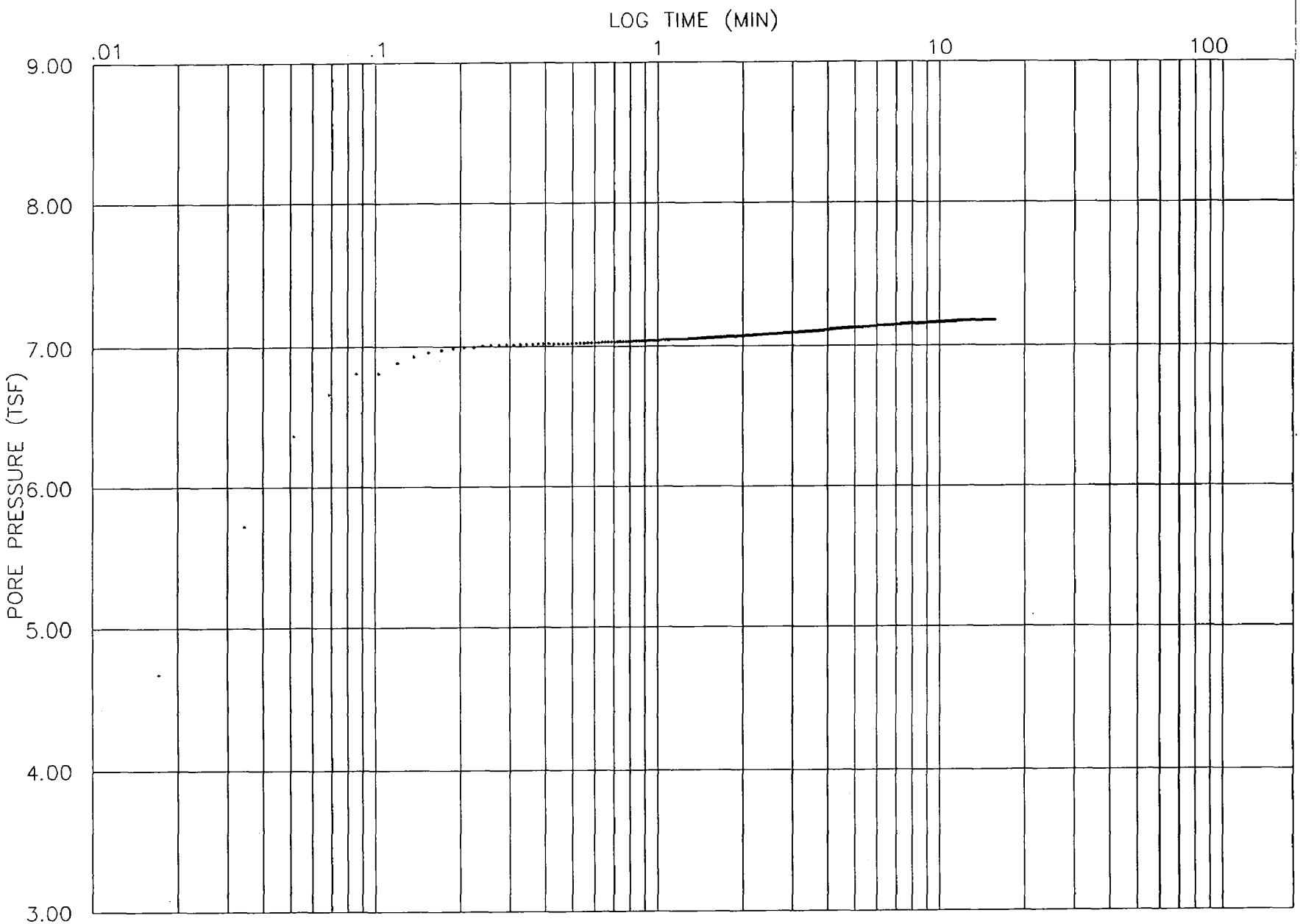
DEPTH: 195.2 FEET
DATE: 15-May-2008




CPT NUMBER: C-601
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 198.7 FEET
DATE: 15-May-2008

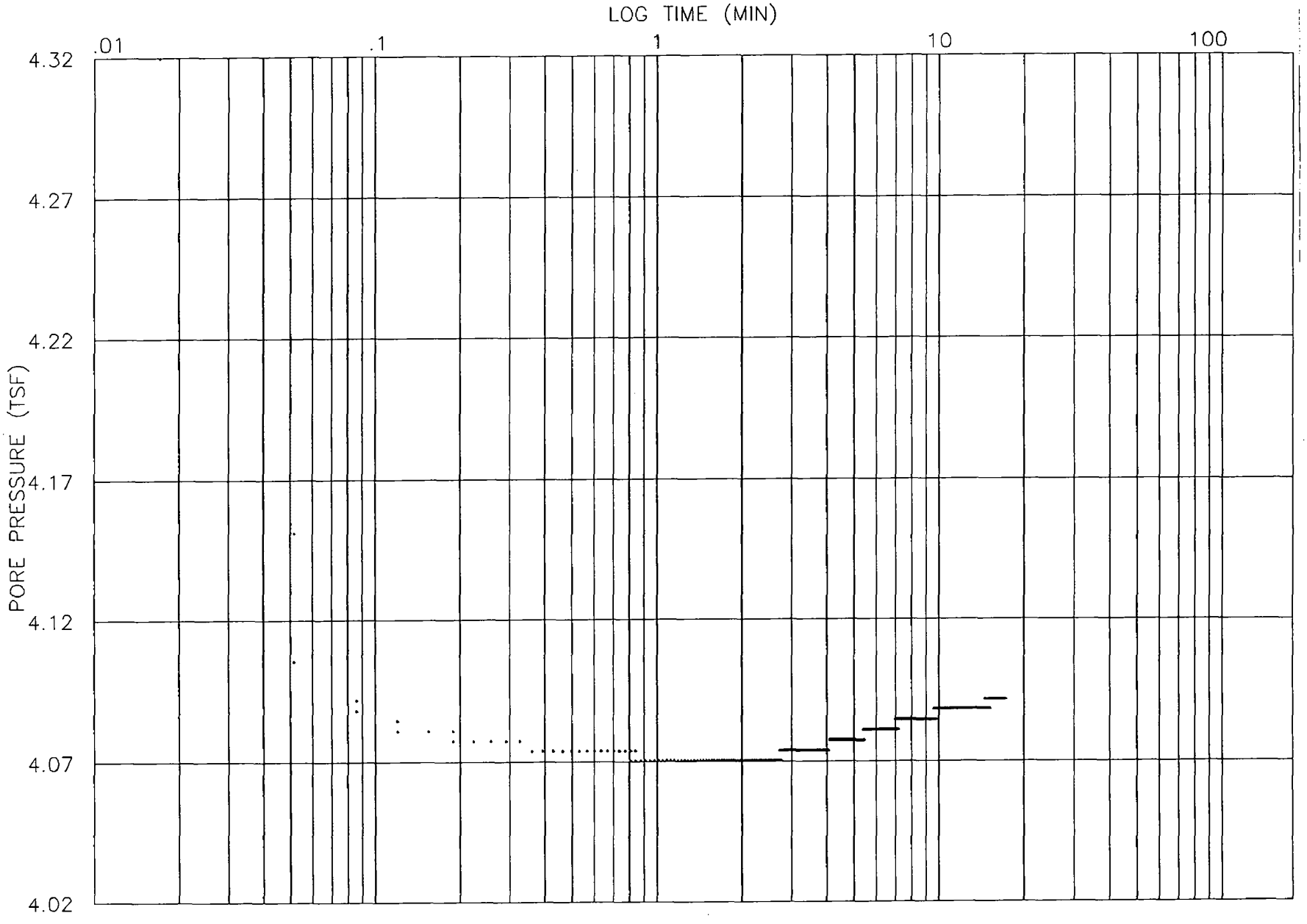



CPT NUMBER: C-601
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 226.3 FEET
DATE: 15-May-2008


FUGRO CONSULTANTS, INC.



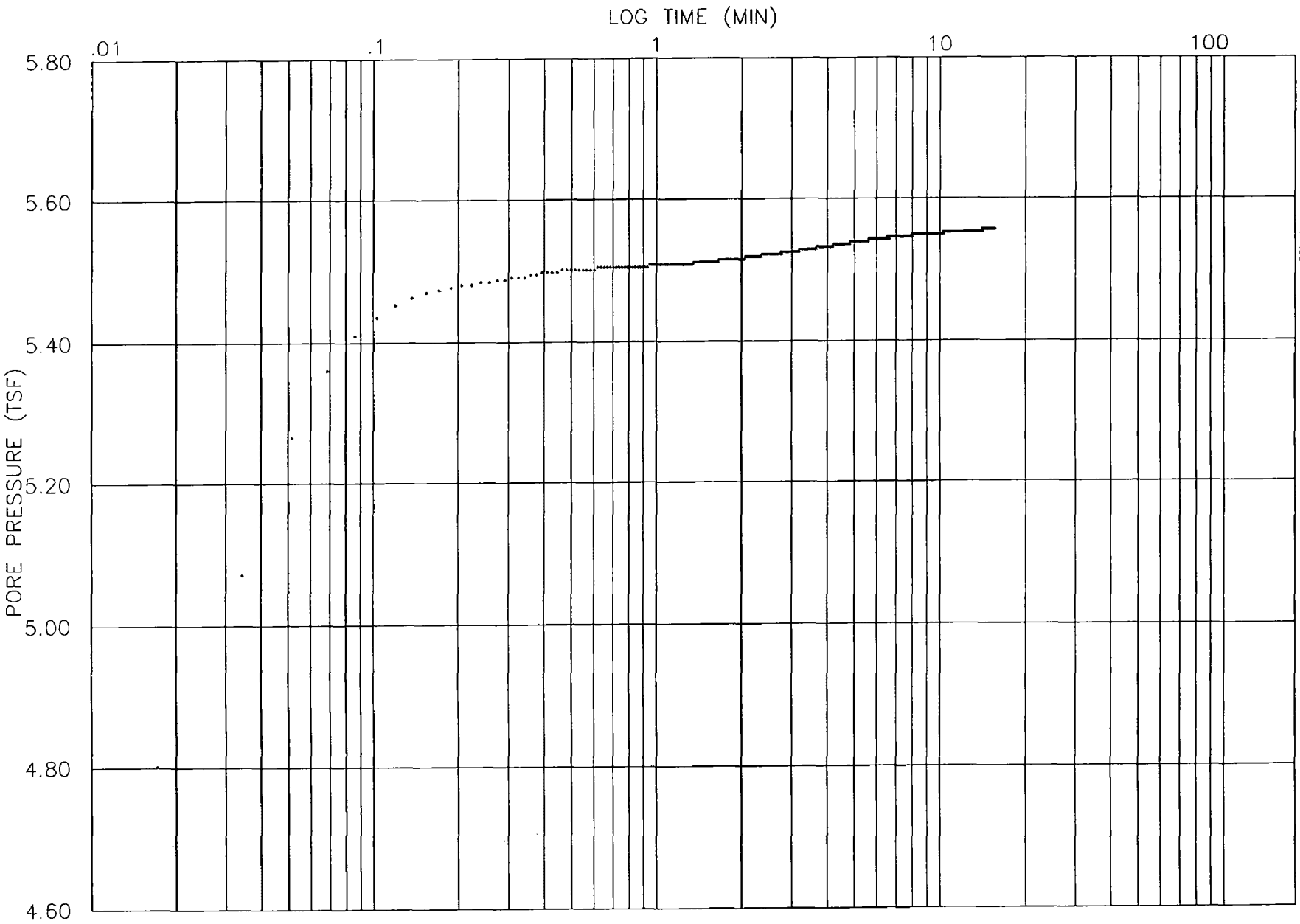

CPT NUMBER: C-602A

JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 128.6 FEET

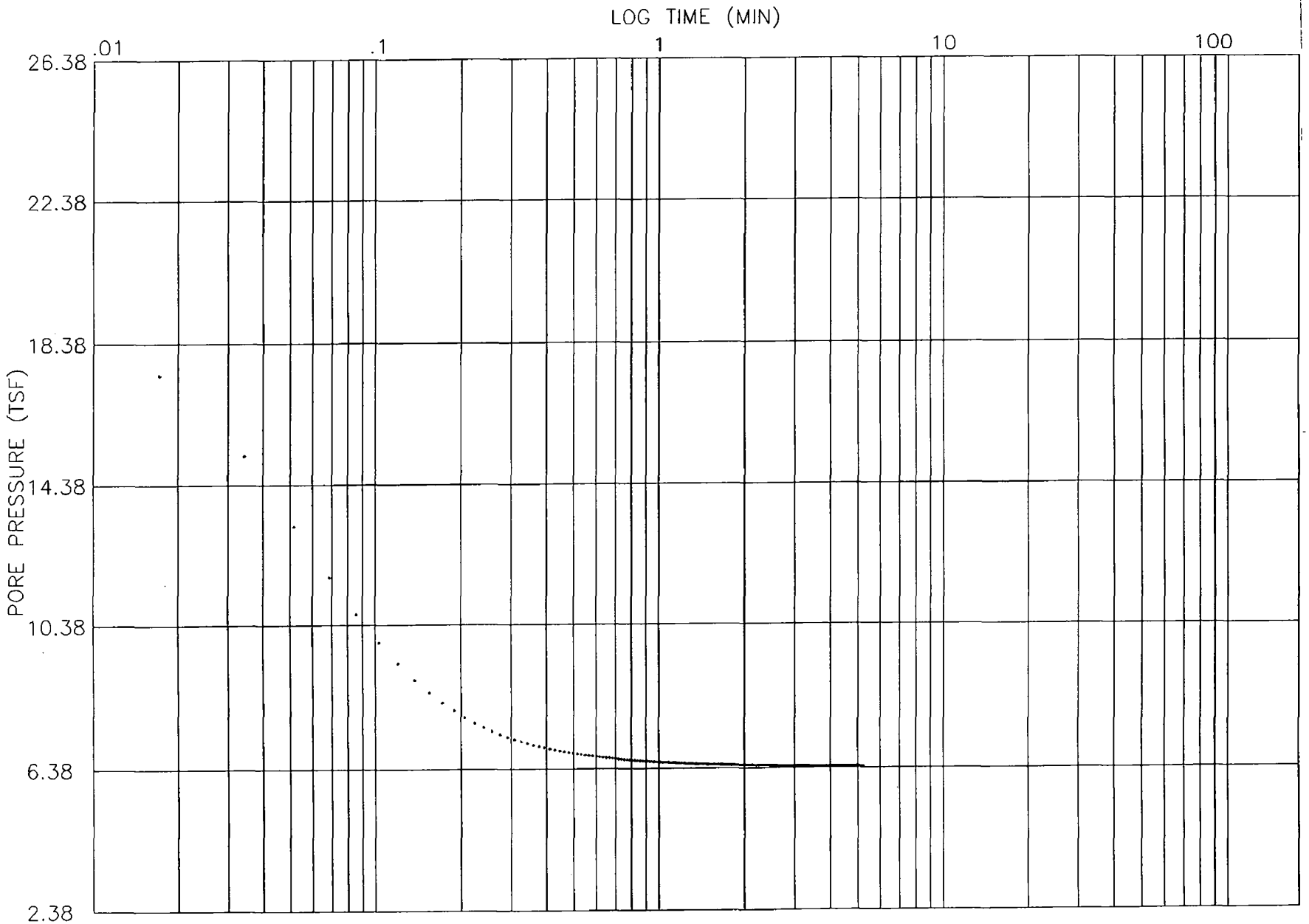
DATE: 17-May-2008




CPT NUMBER: C-602A
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

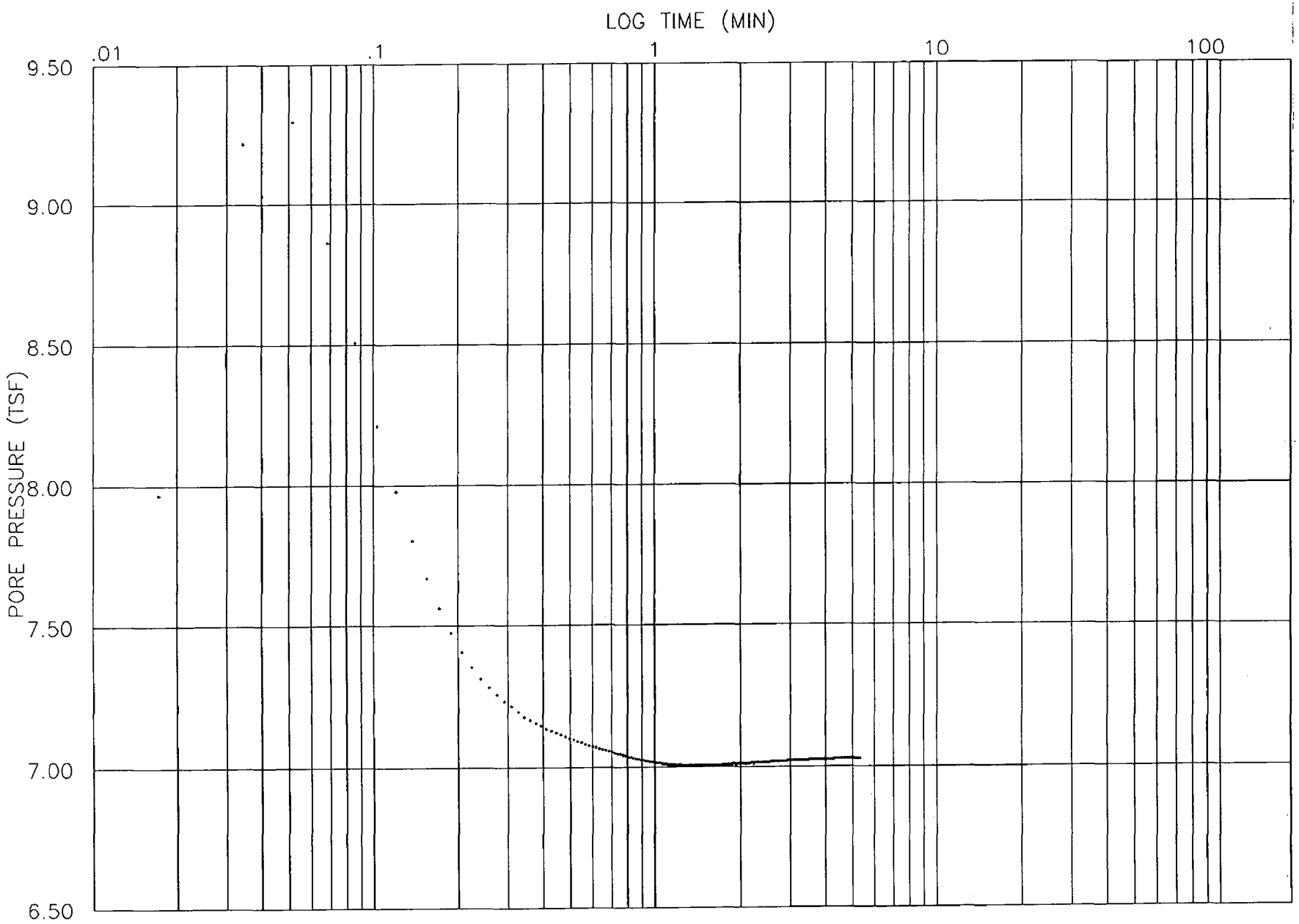
DEPTH: 175.1 FEET
DATE: 17-May-2008




CPT NUMBER: C-602A
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 200.5 FEET
DATE: 17-May-2008



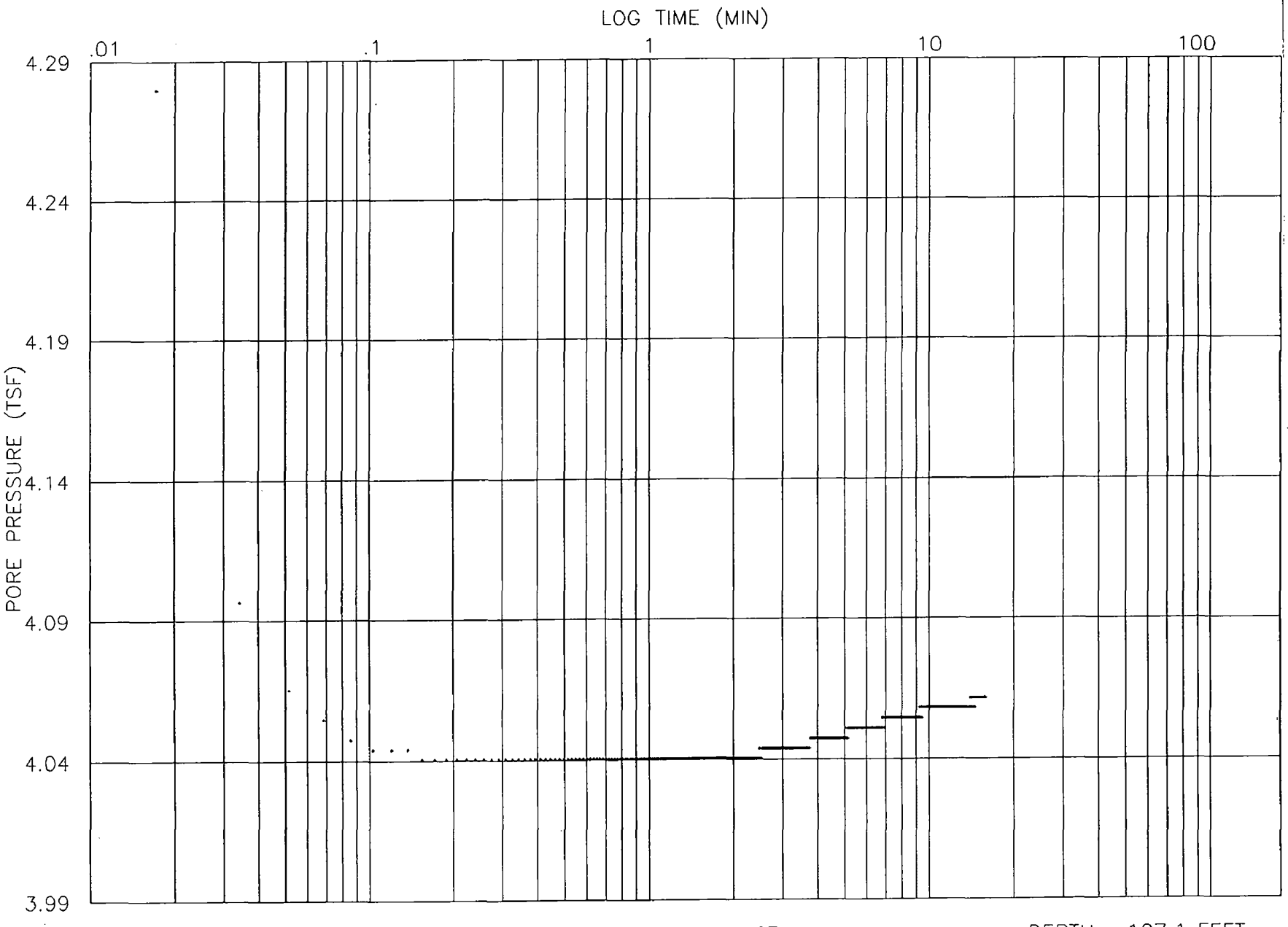

CPT NUMBER: C-602A

JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 221.7 FEET

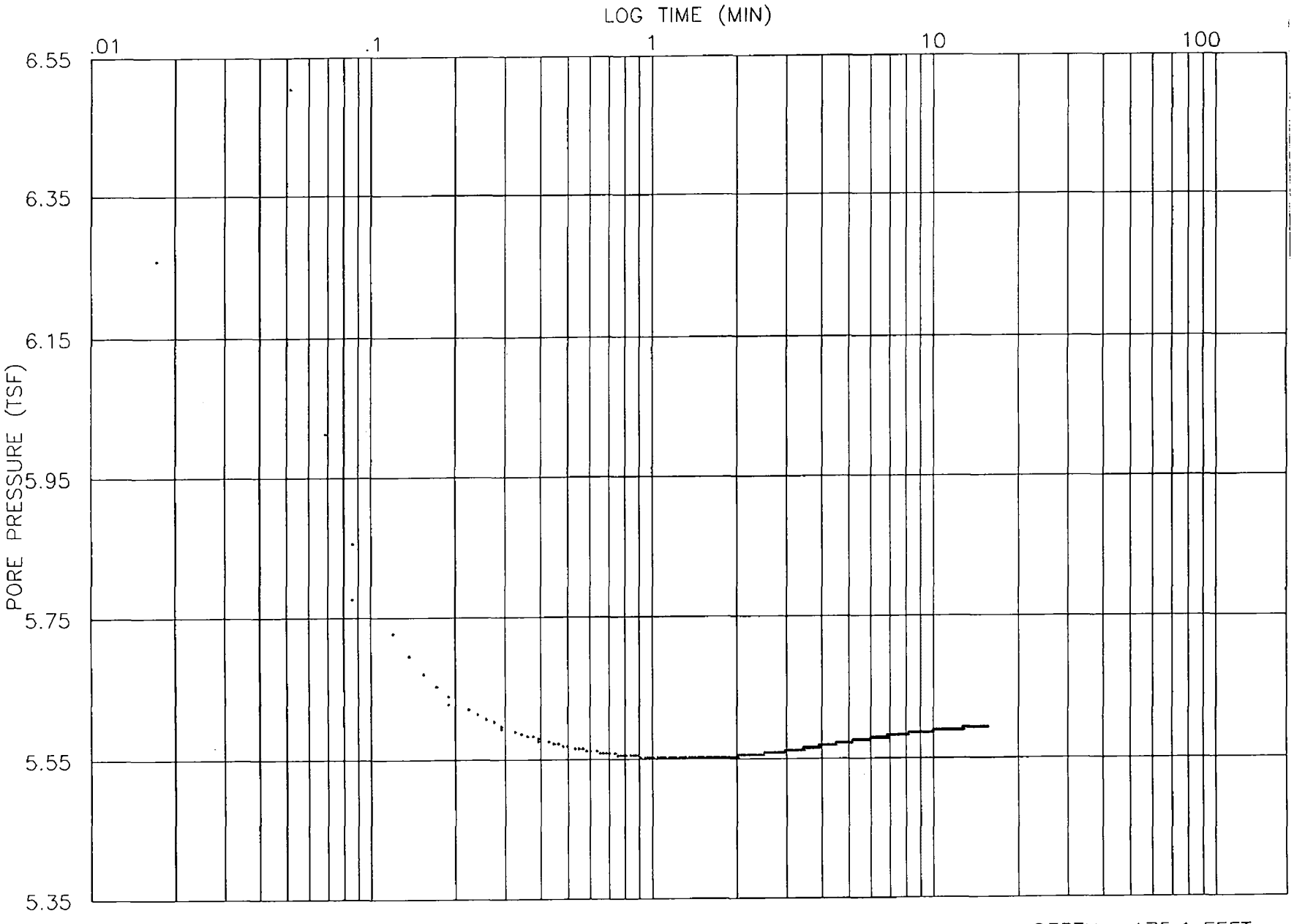
DATE: 17-May-2008




CPT NUMBER: C-701
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

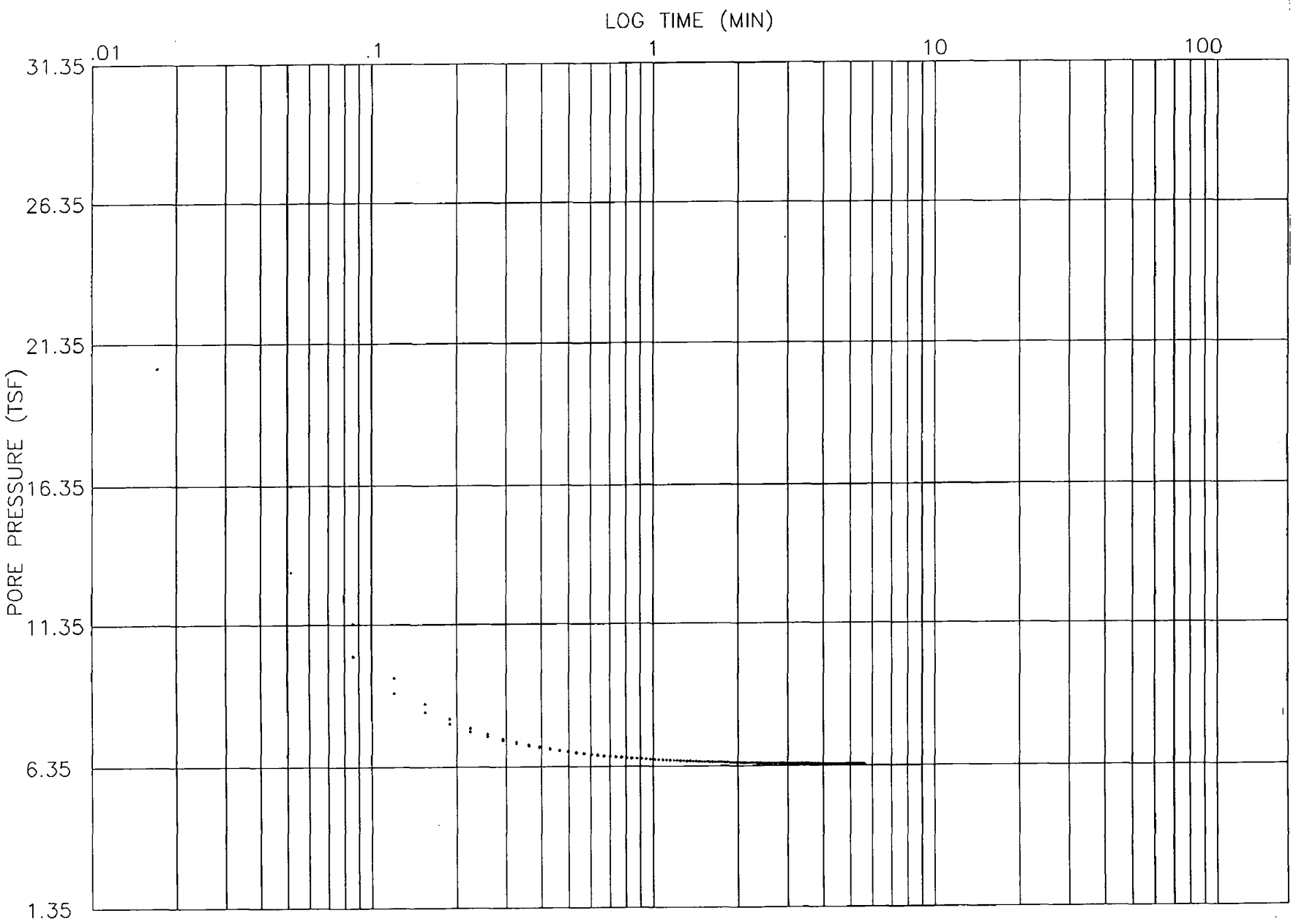
DEPTH: 127.1 FEET
DATE: 18-May-2008




CPT NUMBER: C-701
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

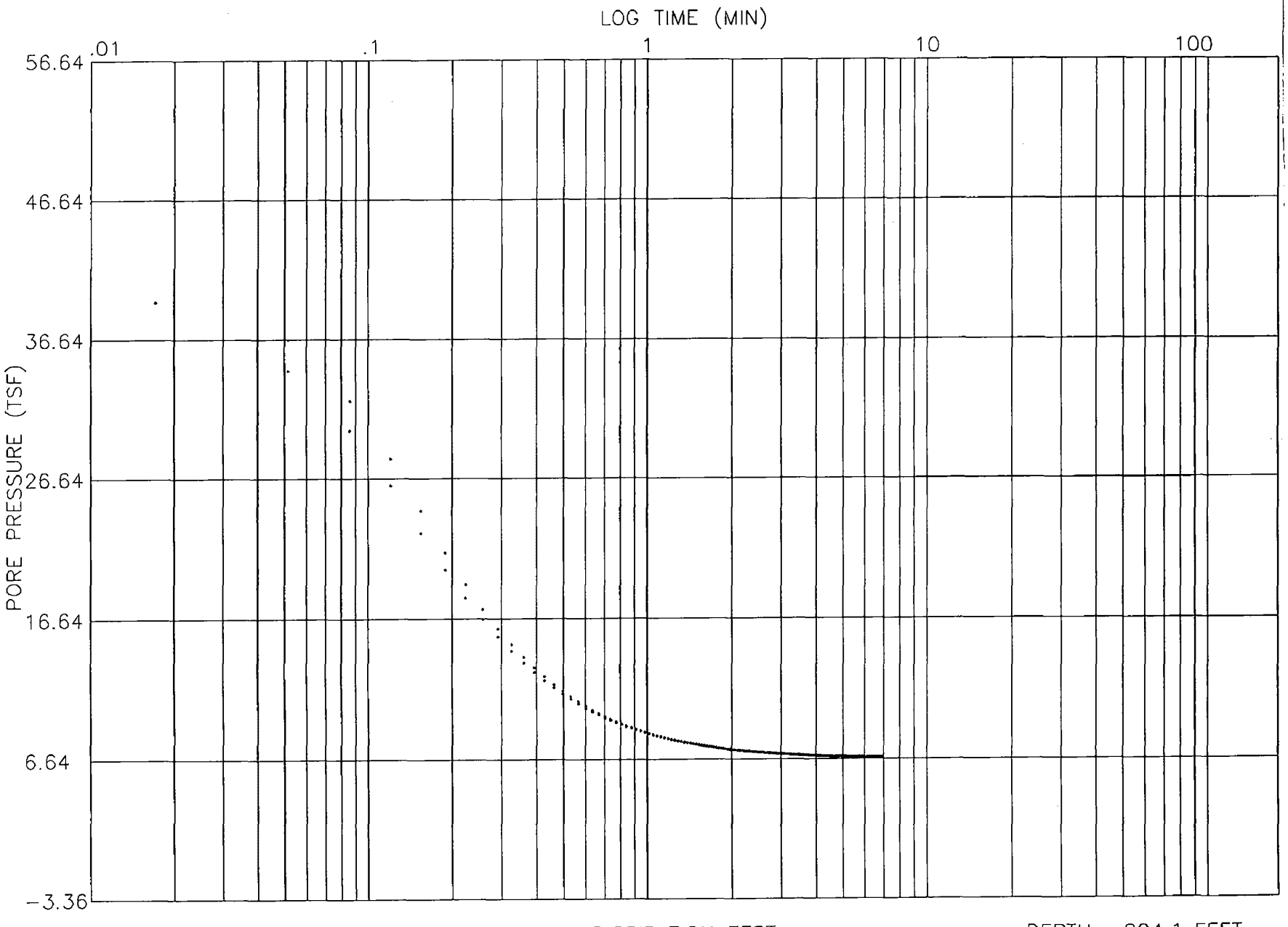
DEPTH: 175.1 FEET
DATE: 18-May-2008




CPT NUMBER: C-701
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

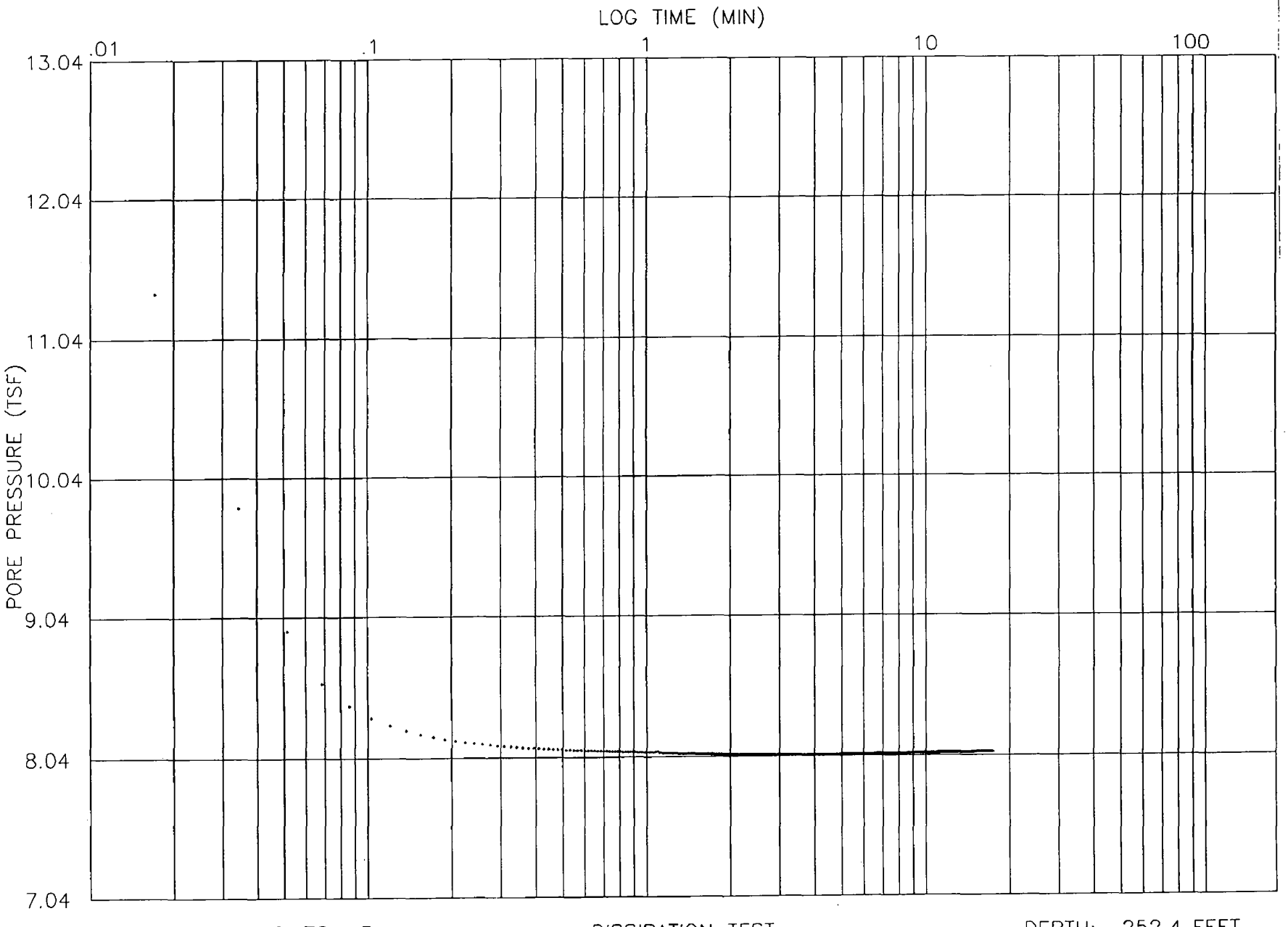
DEPTH: 198.3 FEET
DATE: 18-May-2008




CPT NUMBER: C-701
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

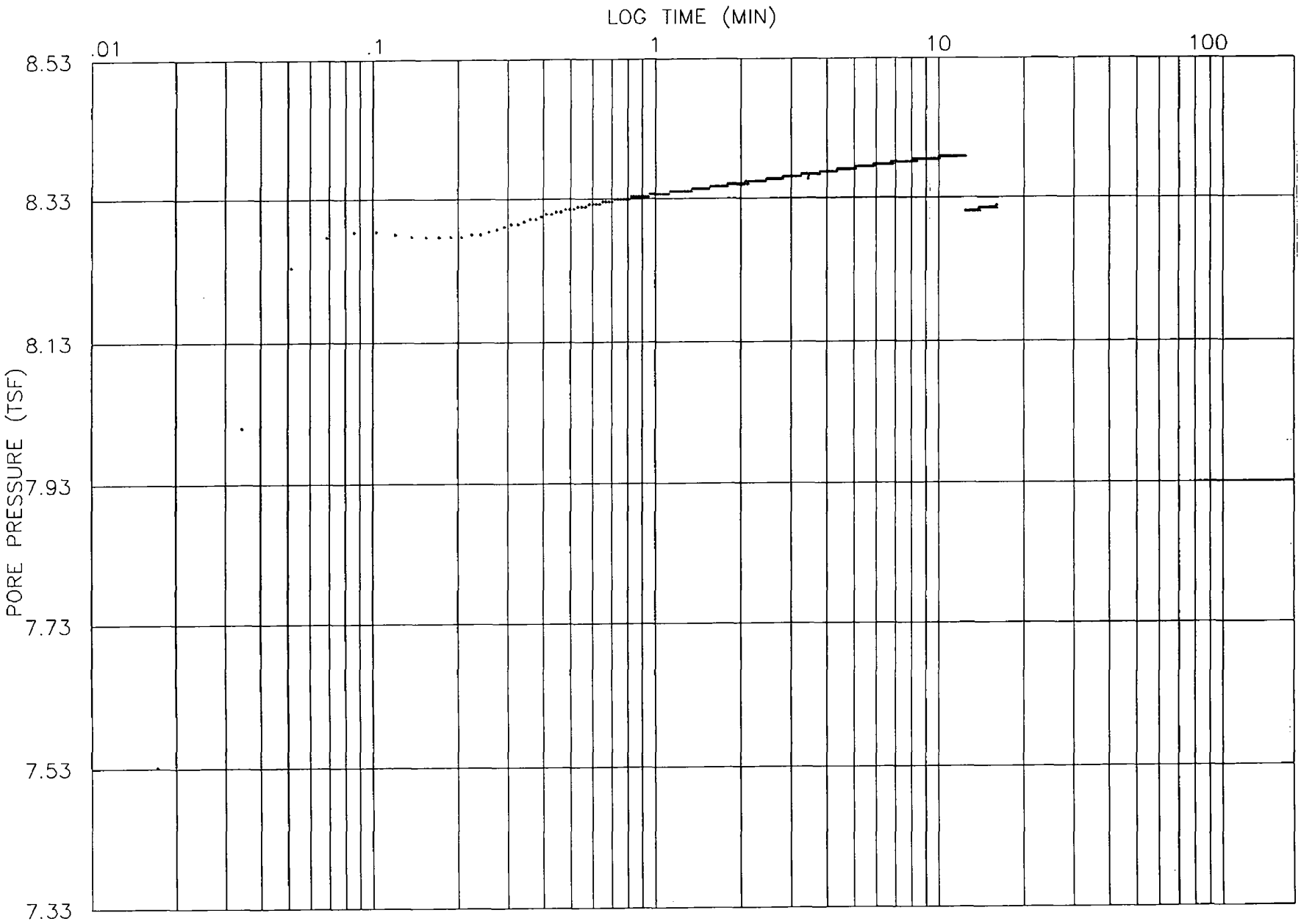
DEPTH: 204.1 FEET
DATE: 18-May-2008




CPT NUMBER: C-701-3
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

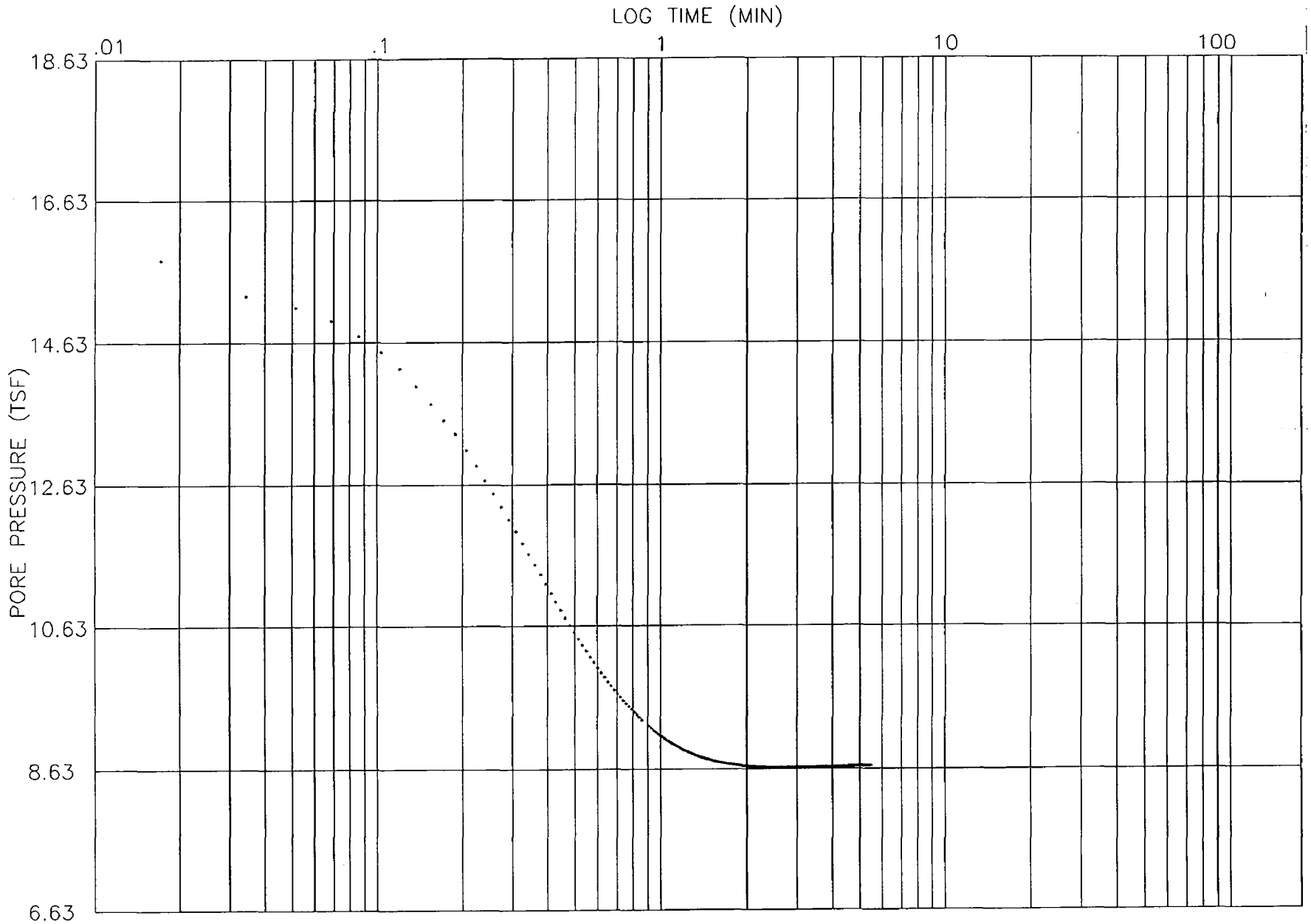
DEPTH: 252.4 FEET
DATE: 20-May-2008




CPT NUMBER: C-701-3
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

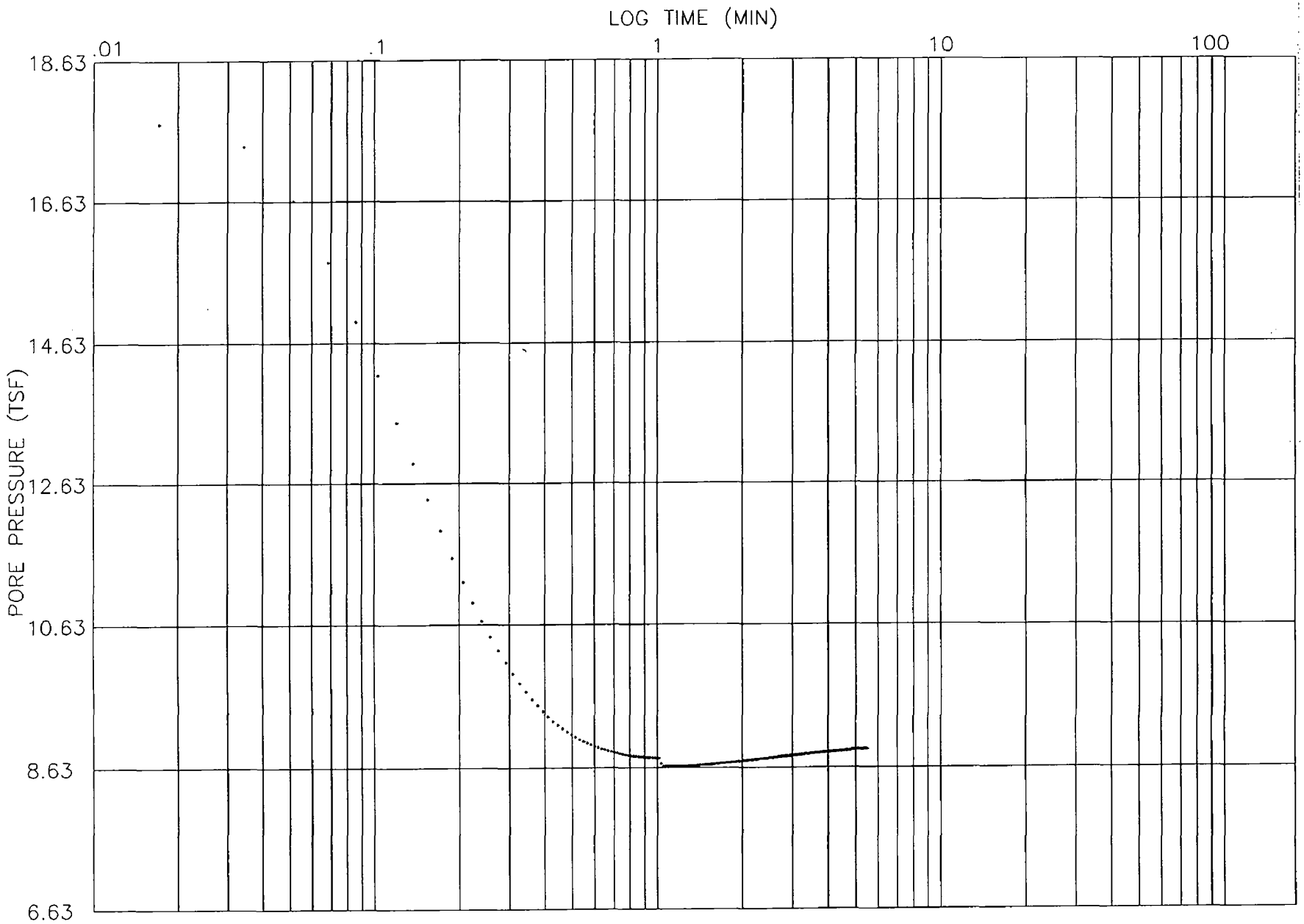
DEPTH: 261.7 FEET
DATE: 20-May-2008




CPT NUMBER: C-701-3
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 273.1 FEET
DATE: 20-May-2008

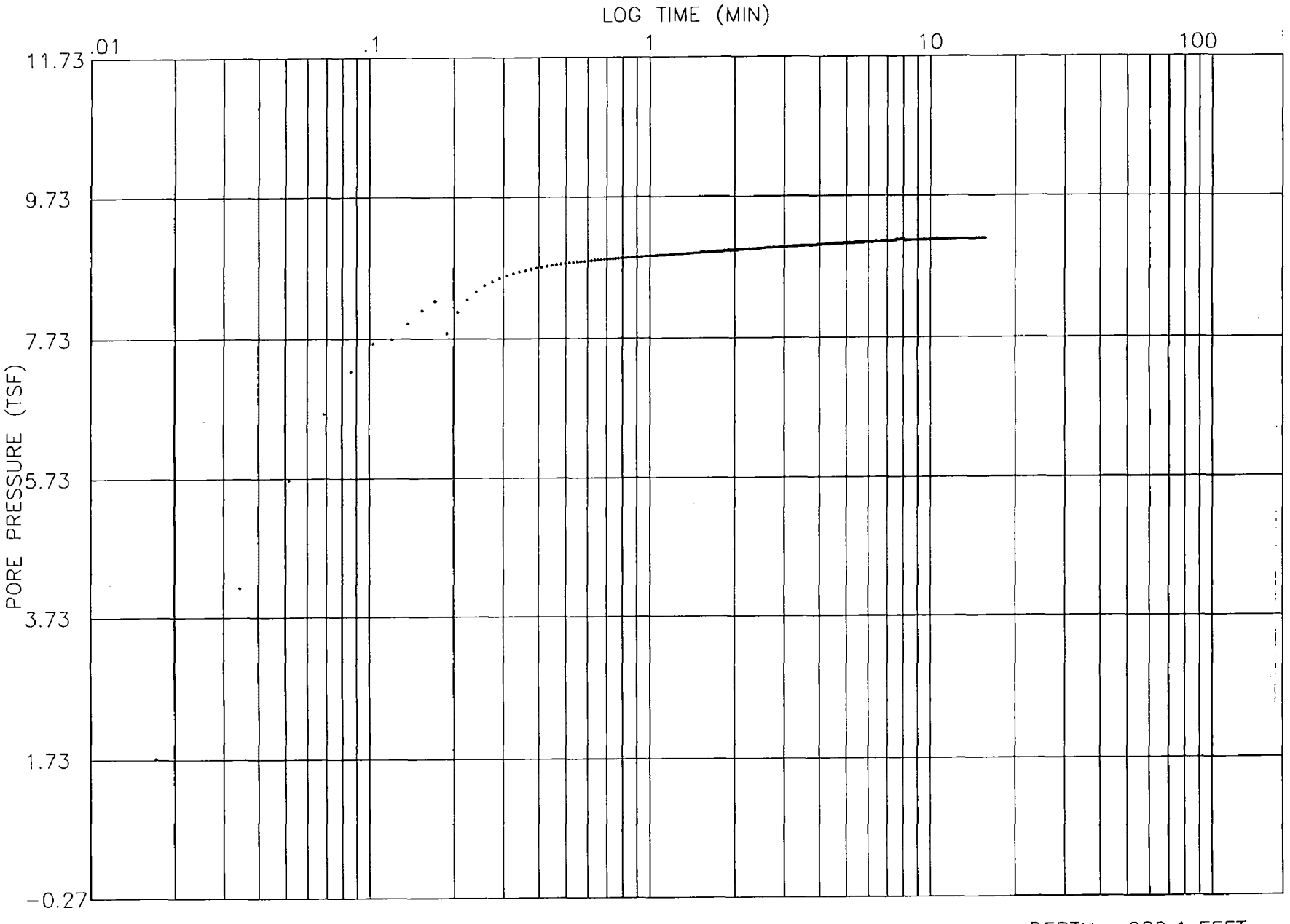



CPT NUMBER: C-701-3
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 283.5 FEET
DATE: 20-May-2008


FUGRO CONSULTANTS, INC.

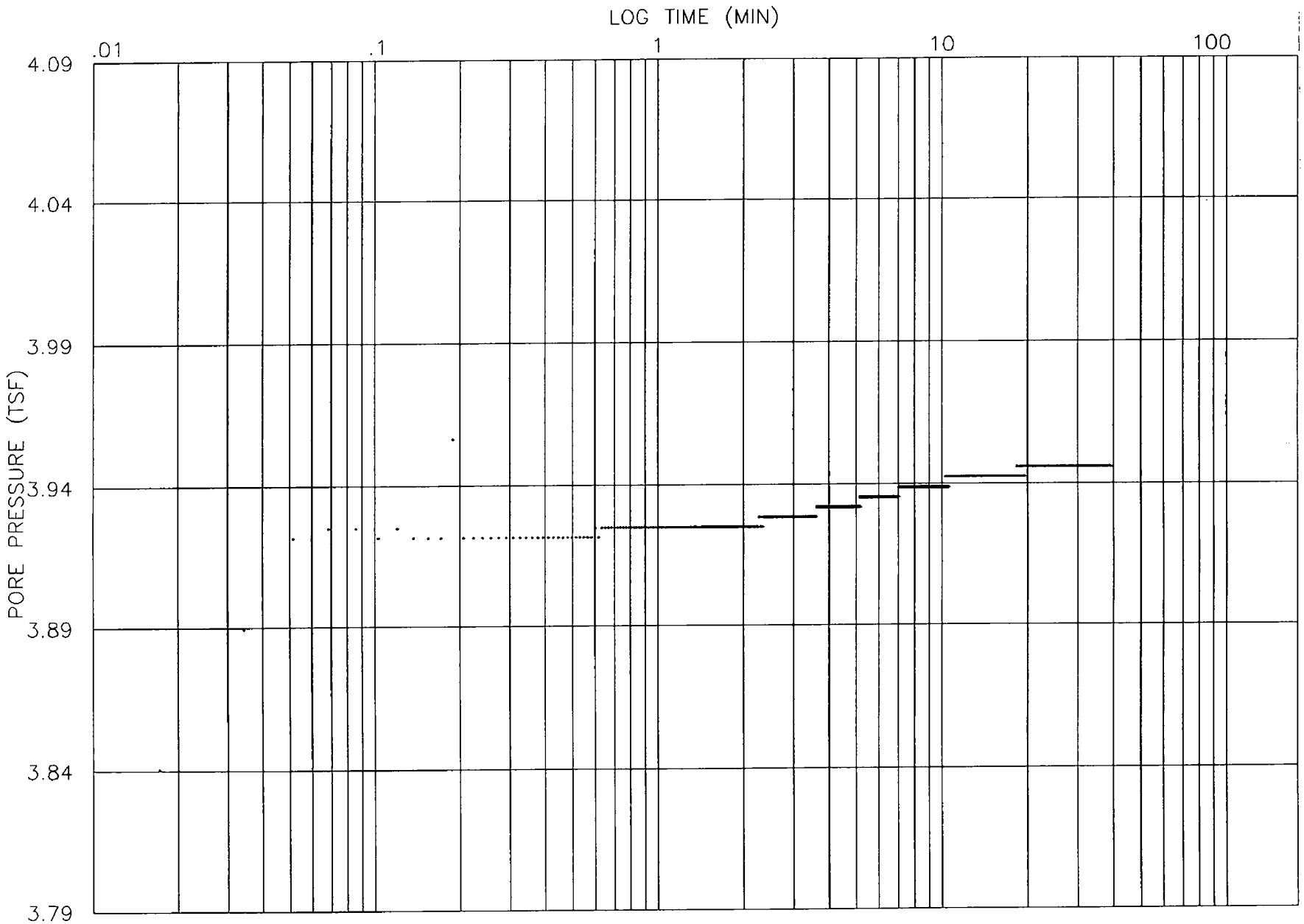



CPT NUMBER: C-701-3
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 289.1 FEET
DATE: 20-May-2008

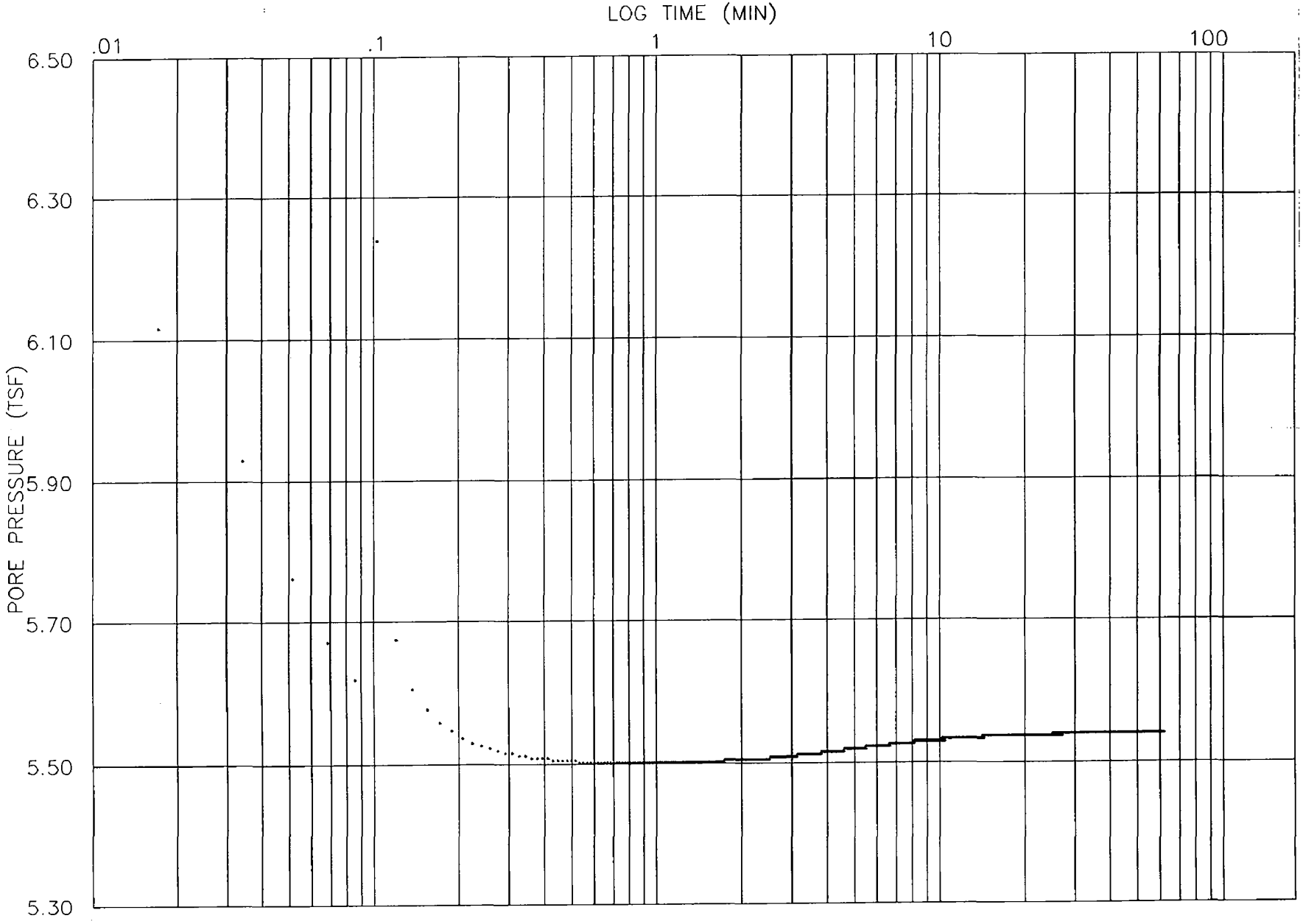

FUGRO CONSULTANTS, INC.




CPT NUMBER: C-702
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 125.2 FEET
DATE: 14-May-2008

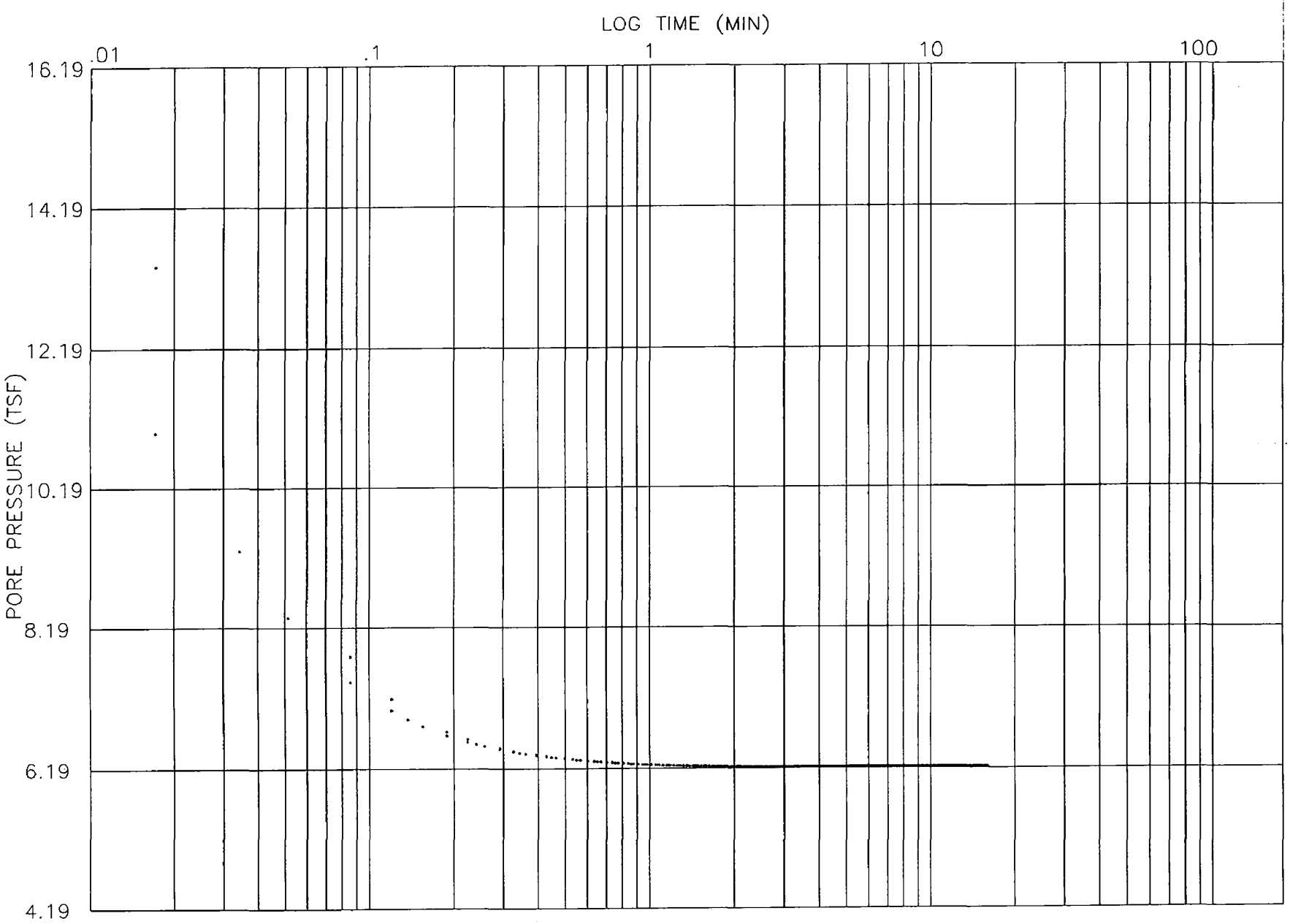



CPT NUMBER: C-702
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 175.1 FEET
DATE: 14-May-2008


FUGRO CONSULTANTS, INC.

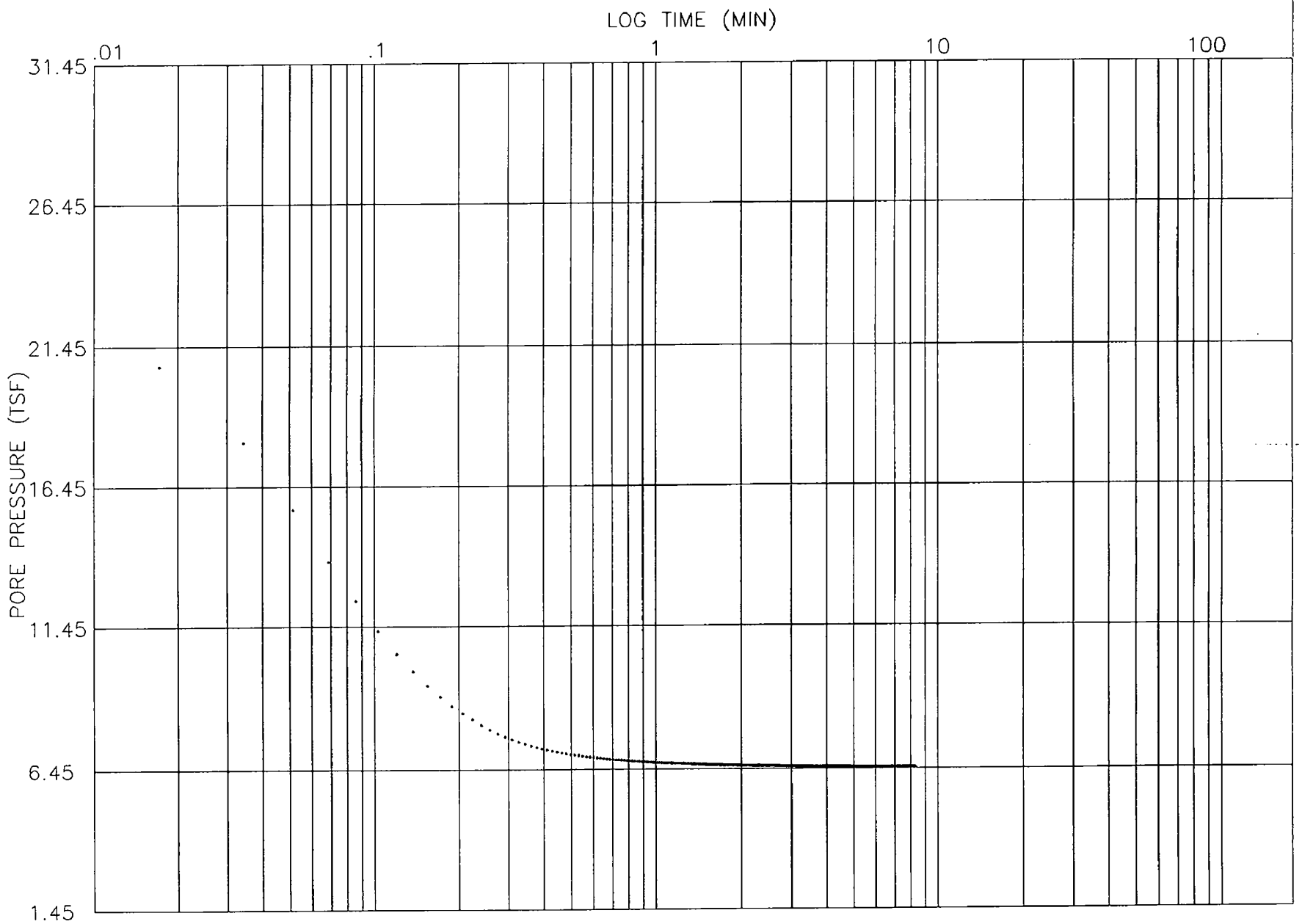



CPT NUMBER: C-702
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 196.2 FEET
DATE: 14-May-2008


FUGRO CONSULTANTS, INC.




CPT NUMBER: C-702
JOB NUMBER: 04.1908-0029

DISSIPATION TEST

DEPTH: 204.0 FEET
DATE: 14-May-2008


FUGRO CONSULTANTS, INC.

# APPENDIX A

# FUGRO'S CONE PENETROMETERS

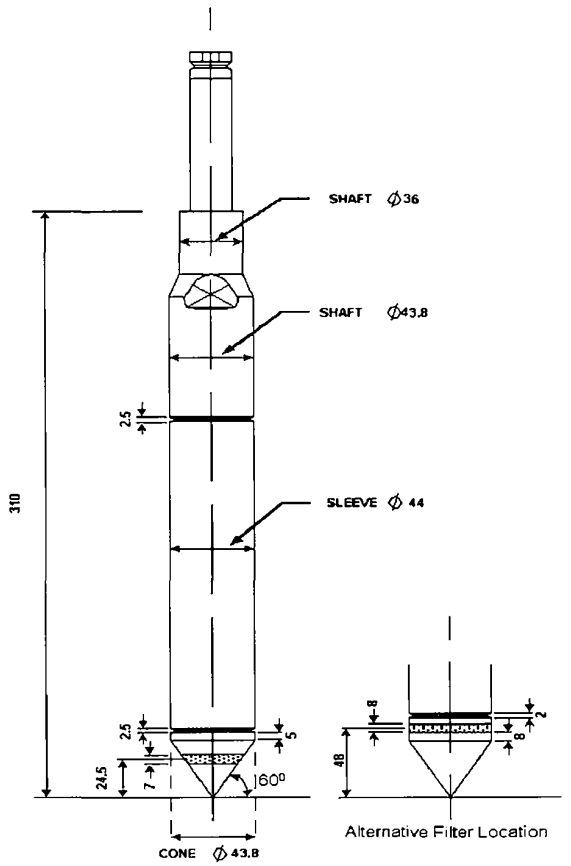
## APPENDIX A

## FUGRO PENETROMETER TIPS DATA - TYPES FCKE

| SPECIFICATIONS LOADCELLS | | F5CKE | F10CKE | F7.5CKE & F15CKE |
|---|---|---|---|---|
| **CONE LOADCELL** | | | | |
| Base Area | $cm^2$ | 10 | 10 | 15 |
| Apex Angle | DEG | 60 | 60 | 60 |
| Full Range | kN | 50 | 100 | 150 |
| Load Limit | kN | 100 | 100 | 200 |
| Effect of 10 bar water pressure | N | 450 | 450 | 880 |
| Output at zero load | mV | < ± 0.5 | < ± 0.5 | < ± 0.5 |
| Full range output (FRO) | mV | 10 | 10 | 10 |
| Input resistance | ohm ca. | 270 | 270 | 270 |
| Output resistance | ohm ca. | 240 | 240 | 240 |
| Non linearity and hysteresis | %FRO | < 0.1 | < 0.1 | < 0.1 |
| Calibration accuracy | %FRO | < 0.5 | < 0.5 | < 0.5 |
| Rated bridge supply voltage | Volt | 10 | 10 | 10 |
| Maximum bridge supply voltage | Volt | 15 | 15 | 15 |
| Thermal zero shift | %FRO/10°C | < 0.2 | < 0.2 | < 0.2 |
| Thermal Sensitivity shift | %FRO/10°C | < 0.1 | < 0.1 | < 0.1 |
| Repeatability | %FRO | < 0.1 | < 0.1 | < 0.1 |
| **SLEEVE + CONE LOADCELL** | | | | |
| Sleeve Area | $cm^2$ | 150 | 150 | 200 |
| Full Range | kN | 50 | 100 | 150 |
| Load Limit | kN | 100 | 100 | 200 |
| Effect of 10 bar water pressure | N | 300 | 300 | 280 |
| Output at zero load | mV | < ± 0.5 | < ± 0.5 | < ± 0.5 |
| Full range output | mV | 10 | 10 | 10 |
| Input resistance | ohm ca. | 270 | 270 | 270 |
| Output resistance | ohm ca. | 240 | 240 | 240 |
| Non linearity and hysteresis | %FRO | < 0.1 | < 0.1 | < 0.1 |
| Calibration accuracy | %FRO | < 0.5 | < 0.5 | < 0.5 |
| Rated bridge supply voltage | Volt | 10 | 10 | 10 |
| Maximum bridge supply voltage | Volt | 15 | 15 | 15 |
| Thermal zero shift | %FRO/10°C | < 0.2 | < 0.2 | < 0.2 |
| Thermal Sensitivity shift | %FRO/10°C | < 0.1 | < 0.1 | < 0.1 |
| Repeatability | %FRO | < 0.1 | < 0.1 | < 0.1 |
| **GENERAL** | | | | |
| Friction output at full range load of cone | %FRO | < 2 | | |
| Compensated temperature range | °C | - 10 to + 40 | | |
| Maximum temperature | °C | 80 | | |
| Insulation resistance | $10^8$ ohm | > 5 | | |
| Slope sensor built-in | | on request | | |

**NOTES:** The friction sleeve is located immediately above the cone.
Standard delivery includes: cone, calibration sheet, and connector tube.
The accuracy during field use will depend on: field calibrations, treatment during testing, readout equipment, abrasion and maintenance.

TYPE F7.5CKEW/V




DIMENSIONS

| | | | |
|---|---|---|---|
| CONE BASE AREA | ($mm^2$) | : | 1,500 |
| SLEEVE AREA | ($mm^2$) | : | 20,000 |
| ά FACTOR | | : | 0.59 |

SPECIFICATIONS

CONE LOAD CELL

| | | | |
|---|---|---|---|
| - FULL SCALE RANGE | (kN) | : | 75 |
| - OVERLOAD CAPACITY | (kN) | : | 200 |

CONE PLUS SLEEVE LOAD CELL

| | | | |
|---|---|---|---|
| - FULL SCALE RANGE | (kN) | : | 75 |
| - OVERLOAD CAPACITY | (kN) | : | 200 |

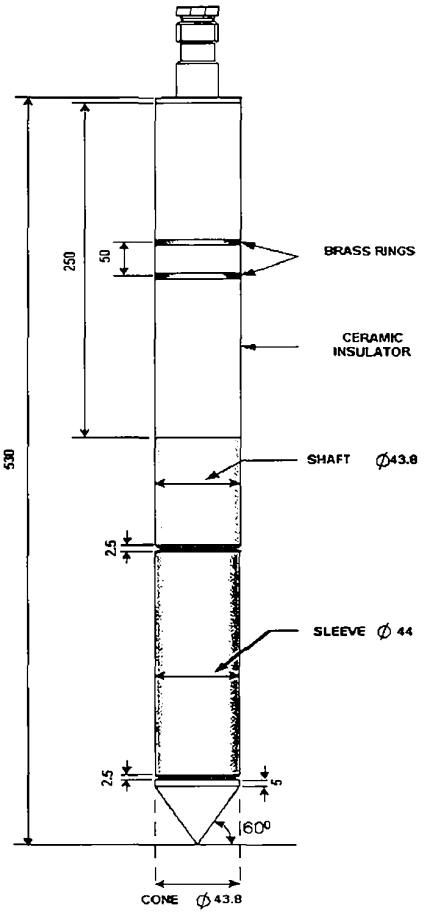
PORE PRESSURE TRANSDUCER

| | | | |
|---|---|---|---|
| - FULL SCALE RANGE | (Mpa) | : | 5.0 |
| - BURST PRESSURE | (Mpa) | : | 12.5 |

NOTES:

1. LOAD CELLS/TRANSDUCERS MAY BE CALIBRATED FOR LOWER RANGES
2. UNEQUAL SLEEVE END AREAS
3. SUBTRACTION TYPE
4. ALL DIMENSIONS IN mm
5. BUILT-IN AMPLIFIERS
6. SLOPE SENSOR INCORPORATED
7. THREADED END : INTERNAL, CONICAL

## TYPE F7.5CKEG/V




DIMENSIONS

| | | | |
|---|---|---|---|
| CONE BASE AREA | ($mm^2$) | : | 1,500 |
| SLEEVE AREA | ($mm^2$) | : | 20,000 |
| ά FACTOR | | : | 0.59 |

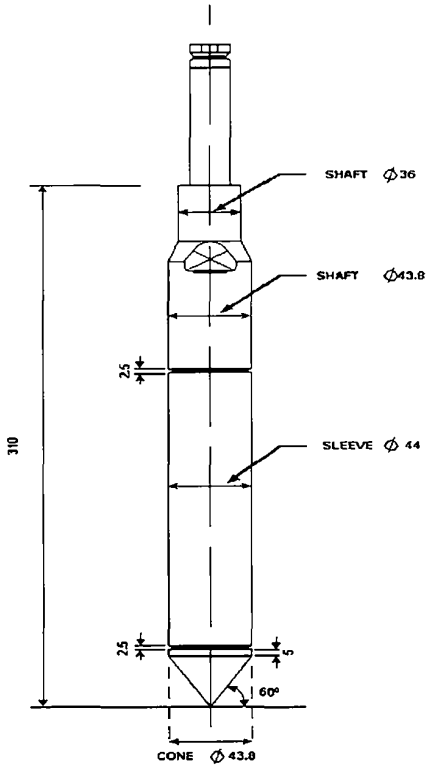
SPECIFICATIONS

| | | | |
|---|---|---|---|
| CONE LOAD CELL | | | |
| - FULL SCALE RANGE | (kN) | : | 75 |
| - OVERLOAD CAPACITY | (kN) | : | 200 |
| CONE PLUS SLEEVE LOAD CELL | | | |
| - FULL SCALE RANGE | (kN) | : | 75 |
| - OVERLOAD CAPACITY | (kN) | : | 200 |
| PORE PRESSURE TRANSDUCER | | | |
| - FULL SCALE RANGE | (Mpa) | : | 5.0 |
| - BURST PRESSURE | (Mpa) | : | 12.5 |
| ELECTRICAL CONDUCTIVITY | | | |
| - FULL SCALE RANGE | (S/m) | : | 1.0 |
| - MAXIMUM RANGE | (S/m) | : | 5.0 |

NOTES:

1. LOAD CELLS/TRNSDUCERS MAY BE CALIBRATED FOR LOWER RANGES
2. UNEQUAL SLEEVE END AREAS
3. SUBTRACTION TYPE
4. ALL DIMENSIONS IN mm
5. BUILT-IN AMPLIFIERS
6. SLOPE SENSOR INCORPORATED
7. THREADED END : EXTERNAL. M28 x 2

## TYPE F7.5CKE/V




DIMENSIONS

| | | |
|---|---|---|
| CONE BASE AREA | ($mm^2$) | : 1,500 |
| SLEEVE AREA | ($mm^2$) | : 20,000 |
| ά FACTOR | | : 0.59 |

SPECIFICATIONS

CONE LOAD CELL

| | | |
|---|---|---|
| - FULL SCALE RANGE | (kN) | : 75 |
| - OVERLOAD CAPACITY | (kN) | : 200 |

CONE PLUS SLEEVE LOAD CELL

| | | |
|---|---|---|
| - FULL SCALE RANGE | (kN) | : 75 |
| - OVERLOAD CAPACITY | (kN) | : 200 |

NOTES:

1. LOAD CELLS/TRANSDUCERS MAY BE CALIBRATED FOR LOWER RANGES
2. UNEQUAL SLEEVE END AREAS
3. SUBTRACTION TYPE
4. ALL DIMENSIONS IN mm
5. BUILT-IN AMPLIFIERS
6. SLOPE SENSOR INCORPORATED
7. THREADED END : INTERNAL, CONICAL

# APPENDIX B

# FUGRO'S DEPLOYMENT SYSTEMS

ECHNICAL AND
ONMENTAL TESTING

OGRO
GEOTECHNICAL
ENVIRONMENTAL
CONE PENETROMETER SYSTEM
HOUSTON, TEXAS
LOS ANGELES, CALIFORNIA
BATON ROUGE, LOUISIANA

FUGRO

FUGRO

# APPENDIX C

# ZERO READINGS

# CPT Zero Readings

| CPT | Date | Cone Type | Cone S/N | Tip Start | Tip Stop | Sleeve Start | Sleeve Stop | Piezo Start | Piezo End | Slope Start | Slope End |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C-601 | 15-May-2008 | F7.5CKE3SW2/B | 1701-0750 | 0.024390 | 0.024455 | 0.025562 | 0.025269 | -0.007617 | -0.007617 | 0.005668 | 0.009609 |
| C-602A | 17-May-2008 | F7.5CKE3SW2/B | 1701-0750 | 0.027478 | 0.026489 | 0.027686 | 0.026530 | -0.007617 | -0.007910 | 0.005520 | 0.005742 |
| C-701 | 18-May-2008 | F7.5CKE3SW2/B | 1701-0750 | 0.027246 | 0.028768 | 0.025525 | 0.027995 | -0.007324 | -0.008203 | 0.005668 | 0.006263 |
| C-701 | 19-May-2008 | F7.5CKE3SW2/B | 1701-0750 | 0.025513 | 0.026855 | 0.026746 | 0.028524 | -0.007617 | -0.007617 | 0.005695 | 0.005547 |
| C-701 | 20-May-2008 | F7.5CKE3SW2/B | 1701-0750 | 0.027600 | 0.027832 | 0.028564 | 0.028931 | -0.007617 | -0.007910 | 0.005855 | 0.005703 |
| C-702 | 14-May-2008 | F7.5CKE3SW2/B | 1701-0750 | 0.021692 | 0.022339 | 0.022510 | 0.023071 | -0.007422 | -0.008008 | 0.005773 | 0.006380 |

FUGRO CONSULTANTS, INC.

6105 Rookin Road
Houston, Texas 77074
Tel: 713-346-4000
Fax: 713-346-4002

June 30, 2008
Report Number 04.19080029

Mactec Engineering and Consulting, Inc.
3301 Atlantic Avenue
Raleigh, North Carolina 27604

Attention: Mr. Scot Auger, P.E., PMP

**CALIBRATION VERIFICATION REPORT**
**FOR PIEZOCONE PENETRATION TESTING**
**TURKEY POINT COL PROJECT**
**FLORIDA**
**MACTEC PROJECT # 6468071950**

Dear Mr. Auger:

Please find enclosed herewith the calibration verification results for the instruments used in the above referenced project. The data has been reviewed and has undergone the appropriate QA/QC process. Calibrations checks were performed on cones F7.5CKESW2/B 1701-1788, and F7.5CKEW2/B 1701-0750 before the project began. Post project calibration checks were performed on cone F7.5CKEW2/B 1701-0750 which was the only cone used on the project. There is no post project verification of the seismograph because no seismic data was obtained on this project.

Fugro's cone penetrometer manufacturing and calibration procedures include ISO 9001, ASTM D5778-2007 and European cone penetrometer standards. Cone penetrometers are tested and calibrated for the following:

**Mechanical Calibration**
- Cross Talk Check
- Dimension Check
- Seal/O-Ring Check

**Electronic Calibration**
- Temperature effect
- Pre and Post test voltage readings (zeros)
- Full scale output load readings
- Pore Pressure transducer calibration
- Slope indicator calibration

**Calibration Verification Methodology**

Manufactured and calibrated according to ISO 9001, the calibration values of the electric cone penetrometers used for this project were verified before and after fieldwork utilizing the following A2LA and/or ANSI/NCSL approved verification systems.


A member of the Fugro group of companies with offices throughout the world.

**Tip and Friction**

| | |
|---|---|
| Load cell: | Geotac |
| Calibrated by: | Interface (A2LA approved) |
| Calibration date: | March 14, 2008 |
| Load cell model: | 560K |
| Load cell serial no: | 129739 |
| Capacity: | 50,000K |

**Pore Pressure Transducer**

Digital Pressure Indicator

| | |
|---|---|
| Calibrated by: | GD Sensing (ANSI/NCSL approved) |
| Manufactured by: | Eaton |
| Model number: | UPS 3000CC |
| Serial number: | A0813 |
| Calibration date: | September 15, 2006 |

**Cone Penetrometer Temperature**

Digital Thermometer

| | |
|---|---|
| Calibrated by: | Houston Precision (ANSI/NCSL approved) |
| Manufactured by: | Cole Parmer |
| Model Number: | Degi-sence Type K |
| Serial Number: | TD-001 |
| Calibration date: | November 16, 2007 |

Utilizing the above systems each was load and pressure tested as follows:

| | |
|---|---|
| Tip: | 0-20,000 lb. |
| Friction: | 0-7,500 lb. |
| Pore Pressure: | 0:350 PSI |
| Temperature effect | 30 Degrees Fahrenheit – 115 Degrees Fahrenheit |

Under each load/pressure increment, the cone penetrometer readings are recorded in millivolts (mV). Load/pressure (pounds/psi) load increments and corresponding cone readings in mV are input into **HGL Instrument Verificaton** software to obtain linear regression and correlation coefficient ($R^2$) values (See attached **HGL Instrument Verification** Forms).

Additionally, load/pressure increments and cone readings were also input into a calibration **Verification Certificate Program** to calculate each cone penetrometer's calibration value in MPa units (See attached **Calibration Verification Certificates** for each cone penetrometer). The last column in these forms represents the calibration values of tip, friction and pore pressure.

**Calculation Example**

| | |
|---|---|
| Load Increment, P1 | = 590 lb. |
| | = 0.295 tons |
| Tip Reading | = 35.2 mV |
| Tip Area, A= 15cm$^2$ | = 0.0161 sq. ft. |
| Tip Pressure | = P1/A = 0.295/0.0161 |

| | |
|---|---|
| | = 18.32298 tsf |
| Tip Pressure Per mV | = 18.32298/35.2 mV |
| | = 0.520539 tsf/mv |
| Tip Pressure Per Volt | = 0.520539 x 1,000 |
| | = 520.539 tsf/volt |
| | = 49.847 MPa/Volt |
| Tip Calibration Valve | ~ 50 Mpa/Volt |

**Temperature Calibration:**

Cone Penetrometers are placed in a temperature-controlled enclosure and zero readings recorded in mV at intervals between 30 degrees (F) and 115 degees (F). Temperatures and zero readings (mV) are entered into the **Calibration Verification Certificate** software which calculates the deviation between the maximum and minimum zero readings (mV) for the tip friction and pore pressure channels.

**Data Recording**

During the cone penetration test, the calibration numbers are automatically recorded in CPT test data files along with the following information (See attached CPT test data file, 6710.DEP):

- Date of CPT test
- Starting time of test
- Project Number
- CPT test number
- Operator name
- Elevation, starting depth, water depth
- Cone serial number
- Number of cone channels (3)
  - Tip calibration (50 MPa)
  - Friction calibration (0.5 MPa)
  - Pore Pressure Calibration (2.5 MPa)
  - Slope calibration (525)
- Initial baseline (zero) readings for depth, tip, friction, pore pressure and slope.

**Seismograph**

Seismic data was collected using an ES-3000 seismograph manufactured by Geometrics, Inc. The accuracy of the time readings of this instrument was verified before and after field work utilizing following A2LA and/or ANSI/NCSL approved verification systems.

| | |
|---|---|
| Function Generator: | Oscilliscope with built function generator. |
| Manufactured by: | EZ Digital, Inc. |
| Model number: | OS-5020G |
| Serial number: | 3080209 |
| Calibrated by: | Transcat Calibration Services (ANSI/NCSL approved) |
| Calibration date: | February 28, 2007 |

Frequency Counter, 120 MHz, 1 Channel

| | |
|---|---|
| Manufactured by: | Insetek God Will Instruments |
| Model number: | GFC – 8010H |
| Serial number: | CF 871549 |
| Calibrated by: | Transcat Calibration Services (A2LA/NCSL approved) |
| Calibration date: | February 28, 2007 |

**Seismograph Verification Methodology**

The function generator was connected to the input of the seismograph and frequency counter. Sine wave signals were generated at 10 Hz intervals from 10-100 Hz. The seismograph was manually triggered for each frequency and the data stored in standard seg2 seismic data format files, one frequency per file. Each file was opened with SeisImager software and converted to the frequency domain. The input and seismograph frequencies were entered into **Calibration Verification Certificate** software (See attached **Calibration Verification Certificate**).

Fugro appreciates the opportunity to submit our calibration verification report for your review. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Very truly yours,
**FUGRO CONSULTANTS, INC.**

Recep Yilmaz
Senior Vice President

RY/jm

# CALIBRATION CERTIFICATES

# TRANSCAT® CALIBRATION SERVICES

NVLAP®

NVLAP LAB CODE
200730-0

# CERTIFICATE OF CALIBRATION

**Customer:** FUGRO CONSULTANTS INC
6100 HILLCROFT
HOUSTON, TX 77081

**Customer Nbr:** 1-525293-000
**PO Nbr:** FO200708

**Cert/RA Nbr:** 5-V8842-1-1
**Manufacturer:** Cole-Parmer
**Model Nbr:** 8528-40
**Description:** Thermometer, Type K

**Serial Nbr:** C95005824
**ID Nbr:** TD 001

**Date Received:** Nov 16, 2007
**Date Calibrated:** Nov 16, 2007
**Next Calibration:** Nov 16, 2008
**Calibration Proc:** 1-AC22434-0
**Item Received:** In Tolerance
**Item Returned:** In Tolerance

For calibration data, see Supplemental Report for RA Nbr 5-V8842-1-1

**Temperature: 70°F / 21.1°C** **Temp/RH Asset: temp02** **Relative Humidity: 33%**

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the Lab's Scope of Accreditation are indicated by the presence of the Accrediting Body's Logo and Certificate Number on this Certificate of Calibration. Any measurements on an accredited calibration not covered by that Lab's Scope are noted below.

Transcat calibrations, as applicable, are performed in compliance with the requirements of ISO 9001:2000, ISO TS16949, ANSI/NCSL Z540-1994, QS-9000 and ISO 10012-1992. When specified contractually, the requirements of 10CFR21, 10CFR50 App. B and NQA-1 are also covered.

Transcat will maintain and document the traceability of all its standards to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC), or to other recognized national or international standard bodies (NMIs), or to measurable conditions created in our laboratory, or accepted fundamental and/or natural physical constants, ratio type of calibration, or by comparison to consensus standards. The specific path of traceability for the reported measurement results is maintained at the Transcat facility and is available there for review.

Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown below.

The results in this report relate only to the item calibrated or tested, and the determination of in or out of tolerance is specific to the model/serial no. referenced above based on the manufacturer's published specifications.

All calibrations have been performed using processes having a test uncertainty ratio of four or more times greater than the unit calibrated, unless otherwise noted. Uncertainties have been estimated at a 95 percent confidence level (k=2). Calibration at a 4:1 TUR provides reasonable confidence that the instrument is within the manufacturer's published specifications. Limitations on the uses of this instrument are detailed in the manufacturer's operating instructions. Any number of factors can cause a unit to drift out of tolerance at any time following its calibration.

**Notes:** Unit meets all manufacturers specifications. When using the K type probe with the unit, the readings were: @0.0°C/ 0.1°C @50.0°C/49.8°C @100.0°C/100.2°C

| Assets | Manufacturer | Model | Description | Cal Date | Due Date | Traceability Numbers |
|---|---|---|---|---|---|---|
| 5072 | Fluke Corporation | 5500A | Multi-Product Calibrator | 5/7/2007 | 5/31/2008 | 5-&5072-3-8 |
| 5342 | Hart Scientific | 1502A | Thermometer, SPRT, -200° to 96 | 8/21/2007 | 8/31/2008 | 15-V54VR-1-1 |
| 5343 | Hart Scientific | 5626 | Probe, Secondary Reference, PR | 8/21/2007 | 8/31/2008 | 15-V54VR-1-1 |
| K1TCW-11 | Omega Engineering, Inc. | Type-K | Thermocouple Probe, Type-K | 6/11/2007 | 12/31/2099 | 6-&K1TCW-507-11 |

**Calibrated at:**
1181 Brittmore
Houston, TX 77043
By: Thomas M. Laguna

**Facility Responsible:**
1181 Brittmore
Houston, TX 77043
713-465-4399

Michael A. Sublett
Lab Manager
Date 11/18/07

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F0013R20 5/02/2007

Certificate - Page 1 of 1



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# SUPPLEMENTAL REPORT FOR 5-V8842-1-1

## CALIBRATION LAB DATA AS FOUND / AS LEFT

| | | | |
|---|---|---|---|
| RA Nbr: | 5-V8842-1-1 | Mfg: | Cole-Parmer |
| Description: | Thermometer, Type K | Model: | 8528-40 |
| Customer: | FUGRO CONSULTANTS INC | Serial: | C95005824 |
| Calibrated: | Nov 16, 2007 | PO Nbr: | FO200708 |
| Date Due: | Nov 16, 2008 | ID Nbr: | TD 001 |
| Service Type: | R6 | Calibration Proc: | 1-AC22434-0 |

| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | OOT | Uncertainty (k=2; ±) | TUR |
|---|---|---|---|---|---|---|---|---|
| Temperature Measure | | | | | | | | |
| Type K (ITS90) | -145.0 °C | ±( 0.25% Rdg + 2 °C) | -147.4 | -142.6 | -145.2 °C | | | |
| | 0.0 °C | ±( 0.25% Rdg + 1 °C) | -1.0 | 1.0 | -0.1 °C | | | |
| | 450.0 °C | ±( 0.25% Rdg + 1 °C) | 447.9 | 452.1 | 450.1 °C | | | |
| | 900.0 °C | ±( 0.25% Rdg + 1 °C) | 896.7 | 903.3 | 900.0 °C | | | |
| | 1350 °C | ±( 0.25% Rdg + 1 °C) | 1346 | 1354 | 1350 °C | | | |
| Units Conversion | 2462 °F | ±( 0.25% Rdg + 1.8 °F) | 2454 | 2470 | 2461 °F | | | |

**Remarks:**

Unit meets all manufacturers specifications. When using the K type probe with the unit, the readings were: @0.0°C/ 0.1°C @50.0°C/49.8°C @100.0°C/100.2°C

When uncertainties are provided, the uncertainty only includes the measurement process and does not include uncertainty contributions of the instrument under test.

Field not applicable.

**TRANSCAT® CALIBRATION SERVICES**

NVLAP LAB CODE
200730-0

# CERTIFICATE OF CALIBRATION

Customer: FUGRO CONSULTANTS LP
6100 HILLCROFT
HOUSTON, TX 77081

Customer Nbr: 1-525293-000

Cert/RA Nbr: 5-V2023-1-1
Manufacturer: EZ Digital, Inc
Description: OSCILLOSCOPE
Model Nbr: OS-5020G
Serial Nbr: 3080209
ID Nbr:
PO Nbr: D111

Date Received: Feb 28, 2007
Date Calibrated: Feb 28, 2007
Next Calibration: Feb 28, 2008
Calibration Proc: 1-AC10468-0
Item Received: Out Of Tolerance
Item Returned: Limited Calibration

For calibration data, see Supplemental Report for RA Nbr 5-V2023-1-1

**Temperature: 72°F / 22.2°C** **Relative Humidity: 47%**

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the Lab's Scope of Accreditation are indicated by the presence of the Accrediting Body's Logo and Certificate Number on this Certificate of Calibration. Any measurements on an accredited calibration not covered by that Lab's Scope are noted below.

Transcat calibrations, as applicable, are performed in compliance with the requirements of ISO 9001:2000, ISO 7810:1995, ANSI/NCSL Z540-1994, QS-9000 and ISO 10012-1992. When specified contractually, the requirements of 10CFR21, 10CFR50 App. B and NQA-1 are also covered.

Transcat will maintain and document the traceability of all its standards to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC), or to other recognized national or international standard bodies (NMIs), or to measurable conditions created in our laboratory, or accepted fundamental and/or natural physical constants, as the type of calibration, or by comparison to consensus standards. The specific path of traceability for the recorded measurement results is maintained at the Transcat facility and is available there for review.

Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown below.

The results in this report relate only to the item calibrated or tested, and the determination of in or out of tolerance is specific to the model/serial no. referenced above based on the manufacturer's published specifications.

All calibrations have been performed using processes having a test uncertainty ratio of four or more times greater than the unit calibrated, unless otherwise noted. Uncertainties have been estimated at a 95 percent confidence level (k=2). Calibration at a 4:1 TUR provides reasonable confidence that the instrument is within the manufacturer's published specifications. Limitations on the use of this instrument are detailed in the manufacturer's operating instructions. Any number of factors can cause a unit to drift out of tolerance at any time following its calibration.

Notes: Limited Calibration: "Limitations on this calibration are: Sweep time is +/- 6%, and Frequency is +/- 10%, approved by (Brent Lawrence, 02/28/2007)." Risetime measurements are calibrated traceable, not accredited.

| Assets | Manufacturer | Model | Description | Cal Date | Due Date | Traceability Numbers |
|---|---|---|---|---|---|---|
| 5346 | Fluke Corporation | 5520A-SC1100 | Multifunction Cal. w/ Scope Op | 03/13/2006 | 03/31/2007 | F3094007 |
| TEMP02 | Oakton Instruments | 35710-10 | RH/Temperature Datalogger | 01/25/2007 | 01/31/2008 | 6-V10A4-1-1 |

Calibrated at:
1181 Brittmore
Houston, TX 77043
By: Jimmy Shipley

Facility Responsible:
1181 Brittmore
Houston, TX 77043
713-465-4399

Michael Sublett 2/28/07
Michael A. Sublett Date
Lab Manager

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FOU13R19 10/10/06

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TRANSCAT® CALIBRATION SERVICES

# SUPPLEMENTAL REPORT FOR 5-V2024-2-1

## CALIBRATION LAB DATA AS FOUND / AS LEFT

| | | | |
|---|---|---|---|
| RA Nbr: | 5-V2024-2-1 | Mfg: | Instek Good Will Instruments |
| Description: | Frequency Counter, 120 MHz, 1 Channel | Model: | GFC-8010H |
| Customer: | FUGRO CONSULTANTS LP | Serial: | CF871549 |
| Calibrated: | Feb 28, 2007 | PO Nbr: | DT11 |
| Date Due: | Feb 28, 2008 | ID Nbr: | NONE |
| Service Type: | S6 | Calibration Proc: | 1-AC17352-0 |

| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | OOT | Uncertainty (k=2; ±) | TUR |
|---|---|---|---|---|---|---|---|---|
| Frequency Accuracy | | | | | | | | |
| Frequency Accuracy | 10.000000 MHz | ±( 12 PPM Rdg) | 9.999880 | 10.000120 | 10.000007 MHz | | [illegible] | [illegible] |
| Input Sensitivity | | | | | | | | |
| 10 Hz to 10 MHz < (15 mVrms) | | [illegible] | P | P | P | | [illegible] | [illegible] |
| 10 MHz to 40 MHz < (20 mVrms) | | [illegible] | P | P | P | | [illegible] | [illegible] |
| 40 MHz to 80 MHz < (35 mVrms) | | [illegible] | P | P | P | | [illegible] | [illegible] |
| 80 MHz to 120 MHz < (50 mVrms) | | [illegible] | P | P | P | | [illegible] | [illegible] |

When uncertainties are provided, the uncertainty only includes the measurement process and does not include uncertainty contributions of the instrument under test.

Field not applicable.

Calibration Lab Data Report - Page 1 of 1

RA Nbr: 5-V2024-2-1

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PAGE 1
16:05:11 02/28/07
PL Run 852503

01V202300

1181 BRITTMOORE
SUITE 600
HOUSTON TX 77043

Ship To: FUGRO CONSULTANTS LP
6100 HILLCROFT
HOUSTON TX 77081

Order 02/27/07
3/09/07
DSNYDER MSUBLETT

| Co/Cust | P.O. No | Order No | Ship Via | WH |
|---|---|---|---|---|
| 01/0000525293 | D111 | V2023/00 | UPS GROUND | 05 |

| Item Number/Description | Ordered | Shipped | B/O | U/M | Loc Seq |
|---|---|---|---|---|---|
| Contact BRENT LAWRENCE | | | | 7133695400 | |
| Carrier: UPS GROUND | | | | | |
| 001 ED1801-6 | 1.000 | 1.000 | .000 | EA | BELOW |
| Cal&Data-EZ Digital, Inc Mdl:OS 5020G OSCILLOSCOPE | | | | | |
| LOC: ZZ 99 99 | | | | | |
| S/N:3080209 UNIT ID: | | | | | |
| 1 YEAR CALIBRATION INTERVAL | | | | | |
| TURNAROUND TIME: 7 BUSINESS DAYS AFTER RECEIPT OF ORDER | | | | | |
| Thank you! Denise Snyder 800-828-1470 x 9505 | | | | | |
| Fax: 800-395-0543 E-Mail: dsnyder@transcat.com | | | | | |

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**TRANSCAT® CALIBRATION SERVICES**

NVLAP®

NVLAP LAB CODE
200730-0

# CERTIFICATE OF CALIBRATION

Customer: FUGRO CONSULTANTS LP
6100 HILLCROFT
HOUSTON, TX 77081

Customer Nbr: 1-525293-000

Cert/RA Nbr: 5-V2024-2-1
Manufacturer: Instek Good Will Instruments
Description: Frequency Counter, 120 MHz, 1 Channel
Model Nbr: GFC-8010H
Serial Nbr: CF871549
ID Nbr: NONE
PO Nbr: D111

Date Received: Feb 27, 2007
Date Calibrated: Feb 28, 2007
Next Calibration: Feb 28, 2008
Calibration Proc: 1-AC17352-0
Item Received: In Tolerance
Item Returned: In Tolerance

For calibration data, see Supplemental Report for RA Nbr 5-V2024-2-1

**Temperature: 72°F / 22.2°C** **Relative Humidity: 47%**

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the Lab's Scope of Accreditation are indicated by the presence of the Accrediting Body's Logo and Certificate Number on the Certificate of Calibration. Any measurements on an accredited calibration not covered by that Lab's Scope are noted below.

Transcat calibrations, as applicable, are performed in compliance with the requirements of ISO 9001:2000, ISO 17025:1999, ANSI/NCSL Z540-1994, QS-9000 and ISO 10012-1992. When specified contractually, the requirements of 10CFR21, 10CFR50 App. B and NQA-1 are also covered.

Transcat will maintain and document the traceability of all its standards to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC), or to other recognized national or international standard bodies (NMIs), as is reasonable considering cost(s) in our laboratory, or accepted fundamental and/or natural physical constants, ratio type of calibration, or by comparison to consensus standards. The specific path of traceability for the reported measurement results is maintained at the Transcat facility and is available there for review.

Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown below.

The results in this report relate only to the item calibrated or tested, and the determination of fit or use of the item is specific to the manufacturer's published specifications.

All calibrations have been performed using processes having a test uncertainty ratio of four or more times greater than the unit calibrated, unless otherwise noted. Uncertainties have been estimated at a 95 percent confidence level (k=2). Calibration at a 4:1 TUR provides reasonable confidence that the instrument is within the manufacturer's published specifications. Limitations on the use of this instrument are detailed in the manufacturer's operating instructions. Any number of factors can cause a unit to drift out of tolerance at any time following its calibration.

Notes:

| Assets | Manufacturer | Model | Description | Cal Date | Due Date | Traceability Numbers |
|---|---|---|---|---|---|---|
| 5219 | Agilent/HP/Agilent Tech | 8902A | Measuring Receiver | 11/20/2006 | 11/30/2007 | 1-496265449-1 |
| 5346 | Fluke Corporation | 5520A-SC1100 | Multifunction Cal. w/ Scope Op | 03/13/2006 | 03/31/2007 | F3094007 |
| J568 | Agilent/HP/Agilent Tech | 11722A | Sensor Module, 100k-2.6GHz | 03/30/2006 | 03/31/2007 | 1-270725701-1 |
| TEMP02 | Oakton Instruments | 35710-10 | RH/Temperature Datalogger | 01/25/2007 | 01/31/2008 | 6-Y10A4-1-1 |

Calibrated at:
1181 Brittmore
Houston, TX 77043
By: Jimmy Shipley

Facility Responsible:
1181 Brittmore
Houston, TX 77043
713-465-4399

Michael A. Subtert 2/28/07
Michael A. Subtert — Date
Lab Manager

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PM013R19 10/07/2006



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PICK LIST 16:05:03 PAGE 1
02/28/07
PL Run 852502

01V202400

35 VANTAGE POINT DR
ROCHESTER NY 14624

Ship To: FUGRO CONSULTANTS LP
6100 HILLCROFT
HOUSTON TX 77081

Order 02/27/07
3/02/07
DSNYDER MSUBLETT

| Co/Cust | P.O. No | Order No | Ship Via | WH |
|---|---|---|---|---|
| 01/0000525293 | D111 | V2024/00 | DO NOT SHIP | 01 |

| Item Number/Description | Ordered | Shipped | B/O | U/M | Loc Seq |
|---|---|---|---|---|---|
| Contact BRENT LAWRENCE | | | 7133695400 | | |
| Carrier: DO NOT SHIP | | | | | |
| 001 GFC8010H | 1.000 | 1.000 | .000 | EA | BELOW |
| FREQUENCY COUNTER 120MHZ | | | | | |
| LOC: I 14.05 | | | | | |
| 002 HHP016 | 1.000 | 1.000 | .000 | EA | BELOW |
| Cal&Data-Instek Good Will instr-uments Mdl:GFC-8010H,FREQUENCY | | | | | |
| LOC: OS.01.01 | | | | | |
| ********* PLEASE SHIP TO HOUSTON LAB UPS RED EARLY AM | | | | | |
| MIKE SUBLETT WILL CALIBRATE TOMORROW 2/28/07 | | | | | |
| 1 YEAR CALIBRATION INTERVAL | | | | | |

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United States Department of Commerce
National Institute of Standards and Technology

# Certificate of Accreditation to ISO/IEC 17025:2005

**NVLAP LAB CODE: 200730-0**

## Transcat - Houston

Houston, TX

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:*

## CALIBRATION LABORATORIES

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).*

2008-01-01 through 2008-12-31

*Effective dates*

Sally S. Bruce

*For the National Institute of Standards and Technology*

# National Voluntary Laboratory Accreditation Program

## SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

**Transcat - Houston**
1181 Brittmore, Suite 600
Houston, TX 77043
Mr. Michael Sublett
Phone: 713-465-4399 Fax: 713-465-0525
E-mail: msublett@transcat.com
URL: www.transcat.com

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200730-0**

*NVLAP Code:* 20/A01 ANSI/NCSL Z540-1-1994; Part 1 Compliant

**DIMENSIONAL**

*NVLAP Code:* D05
Length and Diameter; Step Gages [note 2]

Micrometers – Outside, Inside, Depth

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| (0.02 to 4) in | (12 + 14L) µin | Comparison to Gage Blocks |
| (4 to 8) in | (23 + 14L) µin | Comparison to Gage Blocks |
| (8 to 16) in | (34 + 14L) µin | Comparison to Gage Blocks |
| (16 to 20) in | (46 + 14L) µin | Comparison to Gage Blocks |
| Calipers – Outside, Inside, Depth | | |
| to 36 in | (46 + 14L) µin | Comparison to Gage Blocks |
| Dial Indicators | | |
| (0.0625 to 6) in | (23 + 14L) µin | Comparison to Gage Blocks |

2008-01-01 through 2008-12-31

*Effective dates*

Sally S. Bruce

*For the National Institute of Standards and Technology*

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200730-0**

**ELECTROMAGNETICS – DC/LOW FREQUENCY**

*NVLAP Code:* 20/E02
AC Current

| | *Best Uncertainty (±) in % note 1* *Frequency in Hz* | | | |
|---|---|---|---|---|
| ***Range*** | ***10 to 20*** | ***20 to 40 k*** | ***40 to10 k*** | ***10 k to 30 k*** |
| 100 µA | 0.02 | 0.01 | 0.009 | 0.014 |
| 200 µA | 0.02 | 0.009 | 0.009 | 0.014 |
| 300 µA | 0.02 | 0.01 | 0.007 | 0.013 |
| 1 mA | 0.022 | 0.009 | 0.006 | 0.008 |
| 2 mA | 0.02 | 0.009 | 0.005 | 0.007 |
| 10 mA | 0.024 | 0.009 | 0.005 | 0.006 |
| 20 mA | 0.025 | 0.009 | 0.005 | 0.007 |
| 50 mA | 0.024 | 0.009 | 0.006 | 0.012 |
| 100 mA | 0.024 | 0.009 | 0.005 | 0.008 |
| 200 mA | 0.024 | 0.009 | 0.006 | 0.008 |
| 300 mA | 0.024 | 0.009 | 0.006 | 0.012 |
| 1 A | 0.024 | 0.009 | 0.007 | 0.012 |
| 2 A | 0.024 | 0.009 | 0.006 | 0.012 |
| 3 A | 0.027 | 0.01 | 0.008 | 0.016 |
| 5 A | 0.027 | 0.01 | 0.008 | 0.02 |
| 10 A | 0.049 | 0.042 | 0.042 | 0.044 |
| 20 A | 0.11 | 0.11 | 0.11 | 0.11 |

AC Current *note 2*
Measuring Equipment and Measure

| | *Best Uncertainty (±) in % + A note 1* *Frequency in Hz* | | | |
|---|---|---|---|---|
| ***Range*** | ***10 to 20*** | ***20 to 45*** | ***45 to 100*** | ***100 to 5 k*** |
| (0 to 100) µA | 0.46 + 30 n | 0.18 + 30 n | 0.08 + 30 n | 0.08 + 30 n |
| (0.1 to 1) mA | 0.46 + 200 n | 0.18 + 200 n | 0.07 + 200 n | 0.07 + 200 n |
| (1 to 10) mA | 0.46 + 2 µ | 0.17 + 2 µ | 0.07 + 2 µ | 0.04 + 2 µ |
| (10 to 100) mA | 0.46 + 20 µ | 0.18 + 20 µ | 0.69 + 20 µ | 0.35 + 20 µ |
| (100 to 1000) mA | 0.46 + 200 µ | 0.19 + 200 µ | 0.1 + 200 µ | 0.12 + 200 µ |

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**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200730-0**

*NVLAP Code:* 20/E05
DC Resistance
Measuring Equipment and Measure

| *Range* | *Best Uncertainty (±)*[note 1] | *Remarks* |
|---|---|---|
| 0 Ω to 0.1 mΩ | 1.4 nΩ | Standard Resistors w/Low Thermal Switch |
| 0.1 mΩ to 1 mΩ | 7.1 nΩ | Standard Resistors w/Low Thermal Switch |
| 1 mΩ to 10 mΩ | 5.4 ppm | Standard Resistors w/Low Thermal Switch |
| 10 mΩ to 100 mΩ | 8.2 ppm | Standard Resistors w/Low Thermal Switch |
| 0.1 Ω to 1 Ω | 0.36 ppm | Standard Resistors w/Low Thermal Switch |
| 1 Ω to 10 Ω | 0.5 ppm | Standard Resistors w/Guildline 9975 Bridge |
| 10 Ω to 100 Ω | 0.84 ppm | Standard Resistors w/Guildline 9975 Bridge |
| 100 Ω to 1 kΩ | 0.42 ppm | Standard Resistors w/Guildline 9975 Bridge |
| 1 kΩ to 10 kΩ | 0.31 ppm | Standard Resistors w/Guildline 9975 Bridge |
| 19 kΩ | 0.78 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 100 kΩ | 2.9 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 190 kΩ | 2.8 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 1 MΩ | 3.8 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 1.9 MΩ | 5.1 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 10 MΩ Source | 4.4 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 10 MΩ Measure | 5.0 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 19 MΩ Measure | 8.3 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 100 MΩ | 13 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 1 GΩ Source | 63 ppm | Standard Resistors w/Fluke 8508A in transfer mode |
| 1 GΩ Measure | 200 ppm | Standard Resistors w/Fluke 8508A in transfer Mode |

Resistance Ratio

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| | | |
|---|---|---|
| 1 Ω to 1 kΩ | 0.33 ppm | Guildline 9975 Bridge |

Measuring Equipment and Measure [note 2]

| | | |
|---|---|---|
| 10 mΩ to 10 Ω | 19 ppm + 0.05 mΩ | HP3458A w/Decade Resistor |
| 10 Ω to 1 kΩ | 15 ppm + 0.5 mΩ | HP3458A w/Decade Resistor |
| 1 kΩ to 10 kΩ | 12 ppm + 5 mΩ | HP3458A w/Decade Resistor |
| 10 kΩ to 100 kΩ | 14 ppm + 50 mΩ | HP3458A w/Decade Resistor |
| 100 kΩ to 1 MΩ | 23 ppm + 2 Ω | HP3458A w/Decade Resistor |
| 1 MΩ to 10 MΩ | 73 ppm + 50 Ω | HP3458A w/Decade Resistor |
| 10 MΩ to 100 MΩ | 630 ppm + 1 kΩ | HP3458A w/Decade Resistor |
| 100 MΩ to 1 GΩ | 0.6 % + 10 kΩ | HP3458A w/Decade Resistor |

Measuring Equipment [note 2]

| | | |
|---|---|---|
| 10 GΩ to 100 GΩ | 1.16 % | Biddle Mega Dek |

DC Current
Measuring Equipment and Measure

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| 0 A to 100 μA | 4 ppm + 230 pA | Standard Shunts w/current source |
| 100 μA to 1 mA | 3.1 ppm + 1.2 nA | Standard Shunts w/current source |
| 1 mA to 10 mA | 3.2 ppm + 12 nA | Standard Shunts w/current source |
| 10 mA to 100 mA | 3.2 ppm + 115 nA | Standard Shunts w/current source |
| 100 mA to 1 A | 8.8 ppm + 1.4 μA | Standard Shunts w/current source |
| 1 A to 10 A | 8.8 ppm + 12 μA | Standard Shunts w/current source |
| 10 A to 100 A | 160 ppm + 7 mA | Standard Shunts w/current source |

DC Current [note 2]
Measuring Equipment and Measure

| | | |
|---|---|---|
| 0 μA to 100 μA | 26 ppm + 0.8 nA | HP3458A w/current source |
| 100 μA to 1 mA | 26 ppm + 5 nA | HP3458A w/current source |
| 1 mA to 10 mA | 26 ppm + 50 nA | HP3458A w/current source |
| 10 mA to 100 mA | 42 ppm + 0.5 μA | HP3458A w/current source |
| 100 mA to 1 A | 0.013 % + 10 μA | HP3458A w/current source |
| 1 A to 20 A | 0.12 % | Fluke 5520A w/current shunt |

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| | | |
|---|---|---|
| Measure Only | | |
| 1 A to 100 A | 0.06 % | Valhalla 2575A |
| Clamp-on Ammeter Toroidal Type | | |
| 20 A to 150 A | 0.3 % + 20 mA | 5520A/coil w/Fluke 5220A Amplifier |
| 150 A to 1000 A | 0.3 % + 90 mA | 5520A/coil w/Fluke 5220A Amplifier |
| Non-Toroidal Type | | |
| 20 A to 150 A | 0.6 % + 140 mA | 5520A/coil w/Fluke 5220A Amplifier |
| 150 A to 1000 A | 0.6 % + 540 mA | 5520A/coil w/Fluke 5220A Amplifier |

***NVLAP Code:*** 20/E06
DC Voltage – Fixed Points
Measuring Equipment and Measure

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| 0 V | 90 nV | Ratio Metric w/Zener Reference |
| 1 mV | 90 nV | Ratio Metric w/Zener Reference |
| 10 mV | 9.7 ppm | Ratio Metric w/Zener Reference |
| 100 mV | 1.5 ppm | Ratio Metric w/Zener Reference |
| 1 V | 0.39 ppm | Ratio Metric w/Zener Reference |
| 10 V | 0.2 ppm | Ratio Metric w/Zener Reference |
| 100 V | 0.4 ppm | Ratio Metric w/Zener Reference |
| 1000 V | 0.64 ppm | Ratio Metric w/Zener Reference |
| 10 mV to 100 mV | 4.5 ppm + 90 nV | Ratio Metric w/Zener Reference |
| 100 mV to 1000 V | 2.4 ppm + 90 nV | Ratio Metric w/Zener Reference |
| 1 kV to 120 kV | 91 ppm | High Voltage Divider Comparison |
| DC Voltage [note 2] | | |
| Measuring Equipment and Measure | | |
| 0 V to 100 mV | 7.8 ppm + 0.5 μV | 3458A (002) w/5700A |
| 100 mV to 10 V | 5 ppm + 0.5 μV | 3458A (002) w/5700A |
| 10 V to 100 V | 7.6 ppm + 30 μV | 3458A (002) w/5700A |
| 100 V to 500 V | 11 ppm + 100 μV | 3458A (002) w/5700A |
| 500 V to 800 V | 14 ppm + 100 μV | 3458A (002) w/5700A |

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| | | |
|---|---|---|
| 800 V to 1000 V | 21 ppm + 100 μV | 3458A (002) w/5700A |

*NVLAP Code:* 20/E09
AC Voltage

| *Frequency in Hz* | *Best Uncertainty (±) in %* note 1 | | | *Remarks* |
|---|---|---|---|---|
| | | *22 mV range* | | |
| | *6 mV* | *10 mV* | *20 mV* | |
| 10 | 0.19 | 0.03 | 0.03 | Fluke 792A |
| 20 | 0.14 | 0.03 | 0.02 | Fluke 792A |
| (40, 100) | 0.14 | 0.03 | 0.014 | Fluke 792A |
| (1, 10, 20) k | 0.14 | 0.03 | 0.014 | Fluke 792A |
| 50 k | 0.14 | 0.05 | 0.03 | Fluke 792A |
| 100 k | 0.17 | 0.07 | 0.02 | Fluke 792A |
| 300 k | 0.22 | 0.12 | 0.014 | Fluke 792A |
| 500 k | 0.40 | 0.15 | 0.014 | Fluke 792A |
| 1 M | 0.45 | 0.15 | 0.13 | Fluke 792A |
| | | *220 mV Range* | | |
| | *20 mV* | *60 mV* | *200 mV* | |
| 10 | 0.04 | 0.035 | 0.02 | Fluke 792A |
| 20 | 0.03 | 0.021 | 0.008 | Fluke 792A |
| (40, 100) | 0.02 | 0.017 | 0.004 | Fluke 792A |
| (1, 10, 20) k | 0.02 | 0.017 | 0.004 | Fluke 792A |
| 50 k | 0.03 | 0.021 | 0.01 | Fluke 792A |
| 100 k | 0.05 | 0.041 | 0.015 | Fluke 792A |
| 300 k | 0.07 | 0.068 | 0.045 | Fluke 792A |
| 500 k | 0.11 | 0.11 | 0.06 | Fluke 792A |
| 1 M | 0.2 | 0.17 | 0.06 | Fluke 792A |
| | | *700 mV Range* | | |
| | *200 mV* | | *600 mV* | |
| 10 | 0.022 | | 0.007 | Fluke 792A |
| 20 | 0.008 | | 0.007 | Fluke 792A |
| (40, 100) | 0.005 | | 0.003 | Fluke 792A |
| (1, 10, 20) k | 0.005 | | 0.003 | Fluke 792A |

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| | | | | |
|---|---|---|---|---|
| 50 k | 0.01 | | 0.005 | Fluke 792A |
| 100 k | 0.02 | | 0.006 | Fluke 792A |
| 300 k | 0.05 | | 0.014 | Fluke 792A |
| 500 k | 0.06 | | 0.043 | Fluke 792A |
| 1 M | 0.06 | | 0.06 | Fluke 792A |

*2.2 V Range*

| | *600 mV* | *1 V* | *2 V* | |
|---|---|---|---|---|
| 10 | 0.02 | 0.02 | 0.02 | Fluke 792A |
| 20 | 0.007 | 0.006 | 0.006 | Fluke 792A |
| 40 | 0.003 | 0.003 | 0.003 | Fluke 792A |
| (0.1, 1, 10, 20) k | 0.003 | 0.004 | 0.0011 | Fluke 792A |
| 50 k | 0.005 | 0.005 | 0.004 | Fluke 792A |
| 100 k | 0.006 | 0.012 | 0.005 | Fluke 792A |
| 300 k | 0.012 | 0.043 | 0.012 | Fluke 792A |
| 500 k | 0.043 | 0.045 | 0.043 | Fluke 792A |
| 1 M | 0.06 | 0.045 | 0.045 | Fluke 792A |

*7 V Range*

| | *2 V* | *6 V* | |
|---|---|---|---|
| 10 | 0.02 | 0.02 | Fluke 792A |
| 20 | 0.007 | 0.006 | Fluke 792A |
| 40 | 0.003 | 0.003 | Fluke 792A |
| (0.01, 1, 10, 20) k | 0.003 | 0.0011 | Fluke 792A |
| 50 k | 0.005 | 0.004 | Fluke 792A |
| 100 k | 0.006 | 0.005 | Fluke 792A |
| 300 k | 0.012 | 0.012 | Fluke 792A |
| 500 k | 0.044 | 0.043 | Fluke 792A |
| 1 M | 0.05 | 0.046 | Fluke 792A |

*22 V Range*

| | *6 V* | *10 V* | *20 V* | |
|---|---|---|---|---|
| 10 | 0.02 | 0.02 | 0.02 | Fluke 792A |
| 20 | 0.007 | 0.006 | 0.006 | Fluke 792A |

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| | | | | |
|---|---|---|---|---|
| 40 | 0.003 | 0.003 | 0.003 | Fluke 792A |
| (0.1, 1, 10, 20) k | 0.003 | 0.002 | 0.002 | Fluke 792A |
| 50 k | 0.005 | 0.004 | 0.004 | Fluke 792A |
| 100 k | 0.006 | 0.005 | 0.005 | Fluke 792A |
| 300 k | 0.012 | 0.012 | 0.012 | Fluke 792A |
| 500 k | 0.044 | 0.043 | 0.043 | Fluke 792A |
| 1 M | 0.05 | 0.05 | 0.05 | Fluke 792A |

*70 V Range*

| | *20 V* | *60 V* | |
|---|---|---|---|
| 10 | 0.02 | 0.02 | Fluke 792A |
| 20 | 0.007 | 0.006 | Fluke 792A |
| 40 | 0.003 | 0.003 | Fluke 792A |
| (0.1, 1, 10, 20) k | 0.003 | 0.002 | Fluke 792A |
| 50 k | 0.006 | 0.005 | Fluke 792A |
| 100 k | 0.007 | 0.007 | Fluke 792A |
| 300 k | 0.013 | 0.013 | Fluke 792A |

*220 V Range*

| | *60 V* | *100 V* | *200 V* | |
|---|---|---|---|---|
| 10 | 0.02 | 0.02 | 0.02 | Fluke 792A |
| 20 | 0.007 | 0.007 | 0.006 | Fluke 792A |
| (0.04, 0.1, 1, 10, 20) k | 0.004 | 0.003 | 0.003 | Fluke 792A |
| 50 k | 0.007 | 0.007 | 0.006 | Fluke 792A |
| 100 k | 0.007 | 0.007 | 0.007 | Fluke 792A |
| 200 k | 0.01 | 0.01 | 0.01 | Fluke 792A |

*1000 V Range*

| | *200 V* | *600 V* | *1000 V* | |
|---|---|---|---|---|
| 10 | 0.02 | | | Fluke 792A |
| 20 | 0.009 | | | Fluke 792A |
| (0.04, 0.1, 1, 10, 20) k | 0.004 | 0.004 | 0.003 | Fluke 792A |
| 50 k | 0.007 | 0.007 | 0.006 | Fluke 792A |
| 100 k | 0.007 | 0.008 | 0.007 | Fluke 792A |

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| | | | |
|---|---|---|---|
| (5 to 80) kV @ 60 Hz | | 0.054 | HV Divider Comparison |

AC Voltage – Measure [note 2]

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|---|
| (0 to 10) mV | 1 to 40 | 0.06 % + 3 µV | 3458A |
| | 40 to 1 k | 0.05 % + 1 µV | 3458A |
| | 1 k to 20 k | 0.05 % + 1 µV | 3458A |
| | 20 k to 50 k | 0.12 % + 1 µV | 3458A |
| | 50 k to 100 k | 0.6 % + 1 µV | 3458A |
| | 100 k to 300 k | 4.6 % + 2 µV | 3458A |
| (10 to 100) mV | 1 to 40 | 0.01 % + 4 µV | 3458A |
| | 40 to 1 k | 0.01 % + 2 µV | 3458A |
| | 1 k to 20 k | 0.018 % + 2 µV | 3458A |
| | 20 k to 50 k | 0.036 % + 2 µV | 3458A |
| | 50 k to 100 k | 0.1 % + 2 µV | 3458A |
| | 100 k to 300 k | 0.35 % + 10 µV | 3458A |
| | 300 k to 1 M | 1.2 % + 10 µV | 3458A |
| (100 m to 1) V | 1 to 40 | 0.009 % + 40 µV | 3458A |
| | 40 to 1 k | 0.009 % + 20 µV | 3458A |
| | 1 k to 20 k | 0.017 % + 20 µV | 3458A |
| | 20 k to 50 k | 0.035 % + 20 µV | 3458A |
| | 50 k to 100 k | 0.09 % + 20 µV | 3458A |
| | 100 k to 300 k | 0.35 % + 100 µV | 3458A |
| | 300 k to 1 M | 1.2 % + 100 µV | 3458A |
| (1 to 10) V | 1 to 40 | 0.009 % + 0.4 mV | 3458A |
| | 40 to 1 k | 0.009 % + 0.2 mV | 3458A |
| | 1 k to 20 k | 0.017 % + 0.2 mV | 3458A |
| | 20 k to 50 k | 0.035 % + 0.2 mV | 3458A |
| | 50 k to 100 k | 0.09 % + 0.2 mV | 3458A |
| | 100 k to 300 k | 0.35 % + 1 mV | 3458A |
| | 300 k to 1 M | 1.2 % + 1 mV | 3458A |
| (10 to 100) V | 1 to 40 | 0.025 % + 4 mV | 3458A |
| | 40 to 1 k | 0.025 % + 2 mV | 3458A |

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| | | | |
|---|---|---|---|
| | 1 k to 20 k | 0.025 % + 2 mV | 3458A |
| | 20 k to 50 k | 0.04 % + 2 mV | 3458A |
| | 50 k to 100 k | 0.14 % + 2 mV | 3458A |
| | 100 k to 300 k | 0.5 % + 10 mV | 3458A |
| | 300 k to 1 M | 1.8 % + 10 mV | 3458A |
| (100 to 700) V | 1 to 40 | 0.05 % + 40 mV | 3458A |
| | 40 to 1 k | 0.05 % + 20 mV | 3458A |
| | 1 k to 20 k | 0.07 % + 20 mV | 3458A |
| | 20 k to 50 k | 0.14 % + 20 mV | 3458A |
| | 50 k to 100 k | 0.35 % + 20 mV | 3458A |

AC Voltage *note 2*
Measuring Equipment

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* *note 1* | *Remarks* |
|---|---|---|---|
| (0 to 2.2) mV | 10 to 40 | 0.6 % + 5 µV | 5700A / 5725A |
| | 40 to 50 k | 0.15 % + 5 µV | 5700A / 5725A |
| | 50 k to 100 k | 0.1 % + 7 µV | 5700A / 5725A |
| | 100 k to 300 k | 0.13 % + 13 µV | 5700A / 5725A |
| | 300 k to 500 k | 0.2 % + 30 µV | 5700A / 5725A |
| | 500 k to 1 M | 0.4 % + 30 µV | 5700A / 5725A |
| (2.2 to 22) mV | 10 to 20 | 0.08 % + 5 µV | 5700A / 5725A |
| | 20 to 20 k | 0.05 % + 5 µV | 5700A / 5725A |
| | 20 k to 50 k | 0.06 % + 5 µV | 5700A / 5725A |
| | 50 k to 100 k | 0.13 % + 7 µV | 5700A / 5725A |
| | 100 k to 300 k | 0.15 % + 12 µV | 5700A / 5725A |
| | 300 k to 500 k | 0.13 % + 25 µV | 5700A / 5725A |
| | 500 k to 1 M | 0.4 % + 25 µV | 5700A / 5725A |
| (22 to 220) mV | 10 to 20 | 0.07 % + 13 µV | 5700A / 5725A |
| | 20 to 40 | 0.03 % + 10 µV | 5700A / 5725A |
| | 40 to 20 k | 0.015 % + 10 µV | 5700A / 5725A |
| | 20 k to 50 k | 0.04 % + 8 µV | 5700A / 5725A |
| | 50 k to 100 k | 0.1 % + 25 µV | 5700A / 5725A |
| | 100 k to 300 k | 0.14 % + 25 µV | 5700A / 5725A |
| | 300 k to 500 k | 0.2 % + 35 µV | 5700A / 5725A |

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| | | | |
|---|---|---|---|
| | 500 k to 1 M | 0.34 % + 80 µV | 5700A / 5725A |
| (220 m to 2.2) V | 10 to 20 | 0.06 % + 100 µV | 5700A / 5725A |
| | 20 to 40 | 0.02 % + 25 µV | 5700A / 5725A |
| | 40 to 20 k | 0.01 % + 6 µV | 5700A / 5725A |
| | 20 k to 50 k | 0.014 % + 16 µV | 5700A / 5725A |
| | 50 k to 100 k | 0.03 % + 70 µV | 5700A / 5725A |
| | 100 k to 300 k | 0.06 % + 130 µV | 5700A / 5725A |
| | 300 k to 500 k | 0.13 % + 350 µV | 5700A / 5725A |
| | 500 k to 1 M | 0.26 % + 85 µV | 5700A / 5725A |
| (2.2 to 22) V | 10 to 20 | 0.06 % + 0.8 mV | 5700A / 5725A |
| | 20 to 40 | 0.02 % + 0.3 mV | 5700A / 5725A |
| | 40 to 20 k | 0.009 % + 60 µV | 5700A / 5725A |
| | 20 k to 50 k | 0.014 % + 0.2 mV | 5700A / 5725A |
| | 50 k to 100 k | 0.03 % + 0.4 mV | 5700A / 5725A |
| | 100 k to 300 k | 0.06 % + 1.5 mV | 5700A / 5725A |
| | 300 k to 500 k | 0.15 % + 5 mV | 5700A / 5725A |
| | 500 k to 1 M | 0.32 % + 9 mV | 5700A / 5725A |
| (22 to 220) V | 10 to 20 | 0.06 % + 8 mV | 5700A / 5725A |
| | 20 to 40 | 0.02 % + 3 mV | 5700A / 5725A |
| | 40 to 20 k | 0.01 % + 1 mV | 5700A / 5725A |
| | 20 k to 50 k | 0.03 % + 4 mV | 5700A / 5725A |
| | 50 k to 100 k | 0.06 % + 8 mV | 5700A / 5725A |
| | 100 k to 300 k | 0.18 % + 8 mV | 5700A / 5725A |
| (220 to 1100) V | 40 to 1 k | 0.01 % + 4 mV | 5700A / 5725A |
| | 1 k to 20 k | 0.02 % + 6 mV | 5700A / 5725A |
| | 20 k to 30 k | 0.07 % + 11 mV | 5700A / 5725A |
| (220 to 750) V | 30 k to 50 k | 0.07 % + 11 mV | 5700A / 5725A |
| | 50 k to 100 k | 0.3 % + 45 mV | 5700A / 5725A |

***NVLAP Code:*** 20/E10
Capacitance – Source: (100 to 10 k) Hz

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|

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| | | |
|---|---|---|
| 0.01 pF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 0.1 pF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 1 pF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 10 pf | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 100 pF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 500 pF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 1 nF | 0.002% | Fixed Capacitors w/GR1615-A Bridge |
| 10 nF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |
| 200 nF | 0.02 % | Fixed Capacitors w/GR1615-A Bridge |

Capacitance – Measure: (50 to 1M) Hz

| | | |
|---|---|---|
| (1 a to 1.1 μ) F | 0.012 % + 30 aF | GR1615-A Bridge |
| (1.1 μ to 10 m) F | 0.06 % + 30 aF | Quadtech 7600LCR Bridge |

Capacitance – Measure Equipment *note 2*

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* *note 1* | *Remarks* |
|---|---|---|---|
| (0.19 to 1.0999) nF | 10 to 10 k | 0.60 % + 0.01 nF | 5520A |
| (1.1 to 3.2999) nF | 10 to 3 k | 0.60 % + 0.01 nF | 5520A |
| (3.3 to 10.9999) nF | 10 to 1 k | 0.30 % + 0.01 nF | 5520A |
| (11 to 109.999) nF | 10 to 1 k | 0.30 % + 0.01 nF | 5520A |
| (110 to 329.999) nF | 10 to 1 k | 0.30 % + 0.3 nF | 5520A |
| (0.33 to 1.09999) μF | 10 to 600 | 0.30 % + 1 nF | 5520A |
| (1.1 to 3.2999) μF | 10 to 300 | 0.30 % + 3 nF | 5520A |
| (3.3 to 10.9999) μF | 10 to 150 | 0.30 % + 10 nF | 5520A |
| (11 to 32.9999) μF | 10 to 120 | 0.48 % + 30 nF | 5520A |
| (33 to 109.9999) μF | 10 to 80 | 0.54 % + 100 nF | 5520A |
| (110 to 329.999) μF | DC to 50 | 0.54 % + 300 nF | 5520A |
| (0.33 to 1.09999) mF | DC to 20 | 0.54 % + 1 μF | 5520A |
| (1.1 to 3.29999) mF | DC to 6 | 0.54 % + 3 μF | 5520A |
| (3.3 to 10.9999) mF | DC to 2 | 0.54 % + 10 μF | 5520A |
| (11 to 32.9999) mF | DC to 0.6 | 0.90 % + 30 μF | 5520A |
| (33 to 110) mF | DC to 0.2 | 1.31 % + 100 μF | 5520A |

***NVLAP Code:*** 20/E11
LF Inductance *note 2*

Source Only

| *Range* | *Best Uncertainty (±) in %* *note 1* | *Remarks* |
|---|---|---|
| 1 mH | 0.07 | Fixed Inductors w/Quadtech 7600 |

2008-01-01 through 2008-12-31

*Effective dates*

Sally S. Bruce

*For the National Institute of Standards and Technology*

| | | |
|---|---|---|
| 10 mH | 0.07 | Fixed Inductors w/Quadtech 7600 |
| 100 mH | 0.07 | Fixed Inductors w/Quadtech 7600 |
| 1 H | 0.07 | Fixed Inductors w/Quadtech 7600 |

Measure @ 1 kHz

| | | |
|---|---|---|
| (10 μ to 100) H | 0.07 | Quadtech 7600 |

*NVLAP Code*: 20/E15

AC Phase [note 2]

Measure

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|---|
| 0° to 360° | 1 to 50 k | 3 m° | Clark-Hess 5002 Bridge Set |
| | 50 k to 200 k | 11 m° | Clark-Hess 5002 Bridge Set |

AC Phase – Generate [note 2]

50mV to 100V

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|---|
| 0° to 360° | 1 to 1 k | 13 m° | Clark-Hess 5500-2 Phase Standard |
| | 1 k to 6.25 k | 17 m° | Clark-Hess 5500-2 Phase Standard |
| | 6.25 k to 50 k | 21 m° | Clark-Hess 5500-2 Phase Standard |
| | 50 k to 200 k | 50 m° | Clark-Hess 5500-2 Phase Standard |

100V to 120V

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|---|
| 0° to 360° | 1 to 1 k | 1.7 m° | Clark-Hess 5500-2 Phase Standard |
| | 1 k to 6.25 k | 26 m° | Clark-Hess 5500-2 Phase Standard |
| | 6.25 k to 50 k | 37 m° | Clark-Hess 5500-2 Phase Standard |

2008-01-01 through 2008-12-31

*Effective dates*

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**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200730-0**

| | | |
|---|---|---|
| 50 k to 200 k | 95 m° | Clark-Hess 5500-2 Phase Standard |

**TIME AND FREQUENCY**

***NVLAP Code:*** 20/F01
Frequency – Source and Measure

| *Range in Hz* [note 3] | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| 10 M | $5.8 \times 10^{-11}$ | Rubidium Frequency Standard |

**MECHANICAL**

***NVLAP Code:*** 20/M06
Torque [note 2]

Measure

| *Range* | *Best Uncertainty (±) in %* [note 1] | *Remarks* |
|---|---|---|
| 10 lbf-in to 600 lbf-ft | 2.0 % | CDI |

***NVLAP Code***: 20/M08
Mass [note 2]

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| 8 kg | 12 mg | Echelon III |
| 7 kg | 12 mg | Echelon III |
| 6 kg | 12 mg | Echelon III |
| 5 kg | 9.3 mg | Echelon III |
| 4 kg | 8.8 mg | Echelon III |
| 2 kg | 6.9 mg | Echelon III |
| 1 kg | 3.6 mg | Echelon III |
| 500 g | 2 mg | Echelon III |
| 200 g | 0.68 mg | Echelon III |
| 100 g | 0.34 mg | Echelon III |
| 50 g | 0.17 mg | Echelon III |
| 20 g | 0.10 mg | Echelon III |
| 10 g | 68 µg | Echelon III |
| 5 g | 54 µg | Echelon III |
| 2 g | 54 µg | Echelon III |

2008-01-01 through 2008-12-31

*Effective dates*

Sally S. Bruce

*For the National Institute of Standards and Technology*

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200730-0**

| | | |
|---|---|---|
| 1 g | 54 µg | Echelon III |
| 500 mg | 43 µg | Echelon III |
| 200 mg | 43 µg | Echelon III |
| 100 mg | 43 µg | Echelon III |
| 50 mg | 43 µg | Echelon III |
| 20 mg | 43 µg | Echelon III |
| 10 mg | 43 µg | Echelon III |
| 5 mg | 43 µg | Echelon III |
| 2 mg | 43 µg | Echelon III |
| 1 mg | 43 µg | Echelon III |

**ELECTROMAGNETICS – RF/MICROWAVE**

***NVLAP Code:*** 20/R11
RF-DC Voltage/Current Converters *note 2*

Sinewave Flatness

| *Range in Hz* | *Best Uncertainty (±) in %* *note 1* | *Remarks* |
|---|---|---|
| 30 k to 1 M | 0.014 | Thermal Converters |
| 1 M to 10 M | 0.08 | Thermal Converters |
| 10 M to 30 M | 0.17 | Thermal Converters |
| 30 M to 80 M | 0.71 | Thermal Converters |
| 80 M to 100 M | 0.84 | Thermal Converters |

***NVLAP Code:*** 20/R17
RF Power *note 2*
Absolute

| *Range* | *Frequency in Hz* | *Best Uncertainty (±)* *note 1* | *Remarks* |
|---|---|---|---|
| (+30 to -20) dBm | 0.1 M to 1.3 G | 0.10 dBm + M | 8902A |

Harmonic Distortion (50 and 600 Ω)

| *Range* | *Best Uncertainty (±)* *note 1* | *Remarks* |
|---|---|---|

2008-01-01 through 2008-12-31

*Effective dates*

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*For the National Institute of Standards and Technology*

| | | |
|---|---|---|
| 0 dB @ (10 to 26 G) Hz | 0.3 dB | 8903B<br>71209A<br>8902A |

**THERMODYNAMIC**

*NVLAP Code:* 20/T05
Pressure
Absolute Pressure Source – Pneumatic

| *Range* | *Best Uncertainty (±)* note 1 | *Remarks* |
|---|---|---|
| (0.2 to 100) psia | 11 ppm + 0.07 m psia | Ruska 2465 |
| (100 to 1000) psia | 12 ppm | Ruska 2465 |

Gage Pressure Source – Gage

| *Range* | *Best Uncertainty (±)* note 1 | *Remarks* |
|---|---|---|
| (0 to 1.2) psi | 0.013 m psi | Ruska 2465 |
| (1.2 to 100) psi | 11 ppm | Ruska 2465 |
| (100 to 1000) psi | 12 ppm | Ruska 2465 |
| (-20 to 20) in $H_2O$ | 11 ppm + 240 µin $H_2O$ | Differential |

Gage Pressure Source – Hydraulic

| *Range* | *Best Uncertainty (±)* note 1 | *Remarks* |
|---|---|---|
| (75 to 3000) psi | 16 ppm | DHI PG7000 |
| (725 to 30 000) psi | 36 ppm | DHI PG7000 |

Determination of Piston Area

| *Range* | *Best Uncertainty (±)* note 1 | *Remarks* |
|---|---|---|
| (0.2 to 100) psi | 16 ppm | Ruska 2465 |
| (100 to 1000) psi | 17 ppm | Ruska 2465 |
| (40 to 10 000) psi | 35 ppm | DHI 5300 |

Gage Pressure Source note 2

| *Range* | *Best Uncertainty (±)* note 1 | *Remarks* |
|---|---|---|
| (0.5 to 500) psi | 73 ppm | Pressurements T2300 |

Hydraulic note 2

| *Range* | *Best Uncertainty (±)* note 1 | *Remarks* |
|---|---|---|

2008-01-01 through 2008-12-31

*Effective dates*

Sally S. Bruce

*For the National Institute of Standards and Technology*

| | | |
|---|---|---|
| (500 to 15 000) psi | 0.03 % | Ametek T-150 |

***NVLAP Code:*** 20/T07
Thermodynamic

| *Range in °C* | *Best Uncertainty (±) in C°* [note 1] | *Remarks* |
|---|---|---|
| -10 to 110 | 0.044 | Liquid Bath w/PRT |
| 100 to 300 | 0.12 | Dry Block Calibrator |
| 300 to 600 | 0.23 | Dry Block Calibrator |
| Measure only [note 2] | | |
| -195 to 660 | 0.044 | PRT & Super Thermometer |

***NVLAP Code:*** 20/T08
Thermocouple

Isothermal Block Verification [note 2]

| *Range* | *Best Uncertainty (±)* [note 1] | *Remarks* |
|---|---|---|
| Ambient (~23 °C) | 0.04 °C | Thermocouple Half Junction |

1. Represents an expanded uncertainty using a coverage factor, k = 2, at an approximate level of confidence of 95%.
2. Onsite calibrations available.
3. Uncertainty values of derivatives of 10 MHz will differ due to resolution, noise, and gating errors.

2008-01-01 through 2008-12-31

*Effective dates*

Sally S. Bruce

*For the National Institute of Standards and Technology*

# CERTIFICATE OF CALIBRATION

**Certificate Number** M503691-1

Manufacturer: Geotac
Model No: 560K
Customer PO No.: L-2416

Description: **Load Cell**
Serial No: **129739**
Customer Asset No.: **129739**

**Customer:**
Fugro Consultants LP
6100 Hillcroft
Houston, TX 77081

**Location of Calibration:**
Applied Technical Services, Inc.
1049 Triad Court
Marietta, GA 30062

Calibration Procedure: **ATS-521 Rev. 5: Calibration of Force Gages**

Date of Calibration: **November 28, 2006**
Temperature: **70° F**
Condition Received: **As Found Data Only**

*Next Calibration Due: **November 28, 2007**
Humidity: **29 %**
Condition Returned: **As Found Data Only**

This instrument has been calibrated using primary or secondary standards whose calibration is traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST). Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements.

The reported expanded measurement uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a confidence level of approximately 95%. ATS maintains, wherever possible, at least a 4:1 Test Uncertainty Ratio. Statements of compliance, where applicable, are based on test results falling within specified limits with no reduction by the uncertainty of the measurement, unless otherwise allowed by procedure.

All calibrations are performed in accordance with the ATS Quality Manual QM1, Rev. 7 dated July 7, 2006. Applied Technical Services, Inc.'s Quality System complies with the applicable requirements of ANSI/NCSL Z540-1, ISO 9001-2000, 10CFR 50 Appendix B, 10CFR Part 21 and ISO/IEC 17025. ATS is an ISO/IEC 17025 Accredited Calibration Laboratory through A2LA.

The reported data is valid only at the time of the test and related only to the item calibrated. *Calibration due dates appearing on this Certificate of Calibration and calibration label are determined by the client and do not imply continued conformance to specifications.

This certificate shall not be reproduced except in full, without the permission of Applied Technical Services, Inc.

Notes: *Gage Factor = -2.1826mV/V*

Calibration Equipment Used::

Model: **Tinius Olsen Super L** Desc.: **Universal Testing Machine** ID No.: **ATS-01226** Cal Due Date: **2/11/2007**

Calibrated by: Christopher A. Gerlach
Senior Calibration Technician

# APPLIED TECHNICAL SERVICES, INCORPORATED

## CALIBRATION DATA SHEET



Customer: Fugro Consultants  Purchase Order No.: L-2416

Item Name: Load Cell w/o Display  Asset No.: 129739  ATS Reference No.: M503691-1

Manufacturer: GeoTac  Model No.: 50Klbs  Proc. No.: 521  Rev.: 5

Serial No.: 129739  Calibration Date: 11/28/06  Calibration Due Date: 11/28/07

Reason For Service: ☒ Initial Calibration ☐ Due For Calibration ☐ Repair and Calibration

Equipment Used: ATS-01226 Due: 02/11/07 Universal Testing Machine

Due:

Due:

Due:

Due:

Due:

Calibrated By:

Customer Instrument Under Test

| UNCERTAINTY (SEE NOTE) g | RANGE Lbs | ATS STANDARD Lbs | TOLERANCE Lbs | AS FOUND READING mV | AS CALIBRATED READING Lbs |
|---|---|---|---|---|---|
| 0.03% | 50000 | (Comp.) 5000.000 | As Found Data Only | -2.176 | Same as - As Found |
| 0.03% | | 10000.000 | As Found Data Only | -4.358 | Same as - As Found |
| 0.03% | | 20000.000 | As Found Data Only | -8.722 | Same as - As Found |
| 0.03% | | 30000.000 | As Found Data Only | -13.092 | Same as - As Found |
| 0.03% | | 40000.000 | As Found Data Only | -17.479 | Same as - As Found |
| 0.03% | | 50000.000 | As Found Data Only | -21.826 | Same as - As Found |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Excitation (Before) | 10.0000VDC | | | | |
| Excitation (After) | 10.0000VDC | | | | |
| Zero (Before) | 0.000 | | | | |
| Zero (After) | 0.000 | | | | |
| Gage Factor | -2.1826mV/V | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

* Indicates out of tolerance readings.

Remarks: Measurement Uncertainty reported at coverage factor K = 2 or 95% confidence level.

A= + Excitation B= -Excitation C= + Output D= -Output

ATS 538, 05/03

ACCREDITED
CALIBRATION CERTIFICATE 1991.01

interface
ADVANCED FORCE MEASUREMENT

# LOAD CELL CALIBRATION CERTIFICATION

CUSTOMER : FUGRO CONSULTANTS INC.
ADDRESS : Houston,TX 77081
CONDITION: AS FOUND & FINAL S.O. #: 78664 P.O. #: L-2563
MODEL: FT451-50K SERIAL: 129739 BRIDGE: A CAPACITY: 50 Klbf
PROCEDURE: C-1257

INPUT RESISTANCE: 376.3 OHM OUTPUT RESISTANCE: 354.7 OHM
ZERO BALANCE : 0.166 %RO

## TEST CONDITIONS

TEMPERATURE: 74 °F HUMIDITY: 30 % EXCITATION: 10 VDC

## TRACEABILITY

FORCE STANDARD : STD-14 NIST #: 822/273338-06 DUE: 15-MAR-10
STANDARD INDICATOR: BRD295 NIST #: 512727
TEST INDICATOR : BRD297 NIST #: 512727

## SHUNT CALIBRATION

| | Shunt (± 0.01%) | Output | Straight Line Conversion | Connections* |
|---|---|---|---|---|
| Tension | Kohm | .00000 mV/V | .0000 Klbf | |
| Compression | 60 Kohm | -1.46285 mV/V | 33.650 Klbf | -Out to +Exc |

*For models wired with +Sense, -Sense, or -SCal leads, resistor connections are actually to these leads in place of +Exc, -Exc, or -Out respectively.

## PERFORMANCE

| | RATED OUTPUT | SEB OUTPUT | NONLINEARITY | HYSTERESIS | SEB |
|---|---|---|---|---|---|
| TENSION | .00000 mV/V | .00000 mV/V | .000 %FS | .000 %FS | ± .000 %FS |
| COMPRESSION | -2.17387 mV/V | -2.17364 mV/V | -.027 %FS | .045 %FS | ± .022 %FS |

STATIC ERROR BAND (SEB) - The band of maximum deviations of the ascending and descending calibration points from a best fit straight line through zero OUTPUT. It includes the effects of NONLINEARITY, HYSTERESIS, and nonreturn to MINIMUM LOAD.

| TEST LOAD APPLIED ( Klbf) | RECORDED READINGS (mV/V) Tension | Compression |
|---|---|---|
| 0 | | .00000 |
| 10 | | -.43434 |
| 20 | | -.86897 |
| 30 | | -1.30378 |
| 40 | | -1.73876 |
| 50 | | -2.17387 |
| 20 | | -.86994 |
| 0 | | -.00018 |

Interface® Inc. certifies that force measurements are traceable to primary standards at NIST. Calibration performed per Interface QA program and the requirements of ISO/IEC 17025, MIL-STD-45662A & ANSI/NCSL Z540-1-1994. Estimated measurement uncertainty is 0.040%, expressed as the expanded uncertainty at 95% confidence level using a coverage factor of k=2. Results relate to load cell serial 129739 only.
DO NOT REPRODUCE THIS REPORT except in full or with Interface Inc. written approval.

TECHNICIAN : Josh Smith DATE :14-MAR-08

INTERFACE INC.
7401 EAST BUTHERUS DRIVE · SCOTTSDALE, ARIZONA 85260, U.S.A.
TELEPHONE (480)948-5555 · FAX (480)948-1924

F16-4D-1206

ACCREDITED CALIBRATION CERTIFICATE 1991.01

interface
ADVANCED FORCE MEASUREMENT

# LOAD CELL CALIBRATION CERTIFICATION

CUSTOMER : FUGRO CONSULTANTS INC.
ADDRESS : Houston,TX 77081
CONDITION: FINAL S.O. #: 78664 P.O. #: L-2563
MODEL: FT451-50K SERIAL: 129739 BRIDGE: A CAPACITY: 12.5 Klbf
PROCEDURE: C-1257

INPUT RESISTANCE: 374.7 OHM OUTPUT RESISTANCE: 353.0 OHM
ZERO BALANCE : -0.386 %RO

## TEST CONDITIONS

TEMPERATURE: 75 °F HUMIDITY: 30 % EXCITATION: 10 VDC

## TRACEABILITY

FORCE STANDARD : STD-22 NIST #: 822/275431-07 DUE: 15-SEP-11
STANDARD INDICATOR: BRD106 NIST #: 512727
TEST INDICATOR : BRD300 NIST #: 512727

## SHUNT CALIBRATION

| | Shunt (± 0.01%) | Output | Straight Line Conversion | Connections* |
|---|---|---|---|---|
| Tension | 60 Kohm | 1.46154 mV/V | 33.590 Klbf | -Out to -Exc |
| Compression | Kohm | .00000 mV/V | .0000 Klbf | |

*For models wired with +Sense, -Sense, or -SCal leads, resistor connections are actually to these leads in place of +Exc, -Exc, or -Out respectively.

## PERFORMANCE

| | RATED OUTPUT | SEB OUTPUT | NONLINEARITY | HYSTERESIS | SEB |
|---|---|---|---|---|---|
| TENSION | .54411 mV/V | .54388 mV/V | -.073 %FS | .066 %FS | ± .044 %FS |
| COMPRESSION | .00000 mV/V | .00000 mV/V | .000 %FS | .000 %FS | ± .000 %FS |

STATIC ERROR BAND (SEB) - The band of maximum deviations of the ascending and descending calibration points from a best fit straight line through zero OUTPUT. It includes the effects of NONLINEARITY, HYSTERESIS, and nonreturn to MINIMUM LOAD.

| TEST LOAD APPLIED ( Klbf) | RECORDED READINGS (mV/V) Tension | Compression |
|---|---|---|
| 0.0 | .00000 | |
| 2.5 | .10868 | |
| 5.0 | .21743 | |
| 7.5 | .32609 | |
| 10.0 | .43489 | |
| 12.5 | .54411 | |
| 5.0 | .21779 | |
| 0.0 | .00026 | |

Interface, Inc. certifies that force measurements are traceable to primary standards at NIST. Calibration performed per Interface QA program and the requirements of ISO/IEC 17025, MIL-STD-45662A & ANSI/NCSL Z540-1-1994. Estimated measurement uncertainty is 0.040%, expressed as the expanded uncertainty at 95% confidence level using a coverage factor of k=2. Results relate to load cell serial 129739 only.
DO NOT REPRODUCE THIS REPORT except in full or with Interface Inc. written approval.

TECHNICIAN : Josh Smith DATE :14-MAR-08

INTERFACE INC.
7401 EAST BUTHERUS DRIVE · SCOTTSDALE, ARIZONA 85260, U.S.A.
TELEPHONE (480)948-5555 · FAX (480)948-1924

F16-4D-1206

# THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

## ACCREDITED LABORATORY

A2LA has accredited

**INTERFACE, INC.**
**Scottsdale, AZ**

for technical competence in the field of **Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005*).

Presented this 18th day of October 2006.

President
For the Accreditation Council
Certificate Number 1991.01
Valid to November 30, 2008

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.

# American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO 17025:2005
& ANSI/NCSL Z540-1-1994

INTERFACE, INC.
7401 E. Butherus Drive
Scottsdale, AZ 85260
LaVar Clegg Phone: 480 948 5555 ext 106

CALIBRATION

Valid To: November 30, 2008 Certificate Number: 1991.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1]:

I. Mechanical

| Parameter/Equipment | Range | Best Uncertainty[2] (±) | Comments |
|---|---|---|---|
| Force – Load Cells, Force Transducers | (200 to 240 000) lbf<br>(100 to 1100) lbf<br>(240 000 to 1 000 000) lbf | 0.035 % reading<br>0.050 % reading<br>0.041 % reading | Load cells |
| | (1 to 500) lbf | 0.040 % reading | Free weights |
| | (25 to 1100) lbf | 0.030 % reading | Actuated weights |
| | (10 to 550) lbf | 0.021 % reading | Actuated weights (stainless steel) |
| | (25 to 2000) gf | 0.030 % reading | Free weights |
| Mass – Measure | | | Transfer method using load cells |
| Dead Weight | (1 to 25) lb<br>(25 to 100) lb | 0.0032 %<br>0.0085 % | |

(A2LA Cert. No. 1991.01) 10/18/2006 Page 1 of 2

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974

II. Electrical – DC & Low Frequency

| Parameter/Equipment | Range | Best Uncertainty[2] (±) | Comments |
|---|---|---|---|
| DC Voltage – Measure | (0 to 0.14) V<br>(0.14 to 1.4) V<br>(1.4 to 14) V<br>(14 to 140) V | 0.0026 % + 0.2 μV<br>0.0024 % + 2 μV<br>0.0022 % + 20 μV<br>0.0022 % + 200 μV | Solartron 7071 |
| DC Voltage Ratio | (0 to 0.1) V | 0.0007 % rdg + 0.1 μV/$V_{ref}$ | Kelvin-Varley divider |
| Resistance – Measure | (0 to 1.4) kΩ<br>(0.14 to 1.4) kΩ<br>(1.4 to 14) kΩ<br>(14 to 140) kΩ<br>(140 to 1400) kΩ | 0.0026 % + 0.2 mΩ<br>0.0026 % + 2 mΩ<br>0.0026 % + 20 mΩ<br>0.0028 % + 0.2 Ω<br>0.0036 % + 2 Ω | Solartron 7071 |

[1] This laboratory offers commercial calibration service.

[2] "Best Uncertainty" is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

Roxanne M. Robinson

GE Infrastructure
Sensing

# Calibration Report 060915A0813

Digital Pressure Indicator

for

**Fugro Consultants LP**

6100 Hillcroft
Houston, TX 77081

Date of Issue: September 15, 2006



Manufacturer: Eaton
Sales Order: 216724

Model Number: UPS3000CC
Serial Number: A0813
ID Number: XPE-001

Preceding the calibration, the elastic element of this gauge was exercised and zero was adjusted. The horizontal plane of reference for pressure measurement is at the centerline of the test port.

The calibration and traceability of the transfer standards used in this calibration are maintained according to Quality Manual (QMS-001) Revision R (12/14/2005). The measurement results are traceable through an unbroken chain of comparisons to reference standards developed and maintained by the National Institute of Standards and Technology. The uncertainty reported with the data is the expanded uncertainty, and is based on the standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

This calibration was performed at the GE Infrastructure Sensing Houston facility. At the time of the calibration, the environmental conditions were 21 °C, 60%RH, and 101 kPa. The best estimate of gravitational acceleration at the site of calibration was 9.792778 m/s².

The calibration procedure CS-125 Revision D satisfies the requirements of ANSI/NCSL Z540-1-1994, ISO 9001, ISO/IEC 17025:1999 (E), NIST Handbook 150, and MIL-STD-45662A.

This report shall not be reproduced, except in full, without the written permission of the issuing laboratory.

Approved by: Sharon R. Ellis
Calibration Technician

Calibrated by: Joseph P. Balliew
Calibration Technician

General Electric Company
10311 Westpark Drive
Houston, TX 77042
USA

T 713 975 0547
F 713 975 6338

GE Infrastructure
Sensing

# Calibration Report 060915A0813

Digital Pressure Indicator

for

**Fugro Consultants LP**

6100 Hillcroft
Houston, TX 77081

Date of Issue: September 15, 2006



Full Scale: 250 psi gauge

## As Found Calibration Data

Calibration Date: September 15, 2006

Calibration Standard: PC-89, WS-12, and WS-27

Medium: nitrogen

| Applied psi | Uncertainty psi | Displayed psi |
|---|---|---|
| 0.00 | 0.0E+00 | 0.00 |
| 124.6680 | 1.4E-03 | 124.70 |
| 249.579 | 2.7E-03 | 249.65 |
| 124.6680 | 1.4E-03 | 124.65 |
| 0.00 | 0.0E+00 | 0.05 |

*Note: The instrument was not adjusted prior to the above data being recorded. An asterisk denotes a point that is out of tolerance.*

General Electric Company
10311 Westpark Drive
Houston, TX 77042
USA

T 713 975 0547
F 713 975 6338

GE Infrastructure
Sensing

# Calibration Report 060915A0813

Digital Pressure Indicator

for

**Fugro Consultants LP**

6100 Hillcroft
Houston, TX 77081

Date of Issue: September 15, 2006



Full Scale: 100 psi gauge

## As Found Calibration Data

Calibration Date: September 15, 2006

Calibration Standard: PC-67, WS-12, and WS-27

Medium: nitrogen

| Applied psi | Uncertainty psi | Displayed psi |
|---|---|---|
| 0.00 | 0.0E+00 | 0.00 |
| 49.8390 | 5.0E-04 | 49.80 |
| 99.9320 | 1.0E-03 | 99.88 |
| 49.8400 | 5.0E-04 | 49.76 |
| 0.00 | 0.0E+00 | 0.00 |

*Note: The instrument was not adjusted prior to the above data being recorded. An asterisk denotes a point that is out of tolerance.*

General Electric Company
10311 Westpark Drive
Houston, TX 77042
USA

T 713 975 0547
F 713 975 6338

GE Infrastructure
Sensing

# Calibration Report 060915A0813

Digital Pressure Indicator

for

**Fugro Consultants LP**

6100 Hillcroft
Houston, TX 77081

Date of Issue: September 15, 2006



Full Scale: 500 psi gauge

## As Found / As Left Calibration Data

Calibration Date: September 15, 2006

Calibration Standard: PC-89, and ,WS-12

Medium: nitrogen

| Applied psi | Uncertainty psi | Displayed psi |
|---|---|---|
| 0.0 | 0.0E+00 | 0.0 |
| 124.6700 | 1.4E-03 | 124.7 |
| 249.580 | 2.7E-03 | 249.6 |
| 374.330 | 4.1E-03 | 374.4 |
| 499.070 | 5.5E-03 | 499.2 |
| 249.580 | 2.7E-03 | 249.6 |
| 0.0 | 0.0E+00 | 0.1 |

*Notes: The instrument was not adjusted.*

General Electric Company
10311 Westpark Drive
Houston, TX 77042
USA

T 713 975 0547
F 713 975 6338

GE Infrastructure
Sensing

# Calibration Report 060915A0813

Digital Pressure Indicator

for

**Fugro Consultants LP**

6100 Hillcroft
Houston, TX 77081

Date of Issue: September 15, 2006



Full Scale: 250 psi gauge

## As Left Calibration Data

Calibration Date: September 15, 2006

Calibration Standard: PC-89, WS-12, and WS-27

Medium: nitrogen

| Applied psi | Uncertainty psi | Displayed psi |
|---|---|---|
| 0.00 | 0.0E+00 | 0.00 |
| 61.7960 | 6.8E-04 | 61.80 |
| 124.6680 | 1.4E-03 | 124.65 |
| 186.5430 | 2.1E-03 | 186.55 |
| 249.579 | 2.7E-03 | 249.60 |
| 124.6680 | 1.4E-03 | 124.65 |
| 0.00 | 0.0E+00 | 0.00 |

*Notes: The instrument was adjusted prior to recording the above data.*

General Electric Company
10311 Westpark Drive
Houston, TX 77042
USA

T 713 975 0547
F 713 975 6338

GE Infrastructure
Sensing

# Calibration Report 060915A0813

Digital Pressure Indicator

for

**Fugro Consultants LP**

6100 Hillcroft
Houston, TX 77081

Date of Issue: September 15, 2006



Full Scale: 100 psi gauge

## As Left Calibration Data

Calibration Date: September 15, 2006

Calibration Standard: PC-67, WS-12, and WS-27

Medium: nitrogen

| Applied psi | Uncertainty psi | Displayed psi |
|---|---|---|
| 0.00 | 0.0E+00 | 0.00 |
| 24.86100 | 2.5E-04 | 24.84 |
| 49.8390 | 5.0E-04 | 49.84 |
| 74.9860 | 7.5E-04 | 74.98 |
| 99.9310 | 1.0E-03 | 99.96 |
| 49.8390 | 5.0E-04 | 49.82 |
| 0.00 | 0.0E+00 | 0.00 |

*Notes: The instrument was adjusted prior to recording the above data.*

General Electric Company
10311 Westpark Drive
Houston, TX 77042
USA

T 713 975 0547
F 713 975 6338

National Voluntary Laboratory Accreditation Program

# SCOPE OF ACCREDITATION TO ISO/IEC 17025:1999

**GE Infrastructure Sensing**
10311 Westpark Drive
Houston, TX 77042-5312
Mr. Kenneth A. Kolb
Phone: 713-975-0547 Fax: 713-975-6338
E-mail: kenneth.kolb@ge.com
URL: http://www.gesening.com

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200491-0**

*NVLAP Code:* 20/A01 ANSI/NCSL Z540-1-1994; Part 1 Compliant

**MECHANICAL**

*NVLAP Code:* 20/M08
Mass

Calibration of Primary Piston Gauge Masses

| *Range* | *Best Uncertainty (±) Relative to Indicated Value* [note 1] | *Remarks* |
|---|---|---|
| 1 mg to 17 kg | $5.0 \times 10^{-6}$ but not less than 0.5 mg | Substitution – Mechanical |
| 1 mg to 1.2 kg | $5.0 \times 10^{-6}$ but not less than 0.5 mg | Substitution – Electronic |

Calibration of Secondary Piston Gauge Masses

| | | |
|---|---|---|
| 1 mg to 8.0 kg | $2.0 \times 10^{-5}$ but not less than 0.5 mg | Substitution – Electronic |
| 1 mg to 1.2 kg | $2.0 \times 10^{-5}$ but not less than 0.5 mg | Direct Reading - Electronic |
| 1.2 kg to 8 kg | $2.0 \times 10^{-5}$ but not less than 43 mg | Direct Reading – Electronic |

2006-01-01 through 2006-12-31
*Effective dates*

*For the National Institute of Standards and Technology*

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200491-0**

**THERMODYNAMICS**

*NVLAP Code:* 20/T05
Pressure

Pneumatic Pressure using Primary Piston Gauge *note 2*

| *Range* | *Best Uncertainty (±) of Reading* *note 1* | *Remarks* |
|---|---|---|
| -100 kPa to -1.38 kPa | $1.0 \times 10^{-5}$ but not less than 0.07 Pa | Negative Gauge Mode |
| -16 kPa to 16 kPa | $1.1 \times 10^{-5}$ but not less than 0.034 Pa | Differential Mode |
| 1.38 kPa to 1.4 MPa | $1.0 \times 10^{-5}$ but not less than 0.07 Pa | Gauge Mode *note 4* |
| 1.4 MPa to 7 MPa | $1.1 \times 10^{-5}$ but not less than 2.8 Pa | Gauge Mode *note 4* |
| 7 MPa to 21 MPa | $1.1 \times 10^{-5} + 1.9 \times 10^{-7}$ per MPa | Gauge Mode |
| 21 MPa to 104 MPa | $3.5 \times 10^{-5}$ | Gauge Mode |

Pneumatic Effective Area Determination using Primary Piston Gauge *note 2*

| *Range* | *Best Uncertainty (±) of Reading* *notes 1, 7* | *Remarks* |
|---|---|---|
| 1.38 kPa to 345 kPa | $8.8 \times 10^{-6}$ | |
| 11.72 kPa to 1.4 MPa | $8.3 \times 10^{-6}$ | |
| 14 kPa to 7 MPa | $1.0 \times 10^{-5} + 2.4 \times 10^{-7}$ per MPa *note 3* | |
| 700 kPa to 21 MPa | $1.0 \times 10^{-5} + 4.8 \times 10^{-7}$ per MPa *note 3* | |
| 1.17 MPa to 104 MPa | $3.37 \times 10^{-5}$ | |

Pneumatic Pressure using Precision Transducer *note 2*

| *Range* | *Best Uncertainty (±) of Reading* *note 1* | *Remarks* |
|---|---|---|
| 0 Pa to 133 Pa | 0.133 Pa | Absolute Mode |
| -16 kPa to 16 kPa | $5.0 \times 10^{-5}$ but not less than 0.035 Pa | Differential Mode |
| -100 kPa to 17 MPa | $6.5 \times 10^{-5}$ but not less than 0.22 Pa | Gauge Mode *note 5* |

2006-01-01 through 2006-12-31

*Effective dates*

*For the National Institute of Standards and Technology*

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200491-0**

Pneumatic Effective Area Determination using Precision Transducer [note 2]

| | |
|---|---|
| 20 Pa to 17 MPa | $7.2 \times 10^{-5}$ but not less than 0.05 Pa |

Pneumatic Deadweight Tester Output Pressure Conformance using Precision Transducer [note 2]

| *Range* | *Best Uncertainty (±) of Reading* [notes 1, 8] | *Remarks* |
|---|---|---|
| 20 Pa to 17 MPa | $7.5 \times 10^{-5}$ but not less than 0.053 Pa | |

Hydraulic Pressure using Primary Piston Gauge [note 2]

| *Range* | *Best Uncertainty (±) of Reading* [notes 1, 6] | *Remarks* |
|---|---|---|
| 50 kPa to 7 MPa | $2.5 \times 10^{-5}$ but not less than 10 Pa | Gauge Mode |
| 7 MPa to 140 MPa | $3.5 \times 10^{-5}$ | Gauge Mode |
| 14 MPa to 280 MPa | $7.5 \times 10^{-5}$ | Gauge Mode |
| 280 MPa to 500 MPa | $1.0 \times 10^{-4}$ | Gauge Mode |

Hydraulic Effective Area Determination using Primary Piston Gauge [note 2]

| *Range* | *Best Uncertainty (±) of Reading* [note 1] | *Remarks* |
|---|---|---|
| 50 kPa to 7 MPa | $2.31 \times 10^{-5}$ | |
| 7 MPa to 140 MPa | $3.34 \times 10^{-5}$ | |
| 140 MPa to 280 MPa | $7.29 \times 10^{-5}$ | |
| 280 MPa to 500 MPa | $9.80 \times 10^{-5}$ | |

Hydraulic Effective Area Determination using Secondary Piston Gauge [note 2]

| | |
|---|---|
| 70 kPa to 140 MPa | $7.2 \times 10^{-5}$ |

2006-01-01 through 2006-12-31

*Effective dates*

*For the National Institute of Standards and Technology*

**CALIBRATION LABORATORIES** **NVLAP LAB CODE 200491-0**

Hydraulic Deadweight Tester Output Pressure Conformance using Secondary Piston Gauge [note 2]

| | |
|---|---|
| 70 kPa to 140 MPa | $7.5 \times 10^{-5}$ but not less than 50 Pa |

1. Represents an expanded uncertainty using a coverage factor, k = 2, at an approximate level of confidence of 95 %.
2. This capability includes on-site calibration service, as limited by influences of operating environment.
3. Component uncertainties are combined in quadrature.
4. For absolute mode, uncertainties increase by 1.33E + 00 Pa, combined in quadrature with stated level.
5. For absolute mode, uncertainties increase by 1.88E + 00 Pa, combined in quadrature with stated level.
6. For absolute mode, uncertainties increase by 1.31E + 01 Pa, combined in quadrature with stated level.
7. Calibration process may include the use of transducers to measure small differential pressures.
8. Conformance evaluation of Deadweight Tester output pressure compared to indicated pressure.

2006-01-01 through 2006-12-31

*Effective dates*

*For the National Institute of Standards and Technology*

# QUALITY SYSTEM MANUAL

# FOR

# HOUSTON GEOTECHNICAL LABORATORY

**CONTROL #: GEO-1**

**Fugro Consultants, Inc.**
6100 Hillcroft
Houston, Texas 77081
Phone: (713) 369-5400
Fax: (713) 369-5545

Document Revised: July 07, 2007

| CALIBRATION EQUIPMENT OR REFERENCE STANDARDS | | | |
|---|---|---|---|
| Equipment Name | Calibration Interval | Check Interval | Procedure Used |
| Digital Micrometer & Mechanical Micrometers | 2 years | | Outside Source |
| Force Transducers | 1 year | | Outside Source |
| Metal Specimens | Verify Before Use or After Repair | | HGL 2655 |
| Pressure Gages | 2 years | | Outside Source |
| Set of Gage Blocks | 5 years | | Outside Source |
| Thermometers | 1 year | | Outside Source |
| Torque Transducers | 2 years | | Outside Source |
| Voltmeters/Multimeters (6.5 digit) | 3 years | | Outside Source |

***The term "calibration" is used to maintain consistency with ASTM D 3740. It is taken to mean "verification."**

# PRE JOB CALIBRATION VERIFICATION

# CALIBRATION CERTIFICATE

| | | | | |
|---|---|---|---|---|
| APPLICANT | FGI HOUSTON | Certificate number | FC070040 | Page 1 of 1 |
| SUBMITTED | **A Piezo Cone Penetrometer** | Manufacturer | Fugro Engineers B.V. | |
| Device type | CONE, A15F2.5CKE3SW2/ B, 50 bar | | Serial number | 1701-1788 |

The device contains an electronic data sheet which contains, amongst others, the characteristics of all the sensors inside the device. The data acquisition system calculates the measured value from these known characteristics. All calibration results are conform the values specified below.

## Force calibration

Calibration reference : 548 FRE.001
Procedure : FEBV.CAL.PRO.003 KALIBRATIE KRACHT
Title of channel(s) : Cone and Cone+Fric.
Max. load 150 kN

| Range | Calibration range From | to | Sensitivity Deviation | Zero load output |
|---|---|---|---|---|
| 1 | 0 | 25 kN | < 0.5 % | < 0.75 kN |
| | | | | |
| Calibration uncertainty | | | 0.3 % | 0.008 kN |

## Pressure test :

| | |
|---|---|
| Deviation from specified Alpha factor at 2.5 MPa | < 5 % |

## Cone quality control values :

| | |
|---|---|
| Max. deviation from reference | < 1 % |
| Max. Tip to Sleeve friction Crosstalk | < 1 % |

## Pressure calibration

Calibration reference : 3257-0001
Procedure : FEBV.CAL.PRO.004 KALIBRATIE DRUK
Title of channel : Pore 2
Max. load 30 Mpa

| Range | Calibration range From | | Sensitivity Deviation | Zero load output |
|---|---|---|---|---|
| 1 | 0 | 2.5 MPa | < 1.0 % | < 0.002 MPa |
| | | | | |
| Calibration uncertainty | | | 0.6 % | 0.003 MPa |
| Pore 2 transducer : Kistler 4043A50<br>SN : 1233109 | | | | |

## Calibration of the slope sensor

Calibration reference :
Procedure:FEBV.CAL.PRO.006 KALIBRATIE HELLING
Title of channel : Slope x

| Range | Calibration range From | | Sensitivity Deviation | Zero load output |
|---|---|---|---|---|
| 1 | 0 | 15 deg | < 10 % | < 1.5 deg |
| Calibration uncertainty | | | 1 % | 0.5 deg |

## Typical values for this type of device

| | | | | | |
|---|---|---|---|---|---|
| Cone diameter (mm) | 43.7 | Pore 2 position | 2 | Alpha factor | 0.58 |
| Cone area (square cm) | 15 | Sleeve length (mm) | 144.7 | Cone - Sleeve distance (mm) | 14.4 |
| Sleeve diameter (mm) | 43.9 | Sleeve area (square cm) | 200 | Cone - Pore 2 distance (mm) | 6.0 |

TRACEABILITY. The measurements have been executed using standards for which the traceability to primary and/or (inter)national standards has been demonstrated .

Calibrated by: Hoogendoorn, Raymond

Approved by : Sinjorgo, Gerry

Calibration date: 16-1-2007

Approval date: 16-1-2007

Calibrate before: 16-1-2008

FUGRO ENGINEERS B.V. Veurse

## Calibration Verification Certificate

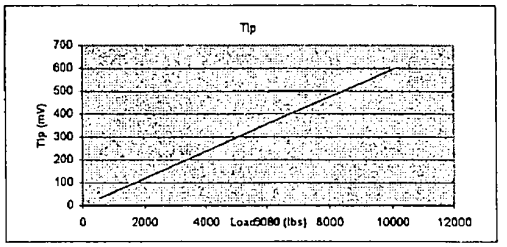
Device Type: Piezo Cone Penetrometer

Device Number: **F7.5CKESW2/V 1701-1788**

### TIP CALIBRATION

Tip area = 15 cm2 = 0.0161 ft2
Tip readings in mV

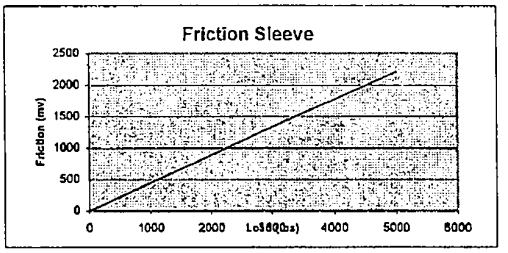
| Load lb | Load Tons | load/area tsf | Tip mV | TIP Cal Factor Mpa |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 540 | 0.27 | 16.77019 | 32.1 | 50.0287963 |
| 5110 | 2.555 | 158.6957 | 303.4 | 50.0883413 |
| 7580 | 3.79 | 235.4037 | 449.8 | 50.1165401 |
| 10020 | 5.01 | 311.1801 | 596.3 | 49.9728639 |
| 15020 | 7.51 | 466.4596 | 892.5 | 50.0487269 |
| 20005 | 10.0025 | 621.2733 | 1183.2 | 50.2819048 |




### FRICTION CALIBRATION

Sleeve area = 200 cm2 = 0.2153 ft2
Friction readings in mV

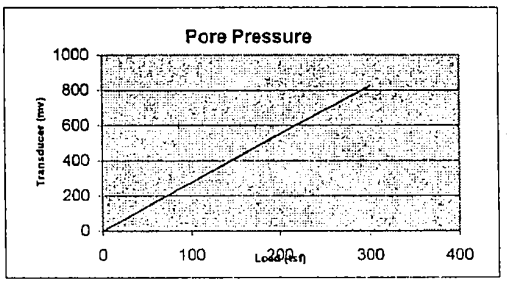
| Load lb | Load Tons | load/area tsf | Friction mV | Friction Cal Factor Mpa |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 620 | 0.31 | 1.439851 | 279.8 | 0.49278463 |
| 1990 | 0.995 | 4.621458 | 884.6 | 0.50028711 |
| 3520 | 1.76 | 8.17464 | 1562.3 | 0.50106193 |
| 5010 | 2.505 | 11.63493 | 2212.2 | 0.5036473 |
| 7510 | 3.755 | 17.44078 | 3308.9 | 0.50474203 |




### PORE PRESSURE TRANSDUCER CALIBRATION

Serial : 1233109
Pore Pressure readings in mV

| Pressure psi | Pressure tsf | Transducer readings mV | P.Pres. Cal Factor Mpa |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 75 | 5.4 | 206.7 | 2.50173026 |
| 150 | 10.8 | 413.6 | 2.50052053 |
| 300 | 21.6 | 824.2 | 2.50962215 |




**Temperature Calibration (30 - 115 degrees F)**

| Temp (deg | TIP (mV) | FRIC (mV) | PIEZO (mV) |
|---|---|---|---|
| 30 | -0.017 | -0.198 | -0.109 |
| 50 | -0.008 | -0.336 | -0.067 |
| 75 | 0.011 | -0.456 | -0.054 |
| 100 | 0.132 | 2.307 | -2.192 |
| 115 | 0.257 | 2.987 | -2.647 |

| Deviation | mV | Mpa | % Full Scale |
|---|---|---|---|
| Tip | 0.274 | 0.0137 | 0.0274 |
| Friction | 3.185 | 0.001593 | 0.3185 |
| Piezo | 2.593 | 0.006483 | 0.2593 |

TIP CALIBRATED BY GEOTAC (A2LA APPROVED) LOAD CELL:
Model 560K, Serial No. 129739
FRICTION CALIBRATED BY INTERFACE (A2LA APPROVED) LOAD CELL :
Model: 1211EX-10K-B, Serial : 113655
PORE PRESSURE TRANSDUCER CALIBRATED BY GE SENSING (AANSI/NCSL APPROVED)
Pressure Indicator Model: UPS3000CC, Serial : A0813
TEMPERATURE CALIBRATED BY HOUSTON PRECISION TYPE K THERMOCOUPLE (A2LA APPROVED)
Model # 8528-40, Serial # C95005824, ID # TD-001

Calibration Verified by: Dennis Stauffer Date: 11/5/2007

Checked By : Recep Yilmaz Date: 11/5/2007

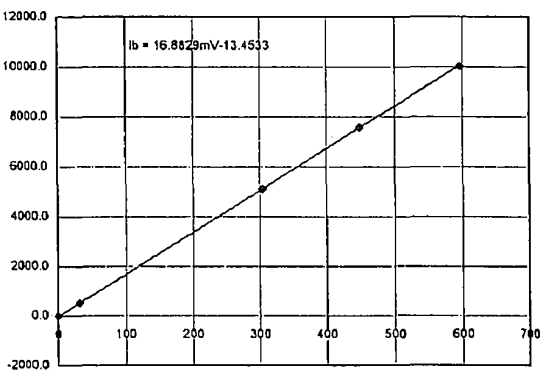
# HGL Instrument Verification

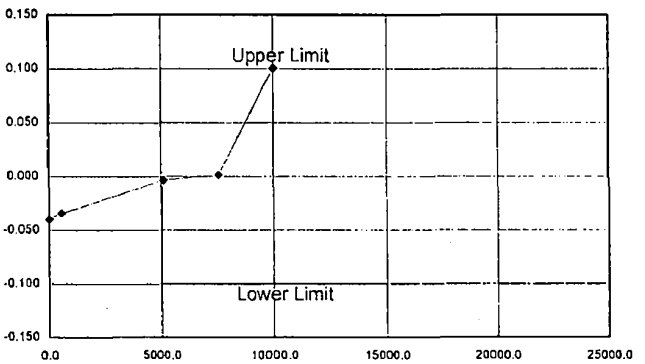
DATE: 11/5/2007 Instrument No.: ft Location: Houston LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mV | Standard lb | Prediction lb | Abs. Error lb | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer_TIP | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | -13.5 | 13.5 | -0.04 |
| Model Number | F7.5CKESW2/B1 | 32.100000 | 540.0 | 528.5 | 11.5 | -0.03 |
| Serial Number | 1701-1788 (Tip) | 303.400000 | 5110.0 | 5108.8 | 1.2 | 0.00 |
| HGL Instrument Number | ft | 449.800000 | 7580.0 | 7580.5 | 0.5 | 0.00 |
| Excitation (V) | | 596.300000 | 10020.0 | 10053.8 | 33.8 | 0.10 |
| Gain/Span Setting | NA | 892.500000 | 15020.0 | 15054.5 | 34.5 | 0.10 |
| Full Range Output (V) | | 1183.200000 | 20005.0 | 19962.4 | 42.6 | -0.13 |
| Full Range/Capacity (lb) | 33716 | | | | | |
| Date Verified | 11/5/2007 | | | | | |
| Date Due | 11/4/2008 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.1 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | Load Cell (A2AL APPROVED) | | | | | |
| Manufacturer | Geotac | | | | | |
| Model Number | 560K | | | | | |
| Serial Number | 129739 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999986252 | | | | | |
| Intercept (lb) | -13.45326099 | | | | | |
| Slope (lb/mV) | 16.88287763 | | | | | |
| Verification (Calib.) Factor | 16.88287763 | | | | | |
| Verification Factor Units | lb/mV | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (lb) | 6.479058372 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (lb) | 12.95811674 | | | | | |
| Max. Abs. or FS Error (%) | -0.13 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For ft | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in lb | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 6.4791 | N | 1.0000 | A | 6.4791 | 41.9782 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 6.4791 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 12.958 | | lb | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: Input By: Reviewed By: Checked By:

File:

Remarks:

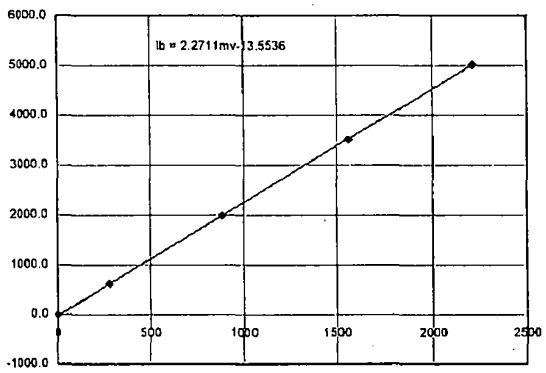
# HGL Instrument Verification

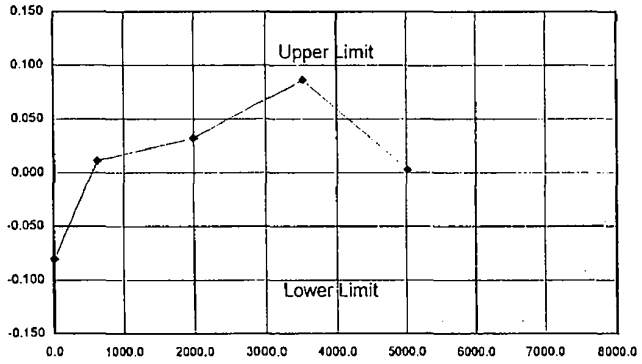
DATE: 11/5/2007 Instrument No.: ft100 Location: LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mv | Standard lb | Prediction lb | Abs. Error lb | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | -13.6 | 13.6 | -0.08 |
| Model Number | F7.5CKESW2/B1 | 279.800000 | 620.0 | 621.9 | 1.9 | 0.01 |
| Serial Number | 1701-1788 (Friction) | 884.600000 | 1990.0 | 1995.4 | 5.4 | 0.03 |
| HGL Instrument Number | ft100 | 1562.300000 | 3520.0 | 3534.5 | 14.5 | 0.09 |
| Excitation (V) | | 2212.200000 | 5010.0 | 5010.5 | 0.5 | 0.00 |
| Gain/Span Setting | NA | 3308.900000 | 7510.0 | 7501.2 | 8.8 | -0.05 |
| Full Range Output (V) | | | | | | |
| Full Range/Capacity (lb) | 16858 | | | | | |
| Date Verified | 11/5/2007 | | | | | |
| Date Due | 11/4/2008 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.1 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | Load Cell (A2AL APPROVED) | | | | | |
| Manufacturer | INTERFACE | | | | | |
| Model Number | 1211EX-10K-B | | | | | |
| Serial Number | 113655 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999987431 | | | | | |
| Intercept (lb) | -13.55356528 | | | | | |
| Slope (lb/mv) | 2.271068817 | | | | | |
| Verification (Calib.) Factor | 2.27106882 | | | | | |
| Verification Factor Units | lb/mv | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (lb) | 2.398188297 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (lb) | 4.796376595 | | | | | |
| Max. Abs. or FS Error (%) | 0.09 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For ft100 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in lb | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 2.3982 | N | 1.0000 | A | 2.3982 | 5.7513 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 2.3982 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 4.796 | | lb | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: [signature] Input By: _____ Reviewed By: _____ Checked By: [signature]

File: _____

Remarks: _____

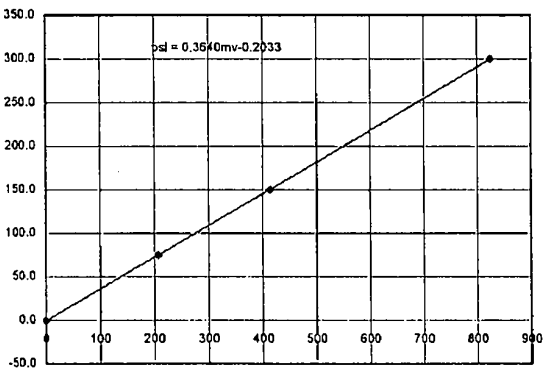
# HGL Instrument Verification

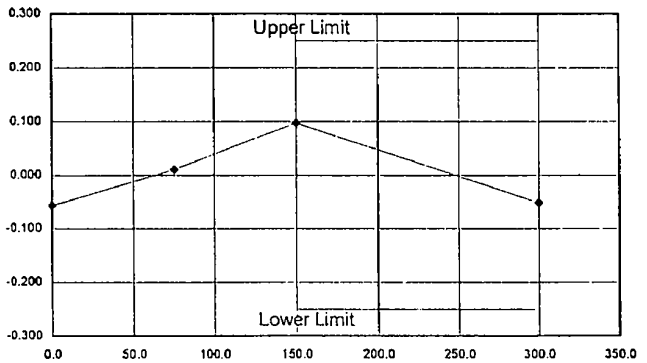
DATE: 11/5/2007 Instrument No.: pt Location: Houston LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mv | Standard psi | Prediction psi | Abs. Error psi | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | -0.2 | 0.2 | -0.06 |
| Model Number | F7.5CKESW2/B1 | 206.700000 | 75.0 | 75.0 | 0.0 | 0.01 |
| Serial Number | 1701-1788-1233109 (Piezo) | 413.600000 | 150.0 | 150.4 | 0.4 | 0.10 |
| HGL Instrument Number | pt | 824.200000 | 300.0 | 299.8 | 0.2 | -0.05 |
| Excitation (V) | | | | | | |
| Gain/Span Setting | NA | | | | | |
| Full Range Output (V) | | | | | | |
| Full Range/Capacity (psi) | 360 | | | | | |
| Date Verified | 11/5/2007 | | | | | |
| Date Due | 11/4/2008 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.25 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | PT(ANSI/NCSL APPROVED) | | | | | |
| Manufacturer | Eaton | | | | | |
| Model Number | UPS3000CC | | | | | |
| Serial Number | A0813 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.99999592 | | | | | |
| Intercept (psi) | -0.20331044 | | | | | |
| Slope (psi/mv) | 0.364010552 | | | | | |
| Verification (Calib.) Factor | 0.36401055 | | | | | |
| Verification Factor Units | psi/mv | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (psi) | 0.064150208 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (psi) | 0.128300415 | | | | | |
| Max. Abs. or FS Error (%) | 0.10 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For pt | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in psi | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 0.0642 | N | 1.0000 | A | 0.0642 | 0.0041 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 0.0642 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 0.128 | | psi | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: [signature] Input By: _____ Reviewed By: _____ Checked By: [signature]

File: _____

Remarks: _____

## Calibration Verification Certificate

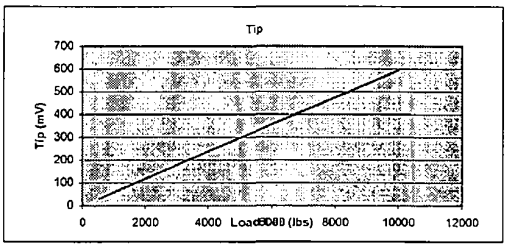
Device Type: Piezo Cone Penetrometer

Device Number: **F7.5CKE3SW2/B 1701-0750**

### TIP CALIBRATION

Tip area = 15 cm2 = 0.0161 ft2
Tip readings in mV

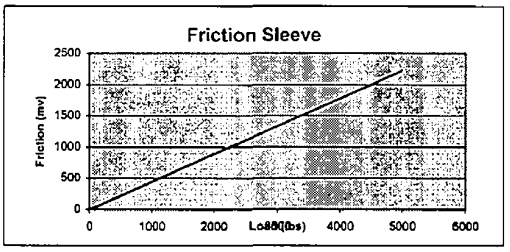
| Load lb | Load Tons | load/area tsf | Tip mV | TIP Cal Factor Mpa |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 530 | 0.265 | 16.45963 | 31.5 | 50.0376197 |
| 5010 | 2.505 | 155.5901 | 298.1 | 49.9812458 |
| 7490 | 3.745 | 232.6087 | 445.2 | 50.0331664 |
| 10020 | 5.01 | 311.1801 | 595.9 | 50.0064083 |
| 15050 | 7.525 | 467.3913 | 895.2 | 49.9974383 |
| 19910 | 9.955 | 618.323 | 1184.3 | 49.9966444 |




### FRICTION CALIBRATION

Sleeve area = 200 cm2 = 0.2153 ft2
Friction readings in mV

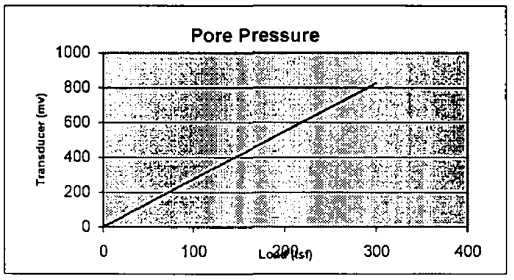
| Load lb | Load Tons | load/area tsf | Friction mV | Friction Cal Factor Mpa |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 520 | 0.26 | 1.207617 | 231.3 | 0.49996647 |
| 2490 | 1.245 | 5.782629 | 1107.3 | 0.50008891 |
| 3750 | 1.875 | 8.708778 | 1665.6 | 0.50069555 |
| 5010 | 2.505 | 11.63493 | 2228.3 | 0.50000833 |
| 7510 | 3.755 | 17.44078 | 3340.2 | 0.50001224 |




### PORE PRESSURE TRANSDUCER CALIBRATION

Serial : 8091223
Pore Pressure readings in mV

| Pressure psi | Pressure tsf | Transducer readings mV | P.Pres. Cal Factor Mpa |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 75 | 5.4 | 206.8 | 2.50052053 |
| 150 | 10.8 | 413.5 | 2.50112525 |
| 300 | 21.6 | 825.7 | 2.50506307 |




**Temperature Calibration (30 - 115 degrees F)**

| Temp (deg | TIP (mV) | FRIC (mV) | PIEZO (mV) |
|---|---|---|---|
| 30 | 0.946 | 0.783 | -0.132 |
| 50 | 0.983 | 0.974 | -0.077 |
| 75 | 1.012 | 1.114 | 0.264 |
| 100 | 1.297 | 1.267 | 0.357 |
| 115 | 1.324 | 1.771 | 0.992 |

| Deviation | mV | Mpa | % Full Scale |
|---|---|---|---|
| Tip | 0.378 | 0.0189 | 0.0378 |
| Friction | 0.988 | 0.000494 | 0.0988 |
| Piezo | 1.124 | 0.00281 | 0.1124 |

TIP CALIBRATED BY GEOTAC (A2LA APPROVED) LOAD CELL:
Model 560K, Serial No. 129739
FRICTION CALIBRATED BY INTERFACE (A2LA APPROVED) LOAD CELL :
Model: 1211EX-10K-B, Serial : 113655
PORE PRESSURE TRANSDUCER CALIBRATED BY GE SENSING (AANSI/NCSL APPROVED)
Pressure Indicator Model: UPS3000CC, Serial : A0813
TEMPERATURE CALIBRATED BY HOUSTON PRECISION TYPE K THERMOCOUPLE (A2LA APPROVED)
Model # 8528-40, Serial # C95005824, ID # TD-001

Calibration Verified by: Dennis Stauffer Date: 4/23/2008

Checked By : Recep Yilmaz Date: 4/23/2008

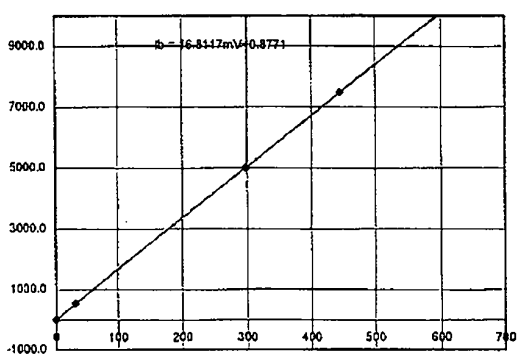
# HGL Instrument Verification

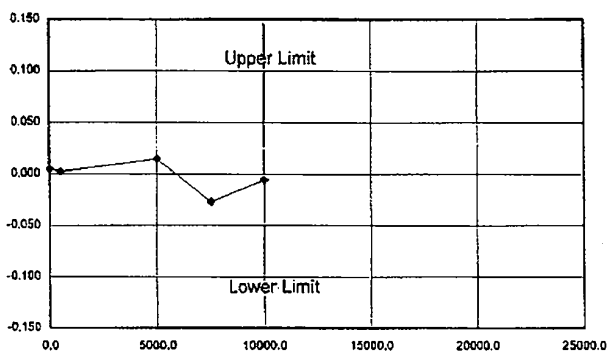
DATE: 4/23/2008 Instrument No.: ft100 Location: Houston LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mV | Standard lb | Prediction lb | Abs. Error lb | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer-TIP | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | 0.9 | 0.9 | 0.01 |
| Model Number | F7.5CKEW2/B | 31.500000 | 530.0 | 530.4 | 0.4 | 0.00 |
| Serial Number | 1701-0750 | 298.100000 | 5010.0 | 5012.5 | 2.5 | 0.01 |
| HGL Instrument Number | ft100 | 445.200000 | 7490.0 | 7485.5 | 4.5 | -0.03 |
| Excitation (V) | | 595.900000 | 10020.0 | 10019.0 | 1.0 | -0.01 |
| Gain/Span Setting | NA | 895.200000 | 15050.0 | 15050.7 | 0.7 | 0.00 |
| Full Range Output (V) | | 1184.300000 | 19910.0 | 19911.0 | 1.0 | 0.01 |
| Full Range/Capacity (lb) | 16858 | | | | | |
| Date Verified | 4/23/2008 | | | | | |
| Date Due | 4/23/2009 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.1 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | Load cell (A2LA APPROVED) | | | | | |
| Manufacturer | GEOTAC | | | | | |
| Model Number | 560K | | | | | |
| Serial Number | 129739 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999999907 | | | | | |
| Intercept (lb) | 0.877122495 | | | | | |
| Slope (lb/mV) | 16.81173849 | | | | | |
| Verification (Calib.) Factor | 16.81173849 | | | | | |
| Verification Factor Units | lb/mV | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (lb) | 0.54832333 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (lb) | 1.09664666 | | | | | |
| Max. Abs. or FS Error (%) | -0.03 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainty Budget Analysis For ft100 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in lb | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 0.5483 | N | 1.0000 | A | 0.5483 | 0.3007 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 0.5483 | Coverage Factor | | 2 | for 95% confidence level. | | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 1.097 | lb | | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: [signature] Input By: _____ Reviewed By: _____ Checked By: [signature]

File: _____

Remarks: _____

2000.2 (06/14/07) Tip0750.xls, 4-23-2008 6/5/2008 FUGRO CONSULTANTS INC

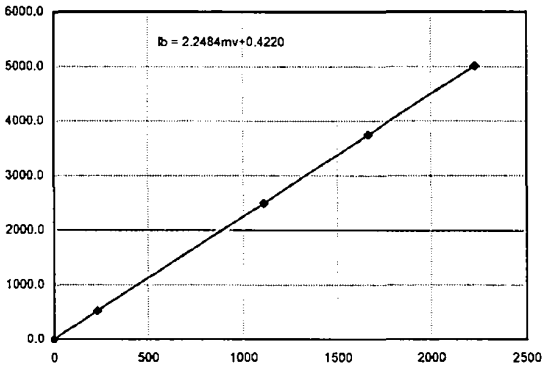
# HGL Instrument Verification

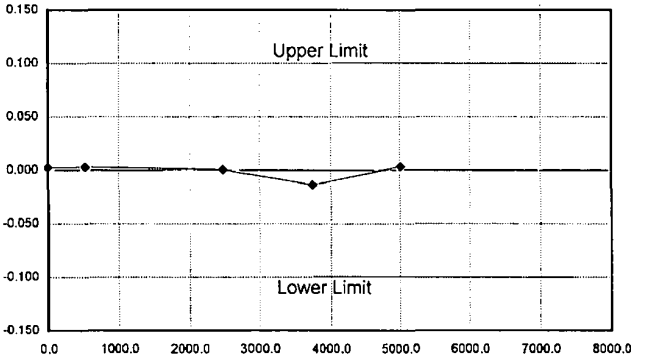
DATE: 4/23/2008 Instrument No.: ft100 Location: LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mv | Standard lb | Prediction lb | Abs. Error lb | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | 0.4 | 0.4 | 0.00 |
| Model Number | F7.5CKE3SW2/B | 231.300000 | 520.0 | 520.5 | 0.5 | 0.00 |
| Serial Number | 1701-0750 | 1107.300000 | 2490.0 | 2490.1 | 0.1 | 0.00 |
| HGL Instrument Number | ft100 | 1666.600000 | 3750.0 | 3747.7 | 2.3 | -0.01 |
| Excitation (V) | | 2228.300000 | 5010.0 | 5010.6 | 0.6 | 0.00 |
| Gain/Span Setting | NA | 3340.200000 | 7510.0 | 7510.7 | 0.7 | 0.00 |
| Full Range Output (V) | | | | | | |
| Full Range/Capacity (lb) | 16858 | | | | | |
| Date Verified | 4/23/2008 | | | | | |
| Date Due | 4/23/2009 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.1 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | Load Cell (A2AL APPROVED) | | | | | |
| Manufacturer | INTERFACE | | | | | |
| Model Number | 1211EX-10K-B | | | | | |
| Serial Number | 113655 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999999834 | | | | | |
| Intercept (lb) | 0.421964823 | | | | | |
| Slope (lb/mv) | 2.248442121 | | | | | |
| Verification (Calib.) Factor | 2.24844212 | | | | | |
| Verification Factor Units | lb/mv | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (lb) | 0.319825144 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (lb) | 0.639650288 | | | | | |
| Max. Abs. or FS Error (%) | -0.01 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For ft100 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in lb | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 0.3198 | N | 1.0000 | A | 0.3198 | 0.1023 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 0.3198 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 0.640 | | lb | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: Input By: Reviewed By: Checked By:

File:

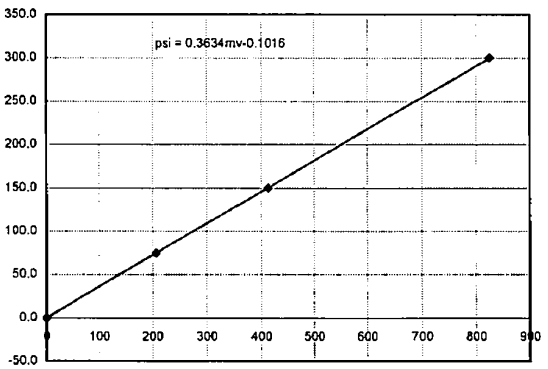
Remarks:

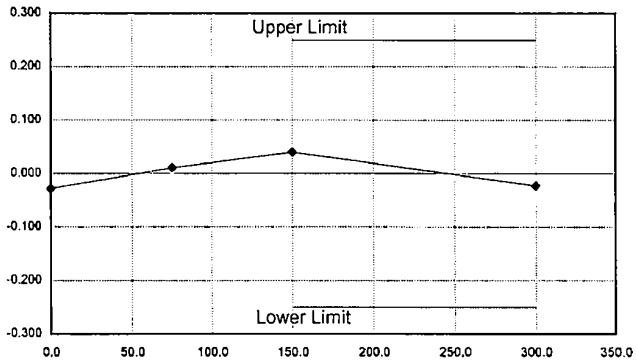
# HGL Instrument Verification

DATE: 4/23/2008 Instrument No.: pt Location: Houston LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mv | Standard psi | Prediction psi | Abs. Error psi | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | -0.1 | 0.1 | -0.03 |
| Model Number | F7.5CKEW2/B | 206.800000 | 75.0 | 75.0 | 0.0 | 0.01 |
| Serial Number | 1701-0750-8091223 | 413.500000 | 150.0 | 150.1 | 0.1 | 0.04 |
| HGL Instrument Number | pt | 825.700000 | 300.0 | 299.9 | 0.1 | -0.02 |
| Excitation (V) | | | | | | |
| Gain/Span Setting | NA | | | | | |
| Full Range Output (V) | | | | | | |
| Full Range/Capacity (psi) | 360 | | | | | |
| Date Verified | 4/23/2008 | | | | | |
| Date Due | 4/23/2009 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.25 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | PT(ANSI/NCSL APPROVED) | | | | | |
| Manufacturer | Eaton | | | | | |
| Model Number | UPS3000CC | | | | | |
| Serial Number | A0813 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999999198 | | | | | |
| Intercept (psi) | -0.101633254 | | | | | |
| Slope (psi/mv) | 0.363351683 | | | | | |
| Verification (Calib.) Factor | 0.36335168 | | | | | |
| Verification Factor Units | psi/mv | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (psi) | 0.021757343 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (psi) | 0.043514685 | | | | | |
| Max. Abs. or FS Error (%) | 0.04 [X] FS; [ ] Abs. | | | MTS [ ] Yes; [X] No | | |




| Uncertainity Budget Analysis For pt | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in psi | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 0.0218 | N | 1.0000 | A | 0.0218 | 0.0005 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 0.0218 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 0.044 | | psi | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: [signature] Input By: _____ Reviewed By: _____ Checked By: [signature]

File: _____

Remarks: _____

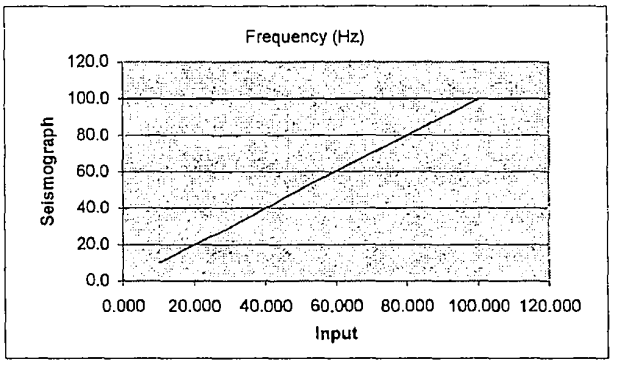
## Calibration Verification Certificate

**Device Type:** **Seismograph**

**Device Manufacturer** **Geometrics, Inc.**
**Model Number:** **ES-3000**
**Serial Number:** **5138**

**Frequency (Hz)**

| Input | Seismograph |
|---|---|
| 10.055 | 9.9 |
| 20.037 | 19.9 |
| 30.071 | 29.3 |
| 40.040 | 40.1 |
| 50.061 | 50.6 |
| 60.048 | 60.3 |
| 70.005 | 70.2 |
| 80.011 | 79.9 |
| 90.090 | 90.1 |
| 100.014 | 99.8 |

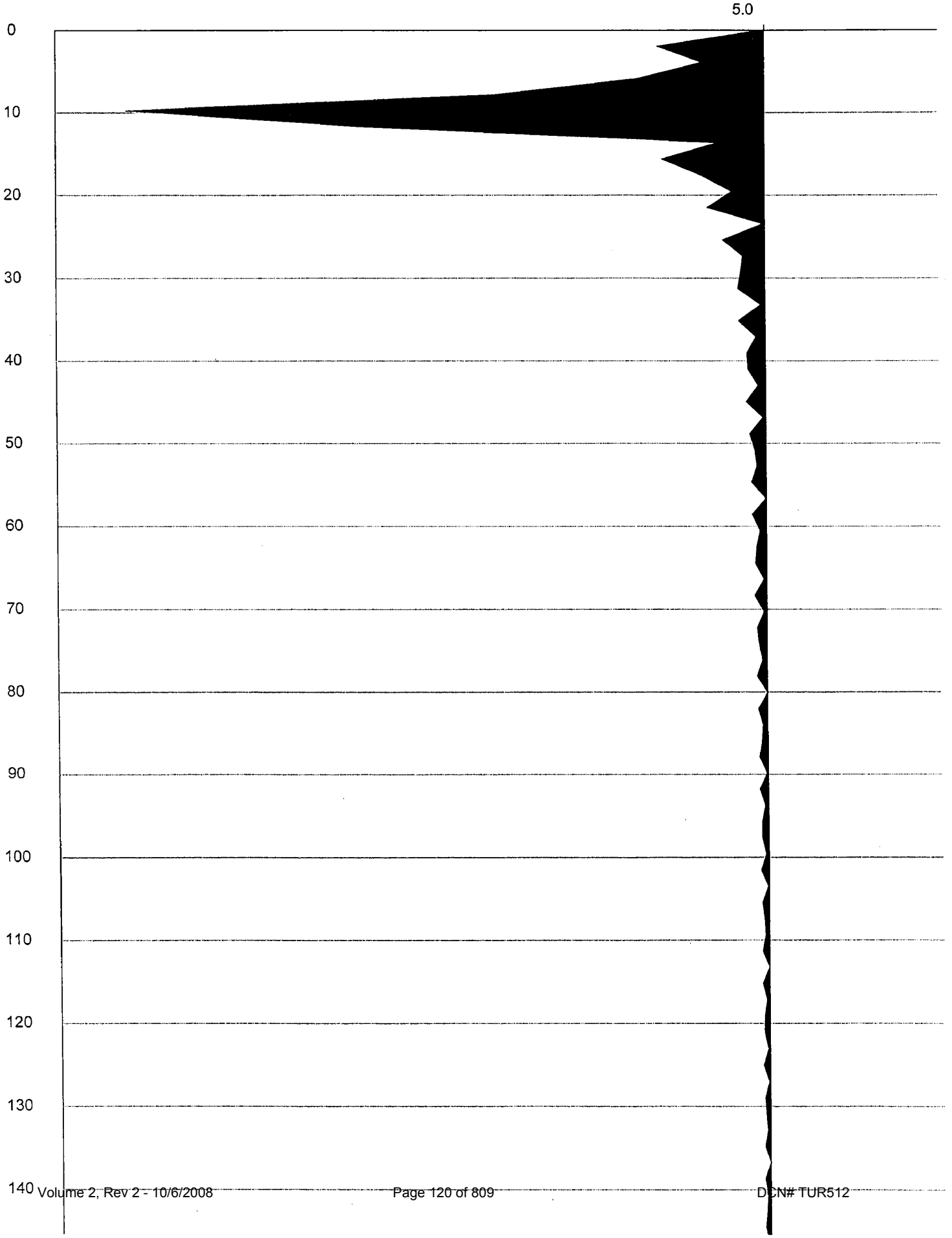



FREQUENCY CALIBRATED BY INSTEK GOOD WILL INSTRUMENTS (A2LA APPROVED) FREQUENCY COUNTER :
Model: GFC-80101H, Serial No. CF871549
FREQUENCY GENERATED BY EZ DIGITAL, INC (A2LA APPROVED) OSCILLISCOPE WITH BUILT IN FUNCTION GENERATOR
Model: OS-5020G, Serial No.: 3080209

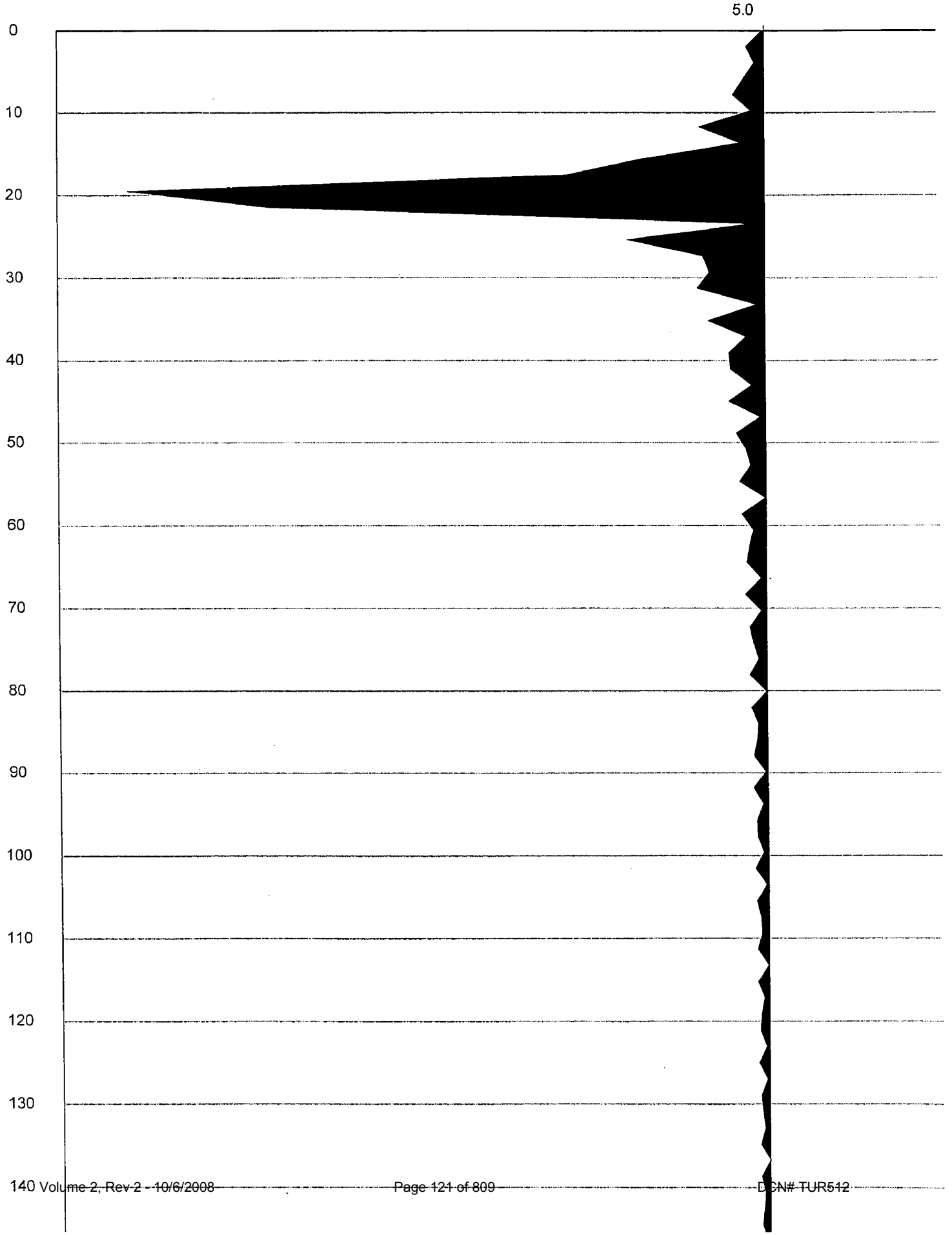
Calibration Verified by: Dennis Stauffer Date: 1/22/2008

Checked By : Recep Yilmaz Date: 1/22/2008

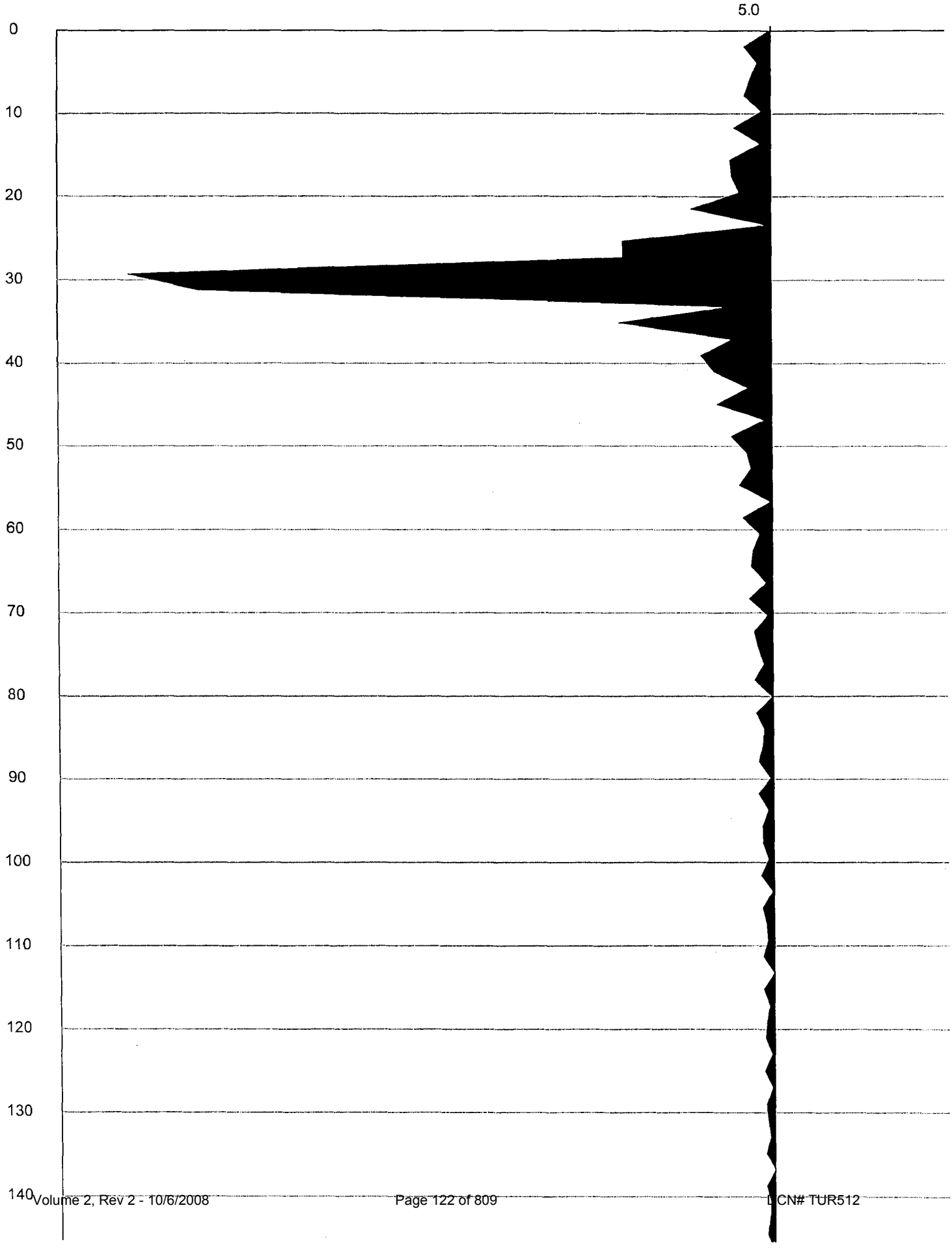
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 10.055 Seismograph: 9.9
Date: 1/22/2008



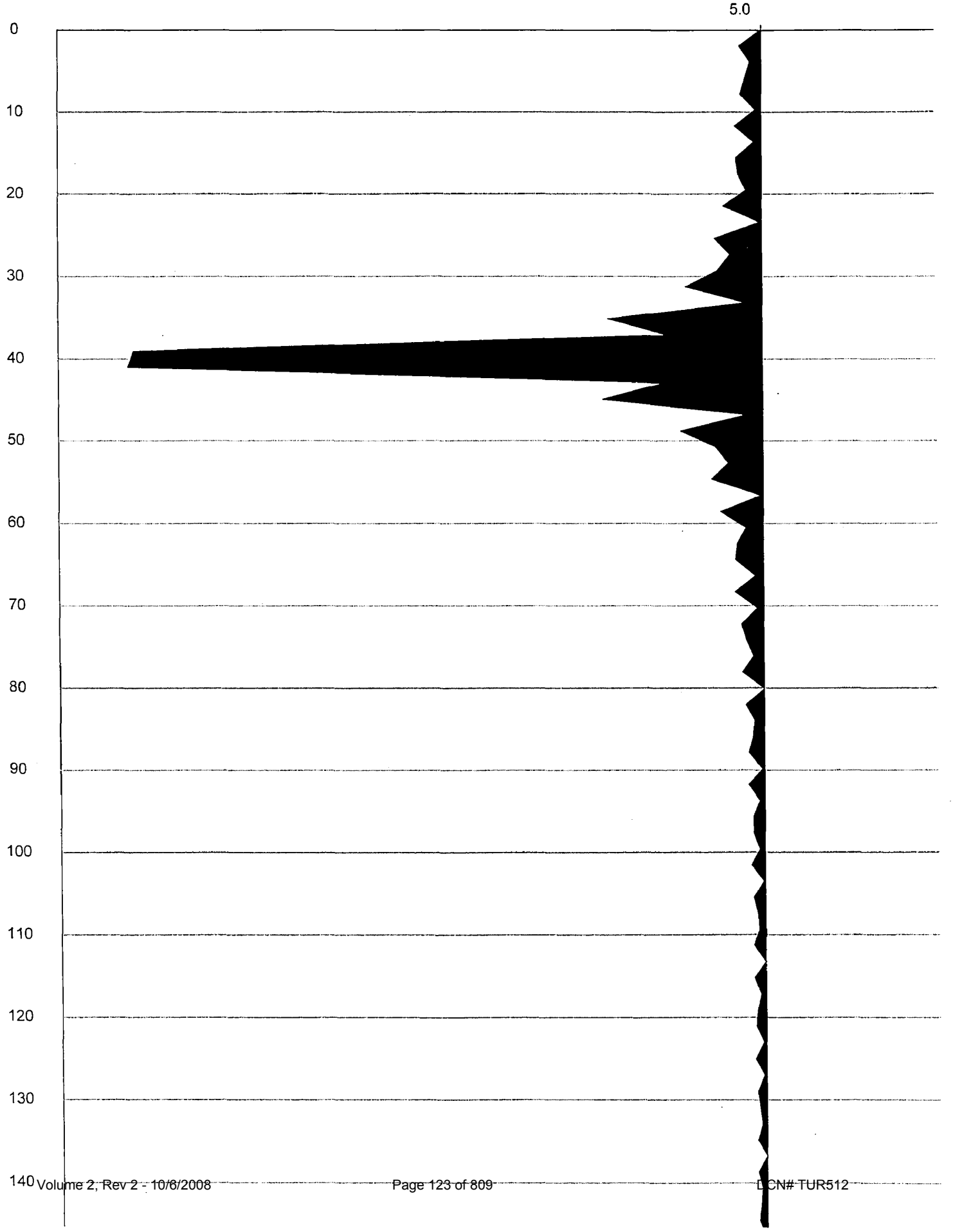
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 20.037 Seismograph: 19.9
Date: 1/22/2008



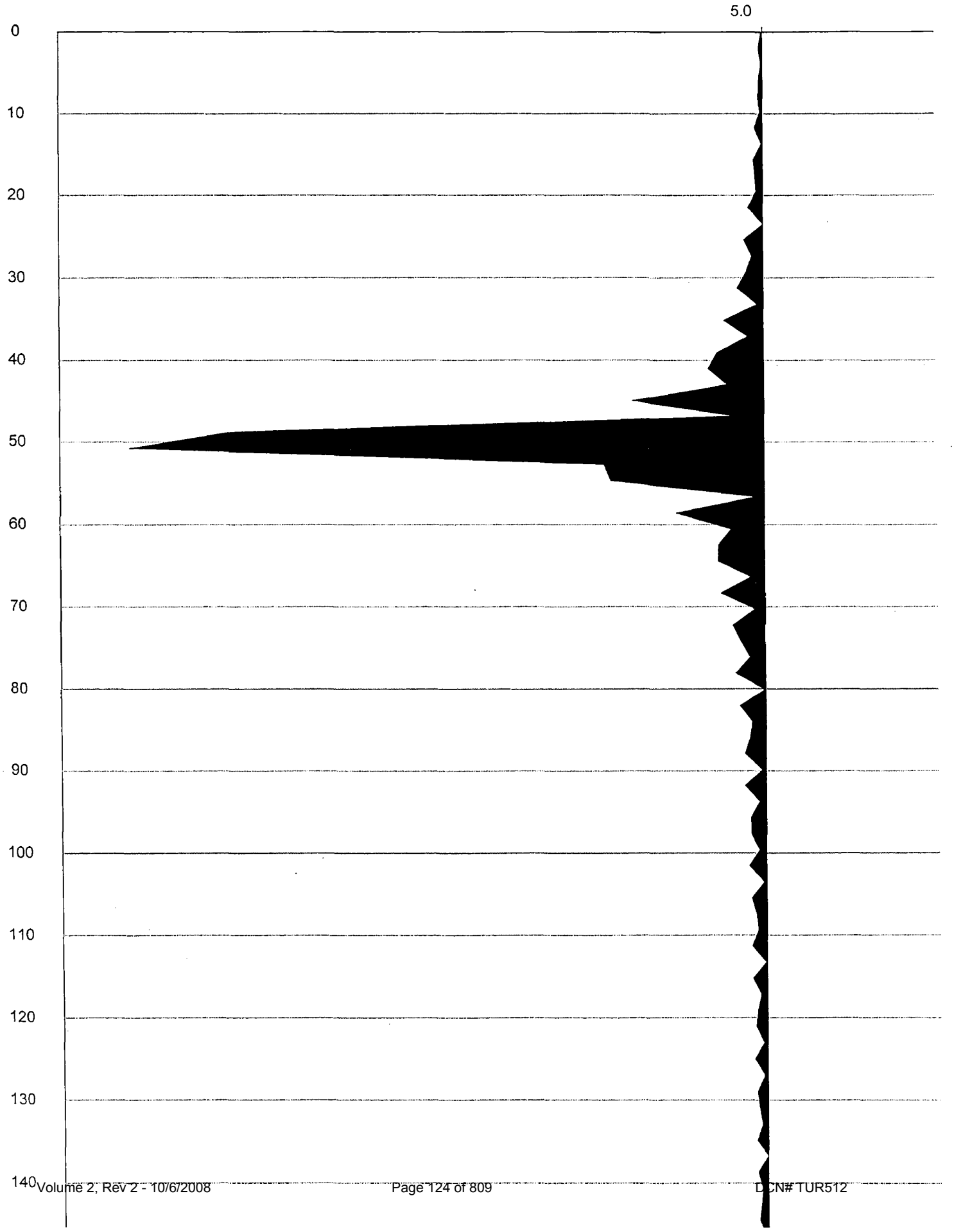
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 30.071 Seismograph: 29.3
Date: 1/22/2008



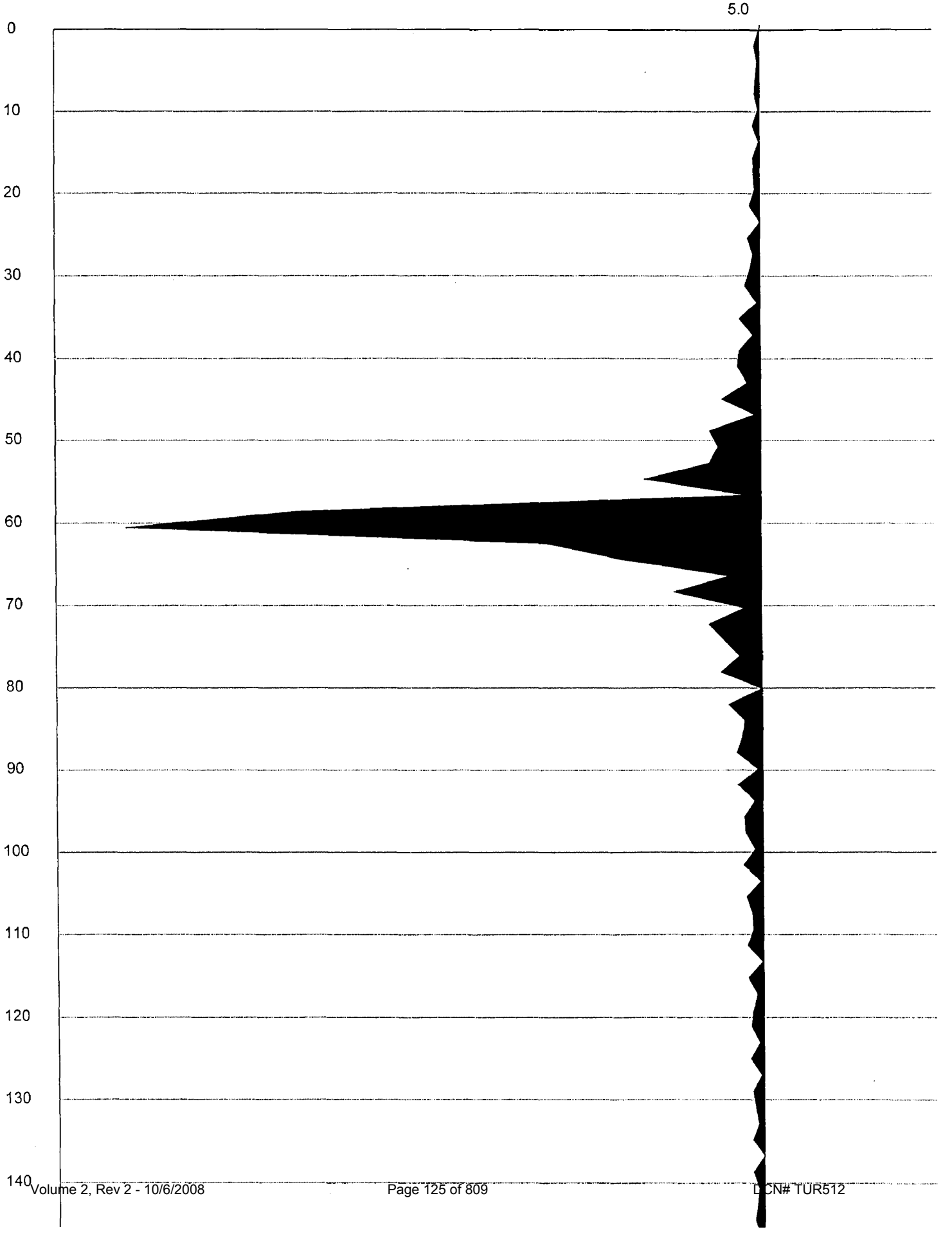
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 40.040 Seismograph: 40.1
Date: 1/22/2008



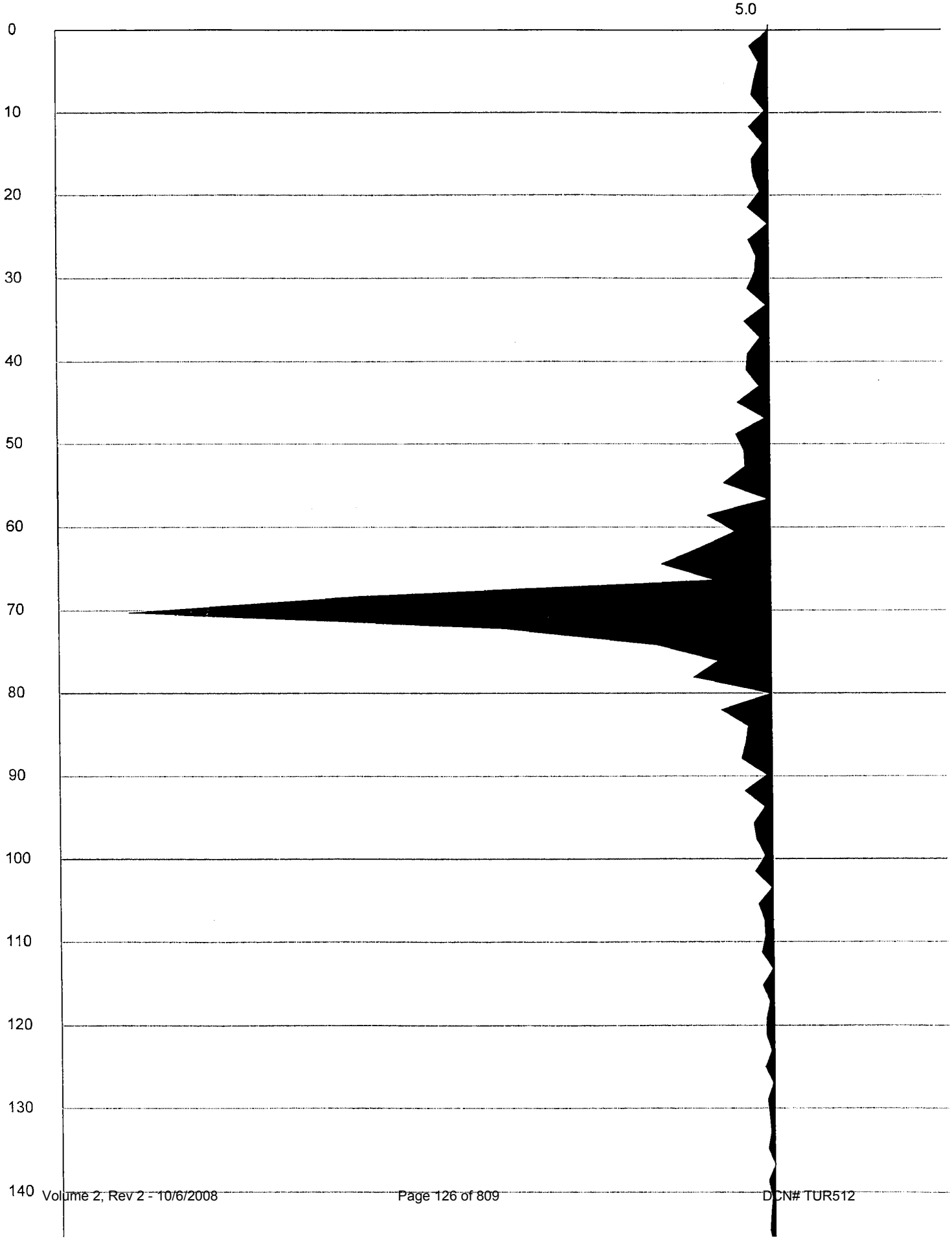
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 50.061 Seismograph: 50.6
Date: 1/22/2008



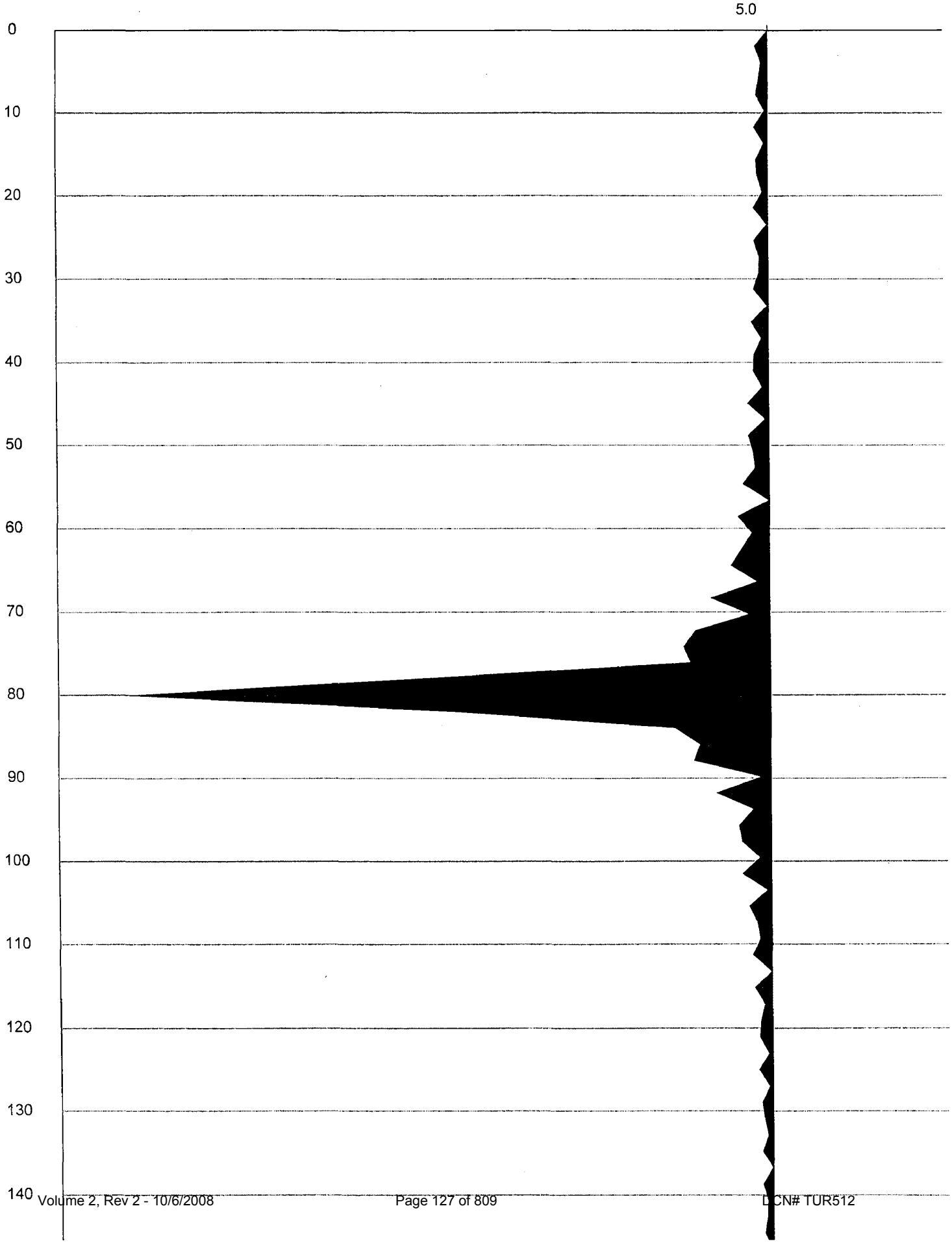
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 60.048 Seismograph: 60.3
Date: 1/22/2008



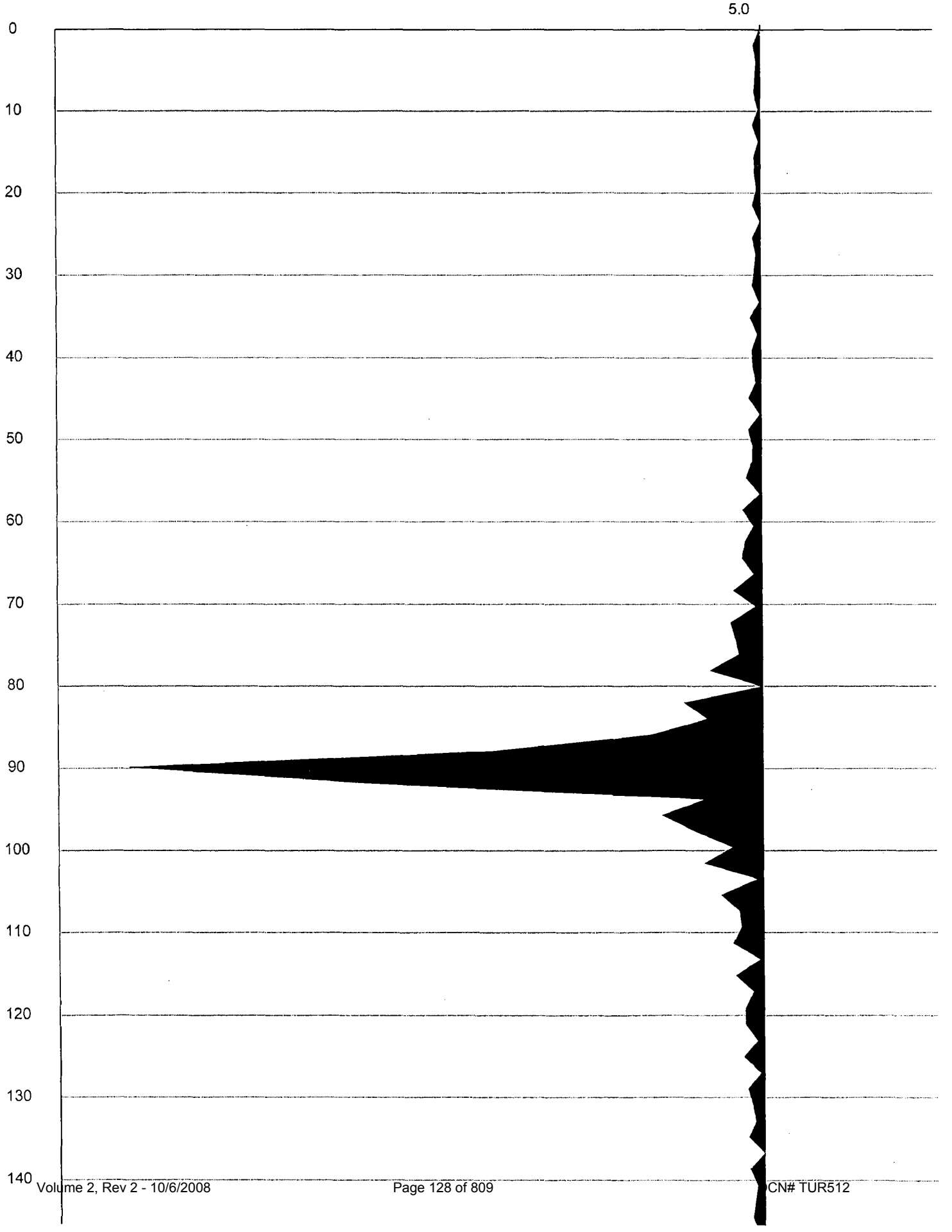
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 70.005 Seismograph: 70.2
Date: 1/22/2008



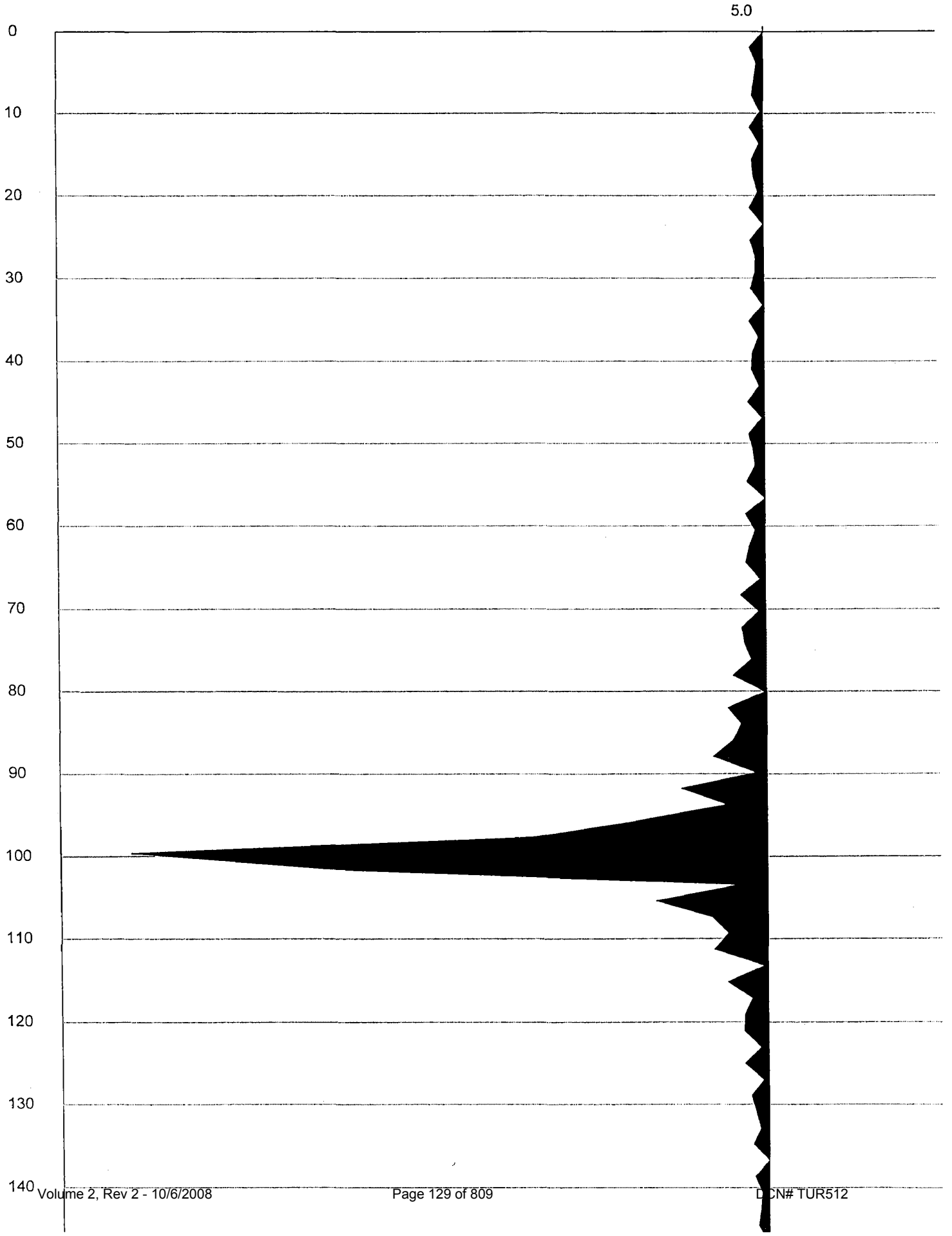
Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 80.011 Seismograph: 79.9
Date: 1/22/2008



Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 90.090 Seismograph: 90.1
Date: 1/22/2008



Geometrics ES-3000 S/N 5138
Frequency (HZ) In: 100.014 Seismograph: 99.8
Date: 1/22/2008



# POST JOB CALIBRATION VERIFICATION

## Calibration Verification Certificate

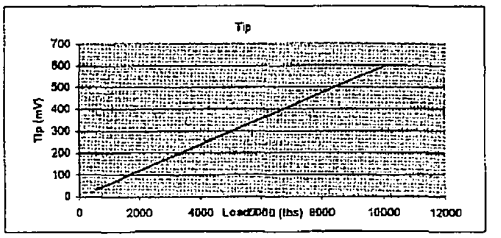
Device Type: Piezo Cone Penetrometer

Device Number: **F7.5CKE3SW2/B 1701-0750**

### TIP CALIBRATION

Tip area = 15 cm2 = 0.0161 ft2
Tip readings in mV

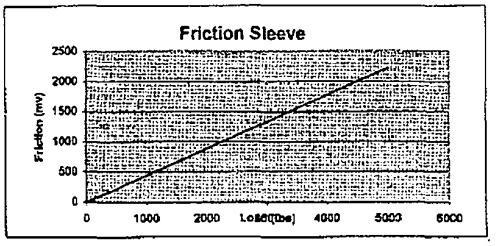
| Load lb | Load Tons | load/area tsf | Tip mV | TIP Cal Factor Mpa |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 540 | 0.27 | 16.77019 | 32.1 | 50.0287963 |
| 5015 | 2.5075 | 155.7453 | 298.3 | 49.9975831 |
| 7510 | 3.755 | 233.2298 | 446.2 | 50.0543352 |
| 10005 | 5.0025 | 310.7143 | 594.3 | 50.0659763 |
| 15010 | 7.505 | 466.1491 | 892.6 | 50.0098021 |
| 19980 | 9.99 | 620.4969 | 1186.6 | 50.0751739 |




### FRICTION CALIBRATION

Sleeve area = 200 cm2 = 0.2153 ft2
Friction readings in mV

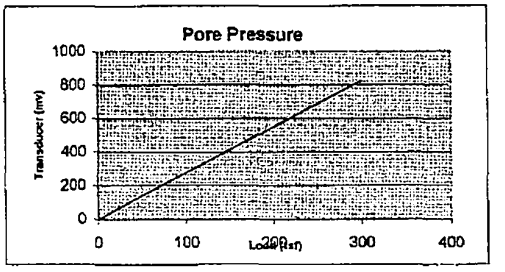
| Load lb | Load Tons | load/area tsf | Friction mV | Friction Cal Factor Mpa |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 500 | 0.25 | 1.16117 | 220.3 | 0.50474111 |
| 2520 | 1.26 | 5.852299 | 1110.6 | 0.50461022 |
| 3755 | 1.8775 | 8.72039 | 1666.2 | 0.5011826 |
| 4990 | 2.495 | 11.58848 | 2215.9 | 0.50079912 |
| 7505 | 3.7525 | 17.42917 | 3335.8 | 0.50033843 |




### PORE PRESSURE TRANSDUCER CALIBRATION

Serial : 8091223
Pore Pressure readings in mV

| Pressure psi | Pressure tsf | Transducer readings mV | P.Pres. Cal Factor Mpa |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 75 | 5.4 | 206.6 | 2.50294116 |
| 150 | 10.8 | 413.3 | 2.50233557 |
| 300 | 21.6 | 823.4 | 2.51206045 |




**Temperature Calibration (30 - 115 degrees F)**

| Temp (deg | TIP (mV) | FRIC (mV) | PIEZO (mV) |
|---|---|---|---|
| 30 | 0.957 | 0.788 | -0.124 |
| 50 | 0.994 | 0.957 | -0.065 |
| 75 | 1.054 | 1.037 | 0.258 |
| 100 | 1.284 | 1.236 | 0.369 |
| 115 | 1.352 | 1.752 | 1.013 |

| Deviation | mV | Mpa | % Full Scale |
|---|---|---|---|
| Tip | 0.395 | 0.01975 | 0.0395 |
| Friction | 0.964 | 0.000482 | 0.0964 |
| Piezo | 1.137 | 0.002843 | 0.1137 |

TIP CALIBRATED BY GEOTAC (A2LA APPROVED) LOAD CELL:
Model 560K, Serial No. 129739
FRICTION CALIBRATED BY INTERFACE (A2LA APPROVED) LOAD CELL :
Model 560K, Serial No. 129739
PORE PRESSURE TRANSDUCER CALIBRATED BY GE SENSING (AANSI/NCSL APPROVED)
Pressure Indicator Model: UPS3000CC, Serial : A0813
TEMPERATURE CALIBRATED BY HOUSTON PRECISION TYPE K THERMOCOUPLE (A2LA APPROVED)
Model # 8528-40, Serial # C95005824, ID # TD-001

Calibration Verified by: Dennis Stauffer Date: 6/2/2008

Checked By : Recep Yilmaz Date: 6/2/2008

# HGL Instrument Verification

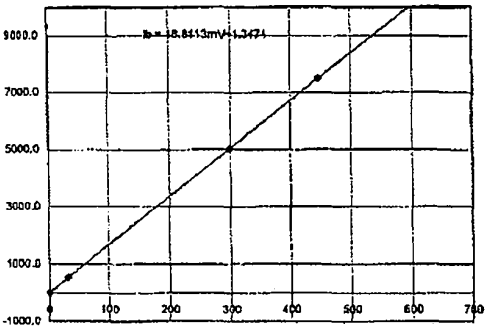
DATE: 6/2/2008 Instrument No.: ft100 Location: Houston LVDT?: [ ] Yes; [X] No

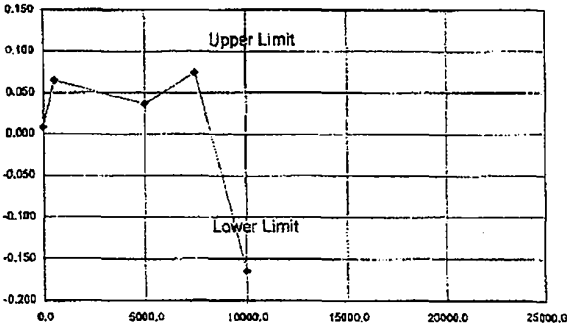
Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | |
|---|---|
| Type | Cone Penetrometer-TIP |
| Manufacturer | Fugro |
| Model Number | F7.5CKEW2/B |
| Serial Number | 1701-0750 |
| HGL Instrument Number | ft100 |
| Excitation (V) | |
| Gain/Span Setting | NA |
| Full Range Output (V) | |
| Full Range/Capacity (lb) | 16858 |
| Date Verified | 6/2/2008 |
| Date Due | 6/2/2009 |
| Service Status | In Service |
| Accept. Abs. or FS Error (%) | 0.1 X FS; Abs. |
| **Verification/Standard Equipment** | |
| Type | Load cell (A2LA APPROVED) |
| Manufacturer | Geotac |
| Model Number | 560K |
| Serial Number | 129739 |
| HGL Instrument Number | |
| Date Verified | |
| Temperature | °C = °F |
| **Linear Regression, Uncertainty, & Error Summary** | |
| Correlation Coeff. ($R^2$) | 0.999986128 |
| Intercept (lb) | 1.347403615 |
| Slope (lb/mV) | 16.81127161 |
| Verification (Calib.) Factor | 16.81127161 |
| Verification Factor Units | lb/mV |
| Absolute Zero (V) | |
| Floating Zero (V) | |
| Combined Uncertainty (lb) | 6.258542548 |
| Coverage Factor | 2 |
| Expanded Uncertainty (lb) | 12.5170851 |
| Max. Abs. or FS Error (%) | -0.25 X FS; Abs. |

| Instrument mV | Standard lb | Prediction lb | Abs. Error lb | Full Scale Error (%) |
|---|---|---|---|---|
| 0.000000 | 0.0 | 1.3 | 1.3 | 0.01 |
| 32.100000 | 530.0 | 541.0 | 11.0 | 0.07 |
| 298.300000 | 5010.0 | 5016.1 | 6.1 | 0.04 |
| 446.200000 | 7490.0 | 7502.5 | 12.5 | 0.07 |
| 594.300000 | 10020.0 | 9992.3 | 27.7 | -0.16 |
| 892.600000 | 15050.0 | 15007.1 | 42.9 | -0.25 |
| 1186.600000 | 19910.0 | 19949.6 | 39.6 | 0.23 |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For ft100 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in lb | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 6.2585 | N | 1.0000 | A | 6.2585 | 39.1694 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 6.2585 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 12.517 | | lb | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: [signature] Input By: _____ Reviewed By: _____ Checked By: [signature]

File: _____

Remarks: _____

2000.2 (06/14/07) Tip0750.xls, 6-2-2008 6/26/2008 FUGRO CONSULTANTS INC

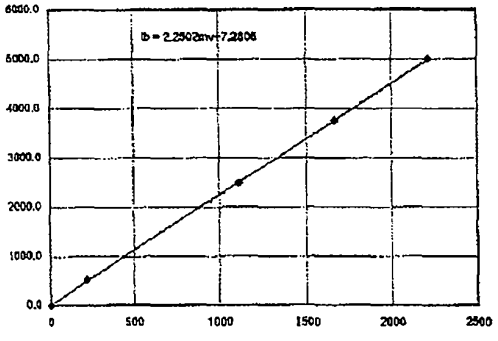
# HGL Instrument Verification

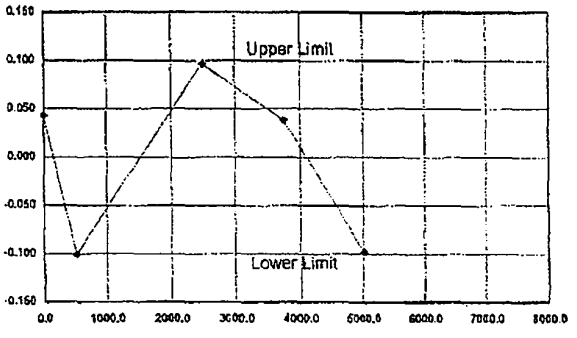
DATE: 6/2/2008 Instrument No.: ft100 Location: _____ LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mv | Standard lb | Prediction lb | Abs. Error lb | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | 7.3 | 7.3 | 0.04 |
| Model Number | F7.5CKE3SW2/B | 220.300000 | 520.0 | 503.0 | 17.0 | -0.10 |
| Serial Number | 1701-0750 | 1110.600000 | 2490.0 | 2506.3 | 16.3 | 0.10 |
| HGL Instrument Number | ft100 | 1666.200000 | 3750.0 | 3756.5 | 6.5 | 0.04 |
| Excitation (V) | | 2215.900000 | 5010.0 | 4993.4 | 16.6 | -0.10 |
| Gain/Span Setting | NA | 3335.800000 | 7510.0 | 7513.4 | 3.4 | 0.02 |
| Full Range Output (V) | | | | | | |
| Full Range/Capacity (lb) | 16858 | | | | | |
| Date Verified | 6/2/2008 | | | | | |
| Date Due | 6/2/2009 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.1 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | Load Cell (A2AL APPROVED) | | | | | |
| Manufacturer | Geotac | | | | | |
| Model Number | 560K | | | | | |
| Serial Number | 129739 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999976621 | | | | | |
| Intercept (lb) | 7.280791244 | | | | | |
| Slope (lb/mv) | 2.250177247 | | | | | |
| Verification (Calib.) Factor | 2.25017725 | | | | | |
| Verification Factor Units | lb/mv | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (lb) | 2.492195376 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (lb) | 4.984390751 | | | | | |
| Max. Abs. or FS Error (%) | -0.10 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For ft100 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in lb | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 2.4922 | N | 1.0000 | A | 2.4922 | 6.2110 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 2.4922 | Coverage Factor | | 2 | | for 95% confidence level. | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 4.984 | | lb | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: _____ Input By: _____ Reviewed By: _____ Checked By: _____

File: _____

Remarks: _____

2000.2 (06/14/07) Fric0750.xls, 6-2-2008 6/26/2008 FUGRO CONSULTANTS INC

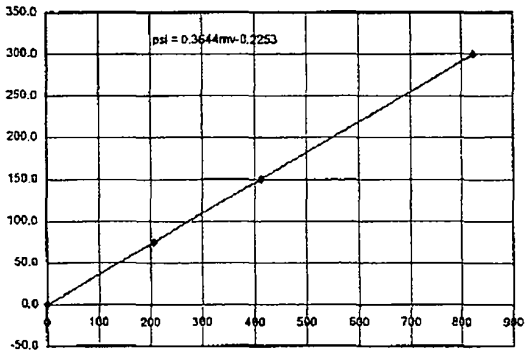
# HGL Instrument Verification

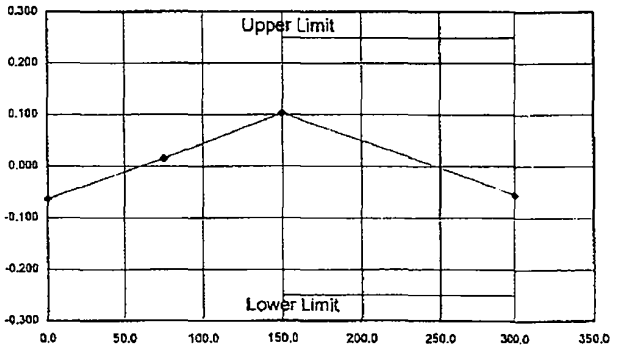
DATE: 6/2/2008 Instrument No.: pt Location: Houston LVDT?: [ ] Yes; [X] No

Type Analysis: [X] BF; [ ] NonBF; [X] FS; [ ] Abs. Reading Resolution of Instrument: 0.000001

| Instrument Identification/Data | | Instrument mv | Standard psi | Prediction psi | Abs. Error psi | Full Scale Error (%) |
|---|---|---|---|---|---|---|
| Type | Cone Penetrometer - Piezo | | | | | |
| Manufacturer | Fugro | 0.000000 | 0.0 | -0.2 | 0.2 | -0.06 |
| Model Number | F7.5CKEW2/B | 206.600000 | 75.0 | 75.1 | 0.1 | 0.02 |
| Serial Number | 1701-0750-8091223 | 413.300000 | 150.0 | 150.4 | 0.4 | 0.10 |
| HGL Instrument Number | pt | 823.400000 | 300.0 | 299.8 | 0.2 | -0.06 |
| Excitation (V) | | | | | | |
| Gain/Span Setting | NA | | | | | |
| Full Range Output (V) | | | | | | |
| Full Range/Capacity (psi) | 360 | | | | | |
| Date Verified | 6/2/2008 | | | | | |
| Date Due | 6/2/2009 | | | | | |
| Service Status | In Service | | | | | |
| Accept. Abs. or FS Error (%) | 0.25 [X] FS; [ ] Abs. | | | | | |
| **Verification/Standard Equipment** | | | | | | |
| Type | PT(ANSI/NCSL APPROVED) | | | | | |
| Manufacturer | Eaton | | | | | |
| Model Number | UPS3000CC | | | | | |
| Serial Number | A0813 | | | | | |
| HGL Instrument Number | | | | | | |
| Date Verified | | | | | | |
| Temperature | °C = °F | | | | | |
| **Linear Regression, Uncertainty, & Error Summary** | | | | | | |
| Correlation Coeff. ($R^2$) | 0.999995309 | | | | | |
| Intercept (psi) | -0.225296318 | | | | | |
| Slope (psi/mv) | 0.364374132 | | | | | |
| Verification (Calib.) Factor | 0.36437413 | | | | | |
| Verification Factor Units | psi/mv | | | | | |
| Absolute Zero (V) | | | | | | |
| Floating Zero (V) | | | | | | |
| Combined Uncertainty (psi) | 0.064742646 | | | | | |
| Coverage Factor | 2 | | | | | |
| Expanded Uncertainty (psi) | 0.129485291 | | | | | |
| Max. Abs. or FS Error (%) | 0.10 [X] FS; [ ] Abs. | | | | | |

MTS [ ] Yes; [X] No




| Uncertainity Budget Analysis For pt | | | | | | | |
|---|---|---|---|---|---|---|---|
| Source of Uncertainty | Value in psi | Distribution | Divisor | Type | Uncertainty ($u_i$) | $u_i^2$ | Comments |
| Standard's Uncertainty | | N | 2.0000 | B | | | |
| Abs. Error-STDEV[1] | 0.0647 | N | 1.0000 | A | 0.0647 | 0.0042 | |
| Resolution of Instrument | 0.0000 | R | 3.4641 | B | 0.0000 | 0.0000 | |
| Repeatability[2] | | N | 1.0000 | A | | | |
| Resolution of Standard | #N/A | R | 3.4641 | B | | | |
| | | | | | | | |
| | | | | | | | |
| Combined Uncertainty | 0.0647 | Coverage Factor | | 2 | for 95% confidence level. | | |
| Expanded Uncertainty (Best Measurement Capability)[3] | | 0.129 | | psi | | | |

(1) This equation follows the approach presented by A2LA, not that typically used in uncertainty calculations; i.e., STDEV of the Mean. (2) This value is unique for type (model) of equipment.

(3) This uncertainty represents an expanded uncertainty expressed as approximately the 95% confidence level using a coverage factor of k=2.

Verified By: [signature] Input By: _____ Reviewed By: _____ Checked By: [signature]

File: _____

Remarks: _____

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