February 15, 2017
Revised March 3, 2017

Proposal No. P1668031-Rev03

North Kent Wind 1 LP
c/o Samsung Renewable Energy Inc.
2020 Derry Road West, 2nd floor
Mississauga, ON L5N 0B9

VIBRATION MONITORING PROGRAM
NORTH KENT WIND FARM
CHATHAM-KENT, ONTARIO

Further to teleconference discussions on February 3 and 24, 2017 with attendance of representatives from Ontario Ministry of the Environment and Climate Change (MOECC), Pattern Development, Samsung Renewable Energy Inc. and Golder Associates Ltd. (Golder), this letter provides the work plan to carry out independent vibration monitoring for the North Kent Wind Farm as part of Section H1 of the Renewable Energy Approval (REA) document issued by the MOECC. This updated work plan was prepared to address comments made by Mr. Miroslav Ubovic of the MOECC as provided in an email on January 13, 2017 and the subsequent teleconferences.

Background

It is understood that 20 to 26 piles will be driven into the ground to support each turbine pile cap and tower foundation. These piles will range in length from about 20 to 30 m depending on location. Presently, it is planned that driving piles will take about 3 days to one week per turbine location during facility construction.

A planned test pile driving program is intended to start in late February and early March, 2017 that will be used to gauge initial pile capacity design prior to production pile driving and construction that will occur in late spring and early summer, 2017. The test pile program will consist of driving one pile at two selected turbine sites to the intended pile depth to measure resistance to downward loads and pile may be removed to measure uplift resistance.

The vibration monitoring work plan outlined below is designed to be flexible, pending the results of vibration measurements completed during the test pile program. At this time, the exact locations of the vibration measurements during any of the monitoring program phases are not known. These locations will be established during an initial site visit and based on results of the test pile and/or production pile program for the operation phase. The attached plans for two possible example sites, turbines T7 and T52, are guidance for the field crews and are provided for review and approval. The final location of the first test pile and associated subsurface vibration monitoring devices will be selected pending additional information on site specific access issues and confirmation of final test pile locations. Golder notes that the specific test pile location is not critical for the initial vibration monitoring testing since the ground conditions throughout the NKW1 project area are reasonably similar, consisting of relatively thin sand and silt deposits overlying thick and soft clay deposits, a layer of granular materials and then bedrock. Conditions at any of the planned turbine sites are considered suitable and the results of the initial vibration monitoring should be readily adaptable to other turbine locations.

As discussed during the teleconference with MOECC on February 3, 2017, this work plan is designed only to address vibration monitoring during an initial construction phase (test pile). The need for, scope, frequency and duration of vibration monitoring during the later construction and long-term operational phases of the facility will be determined after early data is gathered, analysed and reported. Therefore, there is no further discussion of such monitoring included in this work plan.

Work Plan

This initial work plan and subsequent monitoring effort has been divided into three phases:

1) Test Pile Program (one turbine site)
2) Production Pile Driving
3) Initial Turbine Operation

These phases are intended to:

a) address the requirements of Section H1 of the REA conditions;
b) monitor vibrations at a wide variety of frequencies and amplitudes to the practicable capability of available and readily portable equipment as well as equipment that can be installed in deep boreholes;
c) clearly assess, with scientifically-defensible data, the distance-attenuation behavior for the site conditions to allow predictive analyses based on early test and production pile driving programs to refine the subsequent production pile driving monitoring program;
d) use highly sensitive equipment at well locations (or at closest permissible ground location) to better measure small-magnitude vibrations not usually measurable with conventional construction vibration monitoring equipment; and
e) allow for more intensive testing early in the program and re-evaluation of the work at several key stages to assess changes in effort later if and when justified by the data.

As noted above, Phases 2 and 3 are not discussed further in this initial work plan since these will be developed pending the outcome of the first phase.

Phase 1: Test Pile Driving Monitoring Plan (March, 2017)

One test pile will be installed at one monitored turbine site. The general site layout is illustrated in the attached schematic drawings for example sites T7 and T52. The layout of the boreholes and surface monitoring stations will be affected by site-specific constraints related to agricultural uses, vegetation cover, ditches, access for drilling equipment and access to the residential water well head (if allowed). The intent of the work is to obtain surface and subsurface vibration measurements at different distances from the turbine location. If possible, one surface vibration monitoring device will be installed at the ground immediately adjacent to the residential water well casing. If this location is not permitted or not practically accessible or suitable for the monitoring equipment, ground surface vibrations will be measured at the closest point near the property boundary to the assumed or mapped well location. As agreed with MOECC during the February 3, 2017 teleconference, no instruments will be installed within any wells and the wells will not be opened, tested or inspected under this work plan. The subsurface vibration monitoring instruments will be installed in such a manner to monitor the test pile program, production pile driving for the same turbine location and the subsequent operational phase of the same turbine.

Prior to pile driving, the following work will be completed:

1) Three boreholes will be drilled to the bedrock, the bedrock will be cored for approximately 1 m to demonstrate that bedrock has been encountered, and the borehole will be reamed to a diameter sufficient to allow installation of subsurface vibration monitoring equipment (approximately 125 millimetres). Vibration monitoring instruments will be installed in boreholes T7-VM-A and T7-VM-B (example numbering scheme) as follows:

    a. PCB 3713E112G or PCB 356B18 triaxial vibration sensor (see attached specifications) installed within the rock and cemented into place (the choice of sensor will be dependent upon data logger type and availability);

    b. Meggit 731A uniaxial seismic accelerometer (see attached specifications) installed and cemented into the rock, immediately above or below the triaxial sensor);

    c. one each of the instruments identified above will be installed and cemented into the soft clay profile at a depth approximately equivalent to half the thickness of the soft clay in an adjacent borehole (to allow appropriate cementing and coupling to the ground);

    d. the cemented zones will be terminated approximately 1 to 3 m above the sensors with the remaining borehole volume filled with bentonite grout to limit the influence of vibrations within overlying layers on the cement borehole fill; and

    e. the instruments in borehole T7-VM-C will include the same triaxial and uniaxial sensor pair in the bedrock, but only the Meggit 731A vertical sensor for the soft soil zone.

    Note that the triaxial sensors may not be sufficiently sensitive to monitor vibrations during the operational phase of the turbine except, perhaps, in close proximity. Further, vibrations associated with pile driving may exceed the range of the more sensitive seismic accelerometers. Therefore, these instruments will be installed in pairs within the boreholes to capture data for both ranges of anticipated vibration magnitudes. Additionally, the sensitive accelerometers (Meggit 731A) are not manufactured with side ports for the cables and, given the limitations on borehole size, cannot be mounted to capture horizontal motions. Thus, only one of the Meggit 731A instruments can be used down each of the boreholes.

2) Golder anticipates that completion of borehole instrument installation, testing and background measurements will take approximately one week.

3) During the borehole instrumentation installation period, a field staff member will assess the location of the nearest domestic well or location at the property line closest to the well. At this time, background ground vibrations will be measured using a highly sensitive accelerometer. At this time, Golder is proposing to use a Rion DA-21 data logger with PCB 393A03 accelerometers for the more sensitive ground surface vibration measurements. If possible/permissible, the accelerometer will also be used to monitor the vibrations of the well casing itself (including baseline levels), depending on actual well construction. Although water well surveys have been completed as part of early studies (by others), the required information to determine whether or not an accelerometer can be fastened to a well casing is not available. The feasibility, means and methods of fastening an accelerometer to specific well casings will be investigated during the site visit to ensure that an accelerometer can be properly fastened. Vibration measurements will not be made at the

bottom of the well or with the sensors submersed under water since such work would require removing the well and piping and disrupting the water supply.

4) Field personnel will also establish locations for surface instruments, prepare daily site plans and review a final checklist for site-specific supplies (e.g., insulation blankets to keep equipment warm and prolong battery life, etc.).

During driving of the test pile, the following activities will be completed:

1) Over a period of two days, two Golder personnel will monitor pile driving on a full-time basis. The test program will include:

   a. Use of two conventional construction vibration seismographs (Instantel Minimate), one located as close as practicable to the actual pile being driven and one approximately 10 m from the pile driving. A third, highly sensitive accelerometer (as noted above) will be located approximately 30 m to 50 m from the test piles with a fourth sensitive accelerometer located at the residential well or nearest property line (as described above). The highly sensitive instrument is designed to measure vibrations at magnitudes well below the capabilities of conventional construction vibration seismographs and within ranges that are of importance for demonstrating attenuation of vibrations near wells for this project. These instruments will be set to record all vibrations in a continuous mode.

   b. Data loggers will be connected to all down-hole accelerometers to record subsurface vibrations on a continuous basis.

2) Prior to pile driving, it is anticipated that the constructor will provide assistance to Golder to break through frozen ground if and where present. The intent of the work will be to measure vibrations transmitted through the frozen surface layer of ground as well as the underlying unfrozen ground.

3) During pile driving, one of the site personnel will periodically read the output from the instruments and care for the instruments, making sure ground coupling is maintained. The other individual will monitor the times at which the pile driving starts and completes for each pile, any indications of changes in driving behavior and hammer blows per foot or per metre of pile penetration and coordinate driving with monitoring activities. The pile monitoring is considered necessary to correlate pile tip depth, approximate indications of pile driving energy and observed vibrations. Seismograph and accelerometer monitoring will be time-stamped to compare to pile driving conditions. It is expected that driving the test pile to depth will take less than 3 hours. Therefore, Golder will work with the Contractor to periodically restrike the pile to ensure that sufficient data is collected with respect to driving conditions at depth. Golder will also carry out vibration monitoring as the test pile is extracted the subsequent day.

4) At the conclusion of each day, the ground surface instruments will be removed from the site and data will be collected from the instruments. Data will be reviewed in the evening to identify potential data problems (if any) to permit additional data gathering during restrikes the following day.

5) After completion of test pile driving, the data will be reviewed and evaluated by our vibration specialists. It is intended that vibration distance-attenuation curves will be produced from the data that can be utilized for the remaining turbine sites. Further, ground surface and subsurface vibration magnitudes and attenuation will also be compared to correlate the two measurement conditions to allow estimates of both surface and subsurface vibration amplitudes for all other sites based on the relationships developed from the test pile monitoring data. The results of the monitoring will be provided in a brief memorandum summarizing:

a) test program plan and any changes made to this plan on the basis of construction operations, observations or site-specific constraints/conditions identified while on site;

b) conditions observed during installation of the subsurface instruments;

c) conditions observed during pile driving;

d) summary of data; and

e) interpretation of data, vibration-distance attenuation curves to allow for predictive analyses for subsequent monitoring and recommendations for the subsequent two phases of the production pile driving program.

Phase 2: Production Pile Monitoring Program (May-July, 2017)

[Note: As noted above, this phase of the work plan will be developed pending analysis of the monitoring data from the previous Phase 1 and will not be implemented without prior MOECC review and approval. Production pile driving will not commence at the site until a ground-borne vibration monitoring program for production pile driving is submitted to and approved by the Director].

Phase 3: Initial Turbine Operation Phase (To be determined)

[Note: As noted above, this phase of the work plan will be developed pending analysis of the monitoring data from the previous Phases 1 and 2 and will not be implemented without prior MOECC review and approval. The project will not commence the operations phase until a ground-borne vibration monitoring program for project operations is approved by the Director].

Closure

We thank you for the opportunity to submit this updated work plan. Upon review and approval to proceed, the work plan will be stamped and signed by a licenced professional engineer in Ontario. If you have any other questions regarding the proposed work plan or require further clarification, please contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

Storer J. Boone, Ph.D., P.Eng.
Principal

SJB/MEB/cr

Attachments: Figures 1 and 2
PCB 3713E112G, PCB 393A03 Triaxial Vibration Sensor Specifications
Meggit 731A Uniaxial Seismic Accelerometer Specifications

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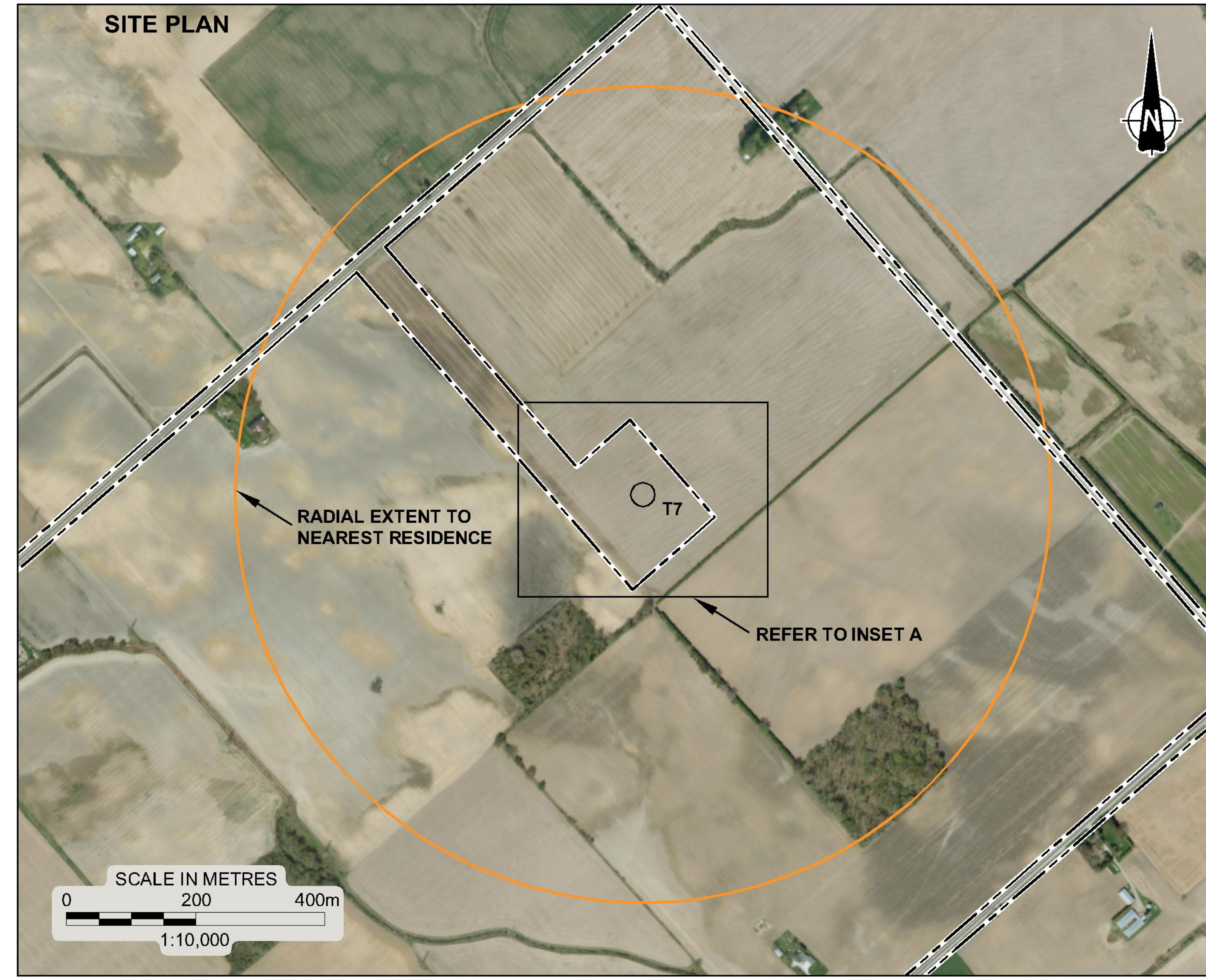
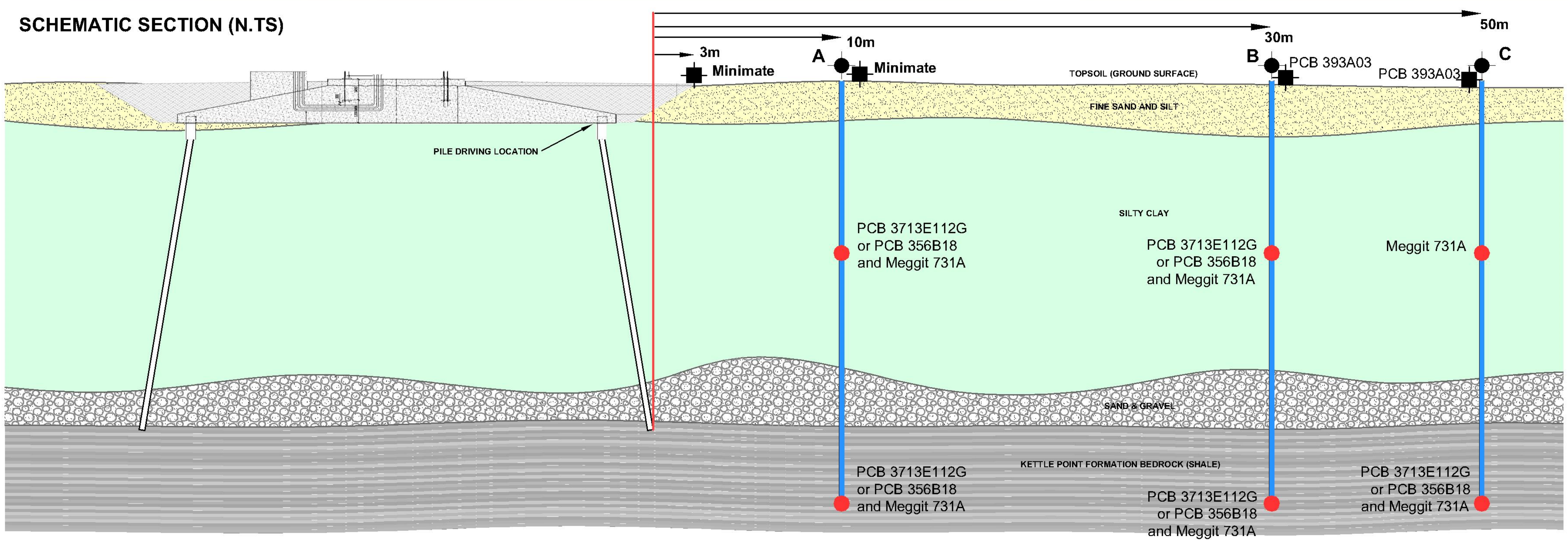
INSET A

SITE PLAN



SCHEMATIC SECTION (N.TS)



LEGEND

- PROPOSED BOREHOLE
- SURFACE MONITORING POINT
- VIBRATING SENSOR

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR OUNTARION; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

VIBRATION MONITORING PROGRAM
NORTH KENT WIND FARM
CHATHAM-KENT, ONTARIO

TITLE

VIBRATION MONITORING PLAN
NORTH KENT WIND 1
T7

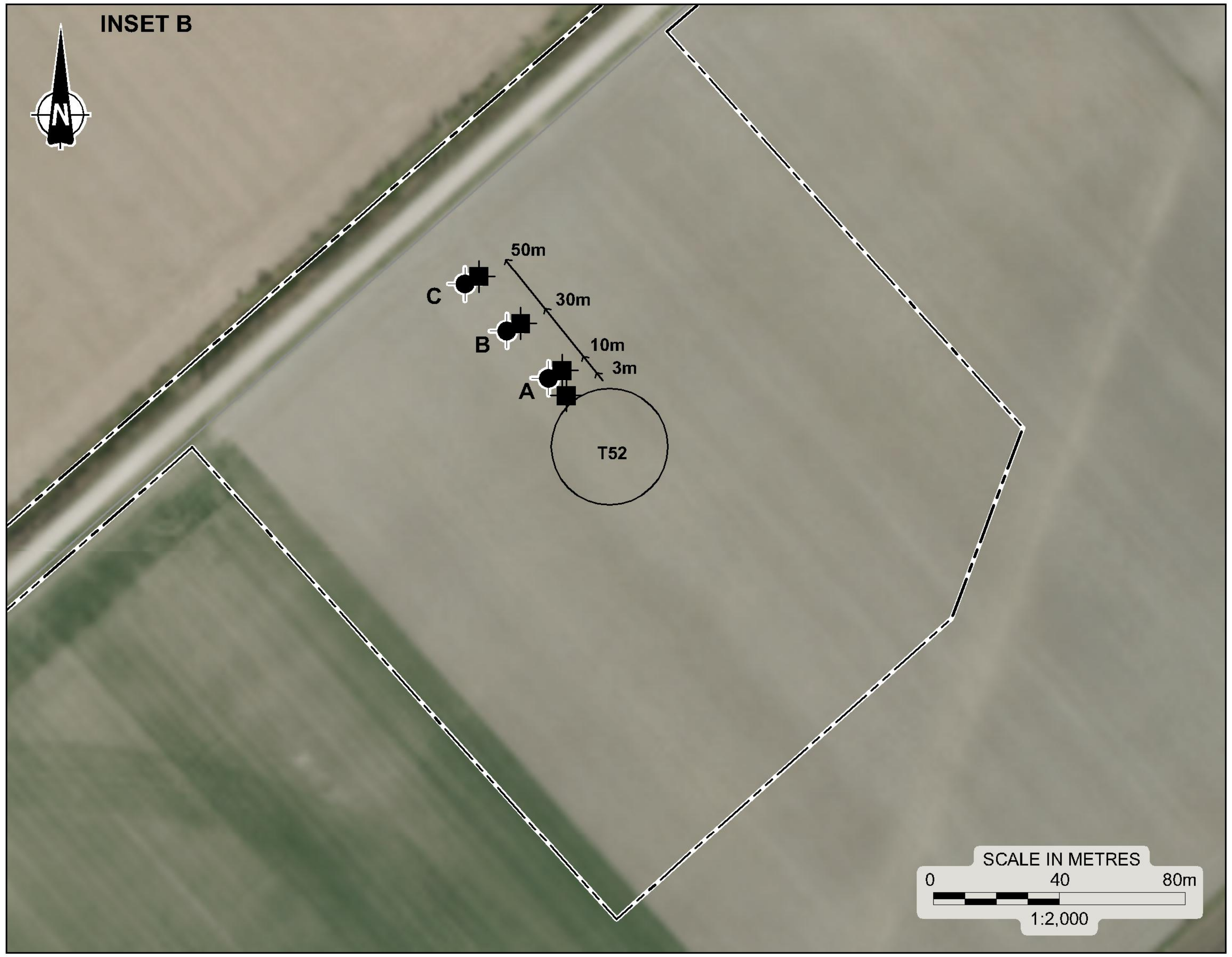
Golder Associates

PROJECT No.	P1668031	FILE No.	P1668031-L01001
		SCALE	AS SHOWN
CADD	DCH	Feb 15/17	REV.
CHECK			

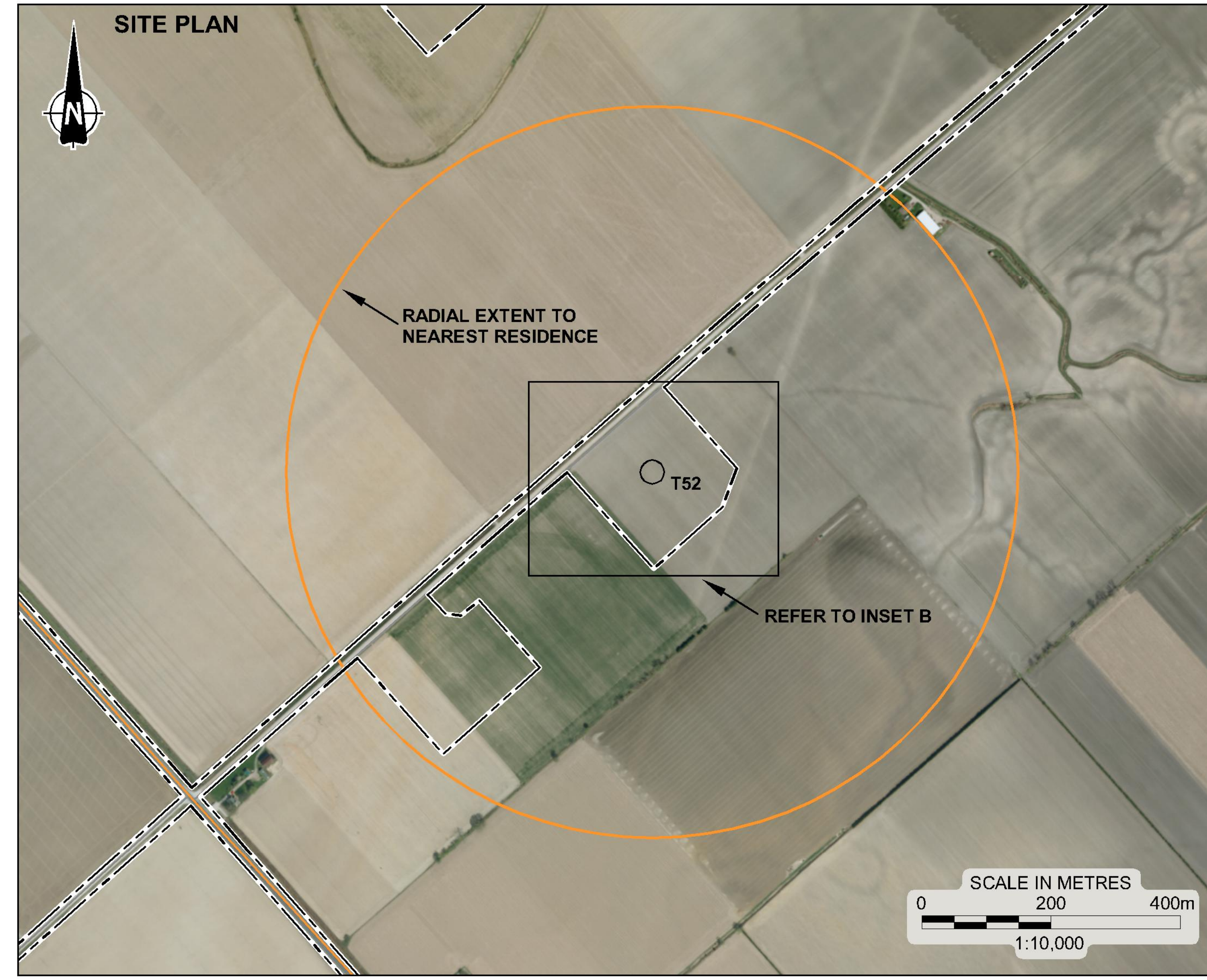
FIGURE 1

Drawing file: P1668031-L01001.dwg Feb 15, 2017 - 4:27pm

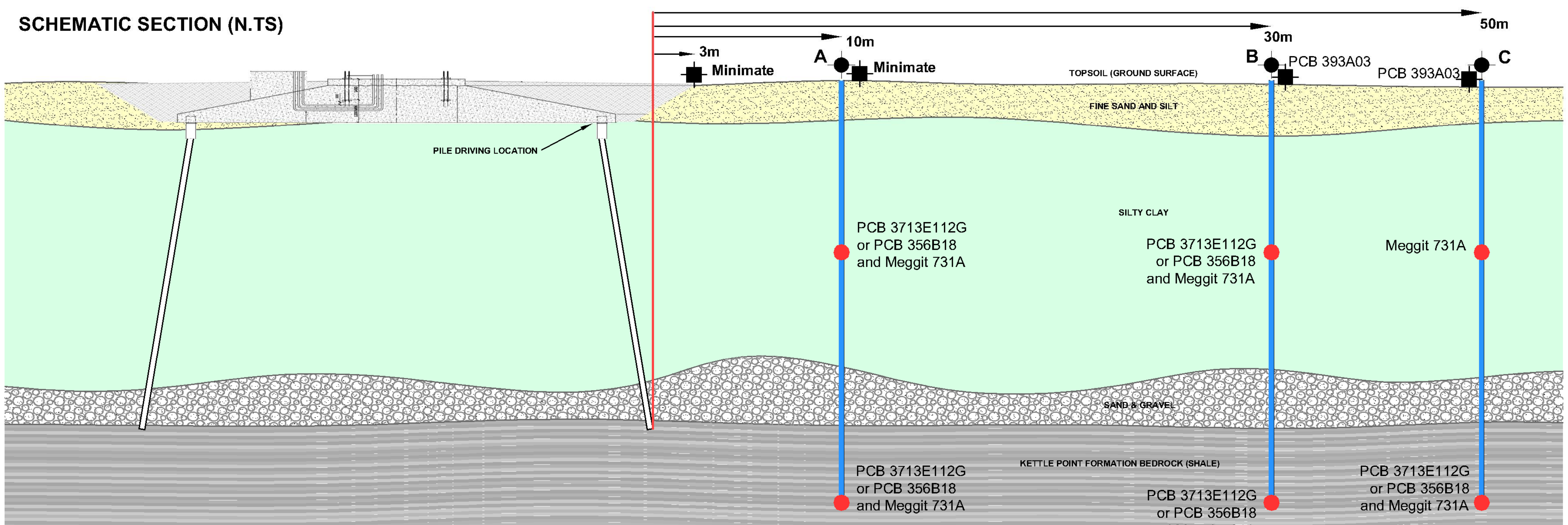
INSET B



SITE PLAN



SCHEMATIC SECTION (N.TS)



LEGEND

PROPOSED BOREHOLE

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR OUNTARION; AND
"FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

VIBRATION MONITORING PROGRAM
NORTH KENT WIND FARM
CHATHAM-KENT, ONTARIO

TITLE

VIBRATION MONITORING PLAN
NORTH KENT WIND 1
T52

Golder Associates

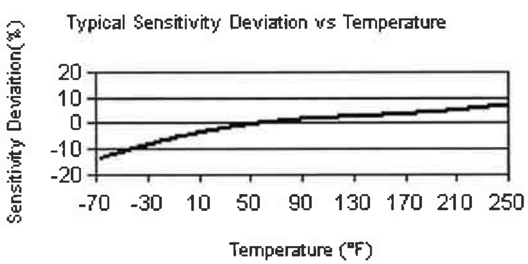
PROJECT No.	P1668031	FILE No.	P1668031-L01001
		SCALE	AS SHOWN
CADD	DCH	Feb 15/17	REV.
CHECK			

FIGURE 2

Drawing file: P1668031-L01001.dwg Feb 15, 2017 - 4:13pm

Model Number		Revision: H
393A03	**SEISMIC ICP® ACCELEROMETER**	ECN #: 29751

Performance	ENGLISH	SI	
Sensitivity(± 5 %)	1000 mV/g	102 mV/(m/s²)	
Measurement Range	± 5 g pk	± 49 m/s² pk	
Frequency Range(± 5 %)	0.5 to 2000 Hz	0.5 to 2000 Hz	
Frequency Range(± 10 %)	0.3 to 4000 Hz	0.3 to 4000 Hz	
Frequency Range(± 3 dB)	0.2 to 6000 Hz	0.2 to 6000 Hz	
Resonant Frequency	≥ 10 kHz	≥ 10 kHz	
Broadband Resolution(1 to 10,000 Hz)	0.00001 g rms	0.0001 m/s² rms	[1]
Non-Linearity	≤ 1 %	≤ 1 %	[2]
Transverse Sensitivity	≤ 7 %	≤ 7 %	
Environmental			
Overload Limit(Shock)	± 5000 g pk	± 49,050 m/s² pk	
Temperature Range	-65 to +250 °F	-54 to +121 °C	
Temperature Response	See Graph	See Graph	
Base Strain Sensitivity	≤ 0.0005 g/με	≤ 0.005 (m/s²)/με	[1]
Electrical			
Excitation Voltage	18 to 30 VDC	18 to 30 VDC	
Constant Current Excitation	2 to 20 mA	2 to 20 mA	
Output Impedance	<250 ohm	<250 ohm	
Output Bias Voltage	8 to 12 VDC	8 to 12 VDC	
Discharge Time Constant	1 to 3 sec	1 to 3 sec	
Settling Time	<15 sec	<15 sec	
Spectral Noise(1 Hz)	2 μg/√Hz	20 (μm/sec^2)/√Hz	[1]
Spectral Noise(10 Hz)	0.5 μg/√Hz	5 (μm/sec^2)/√Hz	[1]
Spectral Noise(100 Hz)	0.2 μg/√Hz	2 (μm/sec^2)/√Hz	[1]
Spectral Noise(1 kHz)	0.1 μg/√Hz	1 (μm/sec^2)/√Hz	[1]
Electrical Isolation(Case)	≥ 10^8 ohm	≥ 10^8 ohm	
Physical			
Sensing Element	Ceramic	Ceramic	
Sensing Geometry	Shear	Shear	
Housing Material	Stainless Steel	Stainless Steel	
Sealing	Hermetic	Hermetic	
Size (Hex x Height)	1 3/16 in x 2 3/16 in	30.2 mm x 55.6 mm	
Weight	7.4 oz	210 gm	[1]
Electrical Connector	2-Pin MIL-C-5015	2-Pin MIL-C-5015	
Electrical Connection Position	Top	Top	
Mounting Thread	1/4-28 Female	1/4-28 Female	
Mounting Torque	2 to 5 ft-lb	3 to 7 N-m	



[3]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

T - TEDS Capable of Digital Memory and Communication Compliant with IEEE P1451.4

Output Bias Voltage	8.5 to 12.5 VDC	8.5 to 12.5 VDC

NOTES:
[1] Typical.
[2] Zero-based, least-squares, straight line method.
[3] See PCB Declaration of Conformance PS023 for details.

SUPPLIED ACCESSORIES:
Model 081B20 Mounting Stud, with shoulder (1/4-28 to 1/4-28) (1)
Model 085A31 Protective Thermal Jacket (1)
Model ACS-1 NIST traceable frequency response (10 Hz to upper 5% point). (1)
Model ACS-4 Single axis, low frequency phase and amplitude response cal from 0.5 to 10 Hz (1)
Model M081B20 Mounting Stud 1/4-28 to M6 X 0.75 (1)

Entered: [illegible]	Engineer: [illegible]	Sales: WDC	Approved: EB	Spec Number:
Date: 12-2-08	Date: 11-24-08	Date: 11-24-08	Date: 12-1-08	**393-1030-80**

PCB PIEZOTRONICS
VIBRATION DIVISION
3425 Walden Avenue, Depew, NY 14043
Phone: 716-684-0001
Fax: 716-685-3886
E-Mail: vibration@pcb.com

Model Number 3713B112G	TRIAXIAL DC RESPONSE ACCELEROMETER	Revision E ECN #: 36673

Performance	ENGLISH	SI	
Sensitivity (±5 %)	1000 mV/g	101.9 mV/(m/s²)	[5]
Measurement Range	±2 g pk	±19.6 m/s² pk	
Frequency Range (±5 %)	0 to 250 Hz	0 to 250 Hz	
Frequency Range (±10 %)	0 to 350 Hz	0 to 350 Hz	
Resonant Frequency	≥1.3 kHz	≥1.3 kHz	
Phase Response (10 Hz)	<2.5 °	<2.5 °	
Broadband Resolution (0.5 to 100 Hz)	0.25 mg rms	0.0025 m/s² rms	[2]
Non-Linearity	≤1 %	≤1 %	[6]
Transverse Sensitivity	≤3 %	≤3 %	
Environmental			
Overload Limit (Shock)	±3000 g pk	±29420 m/s² pk	
Temperature Range (Operating)	-65 to +250 °F	-54.0 to +121 °C	
Temperature Range (Storage)	-65 to +250 °F	-54.0 to +121 °C	
Temperature Coefficient of Sensitivity	±3 %	±3 %	[3]
Zero g Offset Temperature Coefficient	±2 %FSO	±2 %FSO	[4][3]
Base Strain Sensitivity	0.0001 g/με	0.001 (m/s²)/με	[2]
Magnetic Sensitivity	43.7 µg/gauss	4.29 (m/s²)/Tesla	[2]
Electrical			
Excitation Voltage	6 to 30 VDC	6 to 30 VDC	
Current Consumption	≤5 mA	≤5 mA	
Output Impedance	≤100 Ohm	≤100 Ohm	
Offset Voltage (0 g)	±40 mVDC	±40 mVDC	[1]
Spectral Noise (1 to 100 Hz)	22.9 µg/√Hz	225 (µm/sec^2/√Hz	[2]
Electrical Isolation (Case)	>10^8 Ohm	>10^8 Ohm	
Physical			
Housing Material	Titanium	Titanium	
Sealing	Hermetic	Hermetic	
Size (Length x Width x Height)	0.8 in x 0.8 in x 0.8 in	20.3 mm x 20.3 mm x 20.3 mm	
Weight	0.6 oz	17.3 gm	
Electrical Connector	9-Pin	9-Pin	
Electrical Connection Position	Side	Side	
Mounting Thread	10-32 Female	10-32 Female	

CE[7]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.
ICP® is a registered trademark of PCB group, Inc.

Optional Versions (Optional versions have identical specifications and accessories as listed for standard model except where noted below. More than one option maybe used.)

Notes

[1] Offset tolerance is based on 10 ft of 037 test cable.
[2] Typical.
[3] -65 to +250 °F, ref. 75 °F (-54 to +121 °C, ref. 24 °C)
[4] FSO = Full Scale Output over the Measurement Range (4VDC).
[5] Measured at 5 Hz, 1/2 grms.
[6] Zero-based, least-squares, straight line method.
[7] See PCB Declaration of Conformance PS027 for details.

Supplied Accessories

080A12 Adhesive Mounting Base (1)
081B05 Mounting Stud (10-32 to 10-32) (1)
ACS-85T (1)
M081B05 Mounting Stud 10-32 to M6 X 0.75 (1)

Entered: DMW	Engineer: MAM	Sales: WDC	Approved: RPF	Spec Number:
Date: 08/17/2011	Date: 08/17/2011	Date: 08/17/2011	Date: 08/17/2011	**44045**

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Minimate Pro4™

Instantel

Advanced Vibration, Overpressure and Sound Monitor

4 – Channel data acquisition for the following range of Applications:

- Blast-monitoring for compliance
- Remote monitoring - Auto Call Home™
- Near-field blast analyis
- Sound monitoring
- Pile driving
- Construction activity
- Demolition activity
- Structural monitoring
- Underwater monitoring
- Heavy transportation

The **Instantel® Minimate Pro4** vibration, overpressure and sound monitors are built on the success of the **Minimate® Series III** monitoring systems.

The **Minimate Pro4** offers 64MBs of memory, improved ruggedness, including a metal case and connectors, and water resistance.

For reliable compliance monitoring, connect an ISEE or DIN Triaxial Geophone and an ISEE Linear Microphone or optional Sound Microphone.

Versatile

Each compliance sensors calibration date, serial number, and sample rate specification are determined by the Sensor Check feature of the unit and stored in the setup file. The sensor type, calibration date and serial number are also recorded on the Event Report.

For those challenging monitoring applications, such as tunneling, the **Minimate Pro4** monitoring unit includes EMI shielding and built-in noise and anti-aliasing filters; both the sensor and auxiliary channels are isolated.

With the optional **Instantel Blastware® Advanced Module**, perform VDV monitoring, Signature Hole Analysis and real time display of Histogram data.

Intelligent

View Peak Vibration and Zero Crossing Frequencies immediately after each Event occurs. Toggle between Peak Vibration and Peak Overpressure with a simple push of a button. Data highlights, including Operator, Trigger, Duration, and Maximum Vibration and Overpressure, are also available for review, right on the monitors display.

Remote Monitoring

For remote installations, the **Instantel Auto Call Home** feature will automatically transfer event files from field to office as they are recorded using a variety of wireless modems. From there, the **Blastware Mail** feature of the **Instantel Blastware** software automatically distributes files or summary information to multiple e-mail addresses.

Vision™

Auto Call Home integrates with **Vision**, Instantel's Cloud-based event data hosting application (optional). With **Vision**, you can store monitoring data securely in the Cloud and deliver the information your stakeholders need—anytime, anywhere, instantly. Vision also lets you:

- View, sort, filter and print event data to identify trends before they become issues.
- Map your site—using technology from Google, you can place your monitoring units on a street or satellite map.
- Upload photos for a record of the latest progress.

Easy to use

Even with all of these features, the **Minimate Pro4** system is still easy for anyone to use. A high-contrast LCD and ten-key tactile keypad drives simple menu operations, while graphic icons indicate battery and memory levels at a glance.

Key Features

- Dedicated function keys and intuitive menu-driven operation enable quick and easy setup.
- Sample rates from 512 to 65,536 S/s per channel, independent of record times.
- Continuous monitoring means zero dead time between events, even while the unit is processing.
- **Instantel Histogram Combo™** mode allows capturing thousands of full waveform records while simultaneously recording in histogram mode.
- The **Auto Call Home** feature automates remote monitoring applications.
- Non-volatile memory with standard 8,000-plus event storage capacity.
- Records full waveform events over two hours long.
- Match any channel with a variety of sensors; geophones, accelerometers, hydrophones and a dedicated microphone channel.
- Optional Sound Microphone available for sound monitoring. Combine an ISEE or DIN Triaxial Geophone with the Sound Microphone to monitor two types of event data.

Minimate Pro4™

General Specifications

Minimate Pro4 Channels	Channels 1-3, ISEE or DIN Triaxial Geophone, and Channel 4, ISEE Linear or Sound Level Microphone	
Geophone		
Range	Up to 254 mm/s (10 in/s)	
Response Standard	ISEE Seismograph Specification or DIN 45669-1	
Resolution	0.00788 mm/s (0.00031 in/s)	
Frequency Range (ISEE / DIN)	2 to 250 Hz, within zero to -3 dB of an ideal flat response / 1 to 315 Hz or 1 to 80 Hz	
Accuracy (ISEE / DIN)	+/- 5% or 0.5 mm/s (0.02 in/s), whichever is larger, between 4 and 125 Hz / DIN 45669-1 standard	
Transducer Density	2.13 g/cc (133 lbs/ft^3)	
Maximum Cable Length (ISEE / DIN)	75 m (250 ft) / 1,000 m (3,280 ft)	
Microphone (Sold separately)	**ISEE Linear Microphone**	**Sound Level Microphone**
Weighting Scales	ISEE Linear Microphone	A-Weight or C-Weight
Response Standard	ISEE Seismograph Specification (2011)	Fast (125s) or Slow (1s)
Range	2 to 500 Pa (0.00029 to 0.0725 psi [88 to 148 dB])	30 to 140 dB A or C
Resolution	0.0156 Pa (2.2662x10^{-6} psi)	0.05 dB (Display limit 0.1dB)
Frequency Response	2 to 250 Hz between -3 dB roll off points	Up to 20 kHz
Accuracy	+/- 10% or +/- 1dB, whichever is larger, between 4 and 125 Hz	IEC 61672 Class 1
Maximum Cable Length	75 m (250 ft)	75 m (250 ft)
Optional Advanced Sensors Contact Instantel for more information	High Pressure Microphone, High Frequency Geophone, Uniaxial and Triaxial Accelerometer, and Hydrophone	

Waveform Recording

Record Modes	Waveform, Waveform Manual
Seismic Trigger	0.13 to 254 mm/s (0.005 to 10 in/s)
Linear Acoustic Trigger	2.0 to 500 Pa (0.0029 to 0.0725 psi)
Sample Rate	512, 1,024, 2,048, 4,096, 8,192, 16,384, 32,768, 65,536 S/s per channel (independent of record time)
Record Stop Mode	Fixed record time, **Instantel AutoRecord™** record stop mode
Record Time	1-9,000 seconds (1-30 seconds, then 30-second increments up to 150 minutes) plus a 0.25 seconds pre-trigger
AutoRecord Time	Event is recorded until activity remains below trigger level for duration of auto window, or until available memory is filled.
Cycle Time	Recording uninterrupted by event processing, monitoring, or communication - no dead time below 65 KHz.
Minimate Pro4 Storage Capacity	64 MBs. Optional 240 MBs.
Full Waveform Events	8,000-plus 1-second events at 1,024 S/s sample rate

Histogram Recording

Record Modes	Histogram and **Instantel Histogram Combo** (monitor captures triggered waveforms while recording in Histogram mode)
Recording Interval	1 to 30 seconds at 1 second intervals, and 30 seconds to 60 minutes at 30 second intervals
Histogram Storage Capacity	800,000 intervals. Examples: 18.5 days at 2 second intervals, or 555 days at 1 minute
Histogram Combo Storage Capacity	Example: 30 days of Histogram recording at 1 minute intervals, and over 7,500 1 second waveform events

Physical Specifications

Dimensions	25.4(l) x 11.75(w) x 10.80(h) cm (10.00 x 4.63 x 4.25 in); length dimension includes connectors and dust caps
Unit Weight	2.27 kg (5 lbs)
Battery	10 days
User Interface	10 domed tactile with separate keys for common functions
Display	7-line x 32-character, high-contrast, multi-color backlit LCD
PC Interface	Ethernet® cable, supplied, for PC to unit connection (Auto Call Home is not supported over Ethernet), or RS-232 with an optional USB adapter
Auxillary Inputs and Outputs	External Trigger and Remote Alarm
Environmental	
LCD Operating Temperature	-20 to 45 °C (-4 to 113 °F)
Electronics Operating Temperature	-40 to 45 °C (-40 to 113 °F)
Water Resistance	IP67 – submerse to 30 cm (1 ft.) for 24 hours
Remote Communications	Instantel approved serial communication modems Automatically transfers events when they occur through the **Instantel Auto Call Home** feature Monitor start/stop timer
Additional Features	(Optional) **Vision** provides you and your stakeholders with secure, encrypted, Cloud-based access to the data they need, providing instant sharing for time-sensitive projects.
Electrical Standards	CE Class B

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Instantel

StanleyBlack&Decker

720B0001 Rev 10 - Product Specifications are Subject to Change

The World's Most Trusted Monitors — Vibration · Noise · Air Overpressure

Wilcoxon Research

Model 731A
Ultra-quiet, ultra low frequency, seismic accelerometer

Dynamic

Sensitivity, ±10%, 25°C	10 V/g
Acceleration range	0.5 g peak
Amplitude nonlinearity	1%
Frequency response:	
±10%	0.10 - 300 Hz
±3 dB	0.05 - 450 Hz
Resonance frequency	750 Hz
Transverse sensitivity, max.	1% of axial
Temperature response:	
−10°C	−12%
+65°C	+5%

Electrical

Power requirement: voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Electrical noise, equiv. g:	
Broadband 2.5 Hz to 25 kHz	0.5 µg
Spectral 2 Hz	0.03 µg/√Hz
10 Hz	0.01 µg/√Hz
100 Hz	0.004 µg/√Hz
Output impedance, max	100Ω
Bias output voltage	9 VDC
Grounding	case isolated

Environmental

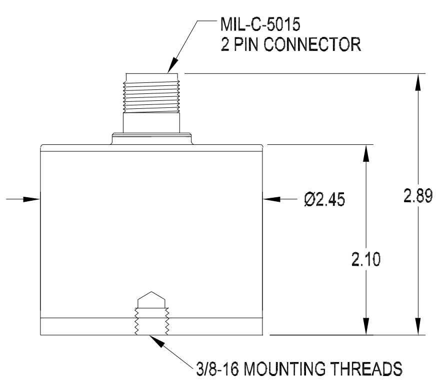
Temperature range	−10 to 65°C
Vibration limit	10 g peak
Shock limit	fragile
Electromagnetic sensitivity @ 60 Hz	20 µg/gauss
Sealing	hermetic
Base strain sensitivity	0.0001 g/µstrain

Physical

Sensing element design	PZT ceramic / flexure
Weight	775 grams
Case material	316L stainless steel
Mounting	3/8 - 16 tapped hole
Output connector	2 pin, MIL-C-5015 style
Mating connector	R6 type
Recommended cabling	J9 / J9T2A

Connector pin	Function
Shell	ground
A	power/ signal
B	common

Features
- Ultra high sensitivity
- Ultra low-noise electronics for clear signals at sub micro-g levels
- Low frequency capable
- Low pass filtered to eliminate high frequencies
- Reverse wiring protection



Note: Special handling required due to sensitivity, wooden protective case included
Accessories supplied: SF7 mounting stud; calibration data (level 3)
Options: Power unit/amplifier P31

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