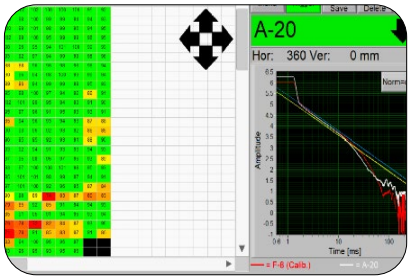
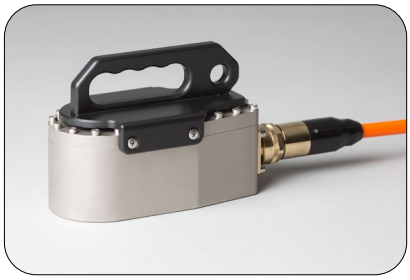
ETHER NDE

MAXWELL PECT

IN-SERVICE PULSED EDDY CURRENT INSPECTION SYSTEM

THE NO-NONSENSE PECT TOOL





ndt MAXWELL

NDT SUPPLY.COM
7952 Nieman Road, Lenexa, KS 66214-1560 USA
Phone: 913-685-0675, Fax: 913-685-1125
www.ndtsupply.com, sales@ndtsupply.com

Pulsed Eddy Current (PEC) is an inspection technique for inspecting carbon steel objects such as pipes and vessels, without the need for contact with the steel surface. PEC can measure percentage variations in steel thickness through any non-conductive and non magnetic materials between sensor and surface such as air, insulation material, concrete, plastics, coatings, sea water and marine growth, paint, deposits, oil, composite repairs, fireproofing, “scabs” aluminium sheeting and other non-magnetic insulation covers; so ideal for Corrosion Under Insulation (CUI) applications.

The MAXWELL PECT instrument is designed for the inspection of carbon steel and low-alloyed steels, which are magnetic. For magnetic test specimens, the eddy currents are concentrated on the surface directly after the magnetic pulse. Subsequently, the eddy currents diffuse into the test specimen, until the backwall is “found”. This results in a characteristic shape A-scan: a straight line, corresponding to the diffusion of the eddy currents, followed by curved section when the backwall is sensed.

Weighing in at 7.5 kg (16.5lbs), including the batteries, the Maxwell system is highly portable; and with a typical battery life of 8 hours is an ideal inspection partner in the field.

PECT can normally be applied to ferromagnetic steel with wall thickness (WT) between 3mm - 50mm (0.15” - 2.0”). Maximum Lift-Off range is 0-250mm (0-10”).

A maximum surface temperature of up to 550°C (1020 °F) may be inspected with the PECT technique, provided the PECT probe is kept below 80°C (175 °F).

Probes S, M, L and XL with and without encoder attachments.

Underwater Probe set covering different depth ratings & lift-off ranges.

• The new PECT instrument has a ruggedized tablet computer on-board connected to a data acquisition unit.

• The set is splash water tight, robust and easy to operate. Data collection is fast (two measurements per second) and has a scanning mode.

• The data is analysed in real-time with various quality control features that assists the operator to correctly analyse the data.

• There are four standard probes, each for a different lift-off range. The probes are optimized for defect sensitivity.

• The instrument can either be operated from the probe and from the tablet computer, using touch screen technology.

• Two cables, length 8m (26ft), is included in the standard kit. Up to 100m (328ft) can be provided.

Hardware Specifications	
Standard set	One PECT instrument: data acquisition unit permanently connected to a U11i Durabook tablet, for data acquisition, with high capacity battery, AC adapter and blue tooth mouse. Four standard probes, with protector shoes & wear piece. Each probe can be used with a one-axis position encoder. Two vibration-suppression shims. Two signal cables, each 8m (26.25ft) long, for connection with any probes (one in use, one spare) Two main batteries for PECT instrument. One external charger for the main battery 110v-230V. Reference plate for functional check by user and annual remote calibration by Maxwell NDT.
Optional items	One-axis position encoder that can be attached to each of the four standard PECT probes (S, M, L and XL). Flat probe for in-service inspection of annular ring atmospheric storage tanks Splash zone probe, 30m (98.5ft) water depth. Underwater probe, 1500m (4921ft) depth rating 29m (95ft) long signal cable in transport case; different lengths are available on request. 100m (328ft) long underwater umbilical in transport case; different lengths are available on request; Telescopic pole: 5.9 ft (1.8m) collapsed – 19.7ft (6m)extended
Data acquisition computer	DURABOOK U11i Touch screen with LED backlight Sunlight Readable Display. Ambient Light Sensor, screen protector, Navigation keypad/ “Quick” keys, 8GB memory, 250 GB SSD.
Standard probes	Four standard probes, types S (small), M (medium), L (large) and XL (extra large) Nominal lift-off ranges: (S)0-20mm (0-0.78ins); (M) 25mm-75mm (0.98-2.95ins); (L) 40mm-125mm (1.57-4.92 ins) and (XL) 75mm-250mm (2.95 9.84ins) Probe selection is automated in the set-up.
Batteries	Main battery, typical life: 8 hours; external chargers ensure no down time due battery re-charging. Hot-swappable. Computer battery is recharged automatically from the main battery, if charge drops below 20%, so no spare battery swap is required.
Communication	Wi-Fi, Bluetooth®, USB 3.0
Environment	Meets IP65. Salt and Fog resistant. Operating Temperature -20°C to +40 °C (-4 °F - 104 °F). Relative humidity < 93% . Atmospheric pressure 70 – 105 kPa.
Compliance	CE, RoHS, FCC Part 15B
Instrument Dimensions	33cm x 26cm x 15cm (13 ins x 10.2 ins x 6 ins)
Instrument Weight	7.5 kg (16.5lbs) (inc. batteries and data acquisition computer). The instrument is provided with 2 hoisting lugs.
Transport of standard set	Operator transport is possible using the rucksack included in the set and instrument carrier belt. Air/Road transport in three Explorer cases (type 4830), 52cm x 45 cm x 24cm (20in x 17.7in x 9.5in). Weight 14 kg (31lbs) each.
Transport of 25m extension lead	One Explorer cases 5823, 67cm x 51 cm x 26cm (26.3in x 20in x 10.25in) . Weight 15kg (33lbs). Cable is configured in a figure of eight.
Transportation splash zone probes	One Explorer case, 7630, each LxWxH = 34in x 22in x 14in (86cm x 56 cm x 36cm) Weight 50m umbilical length: 68lbs (31kg).

Instrument Operation & Software	
Measurement parameters	Probe selection and measurement parameters are automatically set at start of an inspection using test measurements.
Data Storage Software	All PECT signals are fully stored in data files for verification purposes.
Data Collection Software	GUI user interface . Customizable . Direct reporting to MS Excel 2019
Data collection speed	Typical recording speed (second per reading): 0.19in <WT≤ 0.47in 0.5s (3mm< WT ≤12mm 0.5s) 0.47in <WT≤ 0.98in 1s (12mm< WT ≤25mm 1s) 0.98in <WT≤ 1.97in 2s (25mm< WT ≤50mm 2s) Note: the measurement time depends on a number of parameters that are hard to quantify, such as pipe vibration.
Data Collection with Position Encoder	Data can be recorded with and without position encoder: **Point-to-point** measurements by manual or remote trigger. **Dynamic Scanning:** measurement triggered by encoder while moving the probe, ideal under favourable circumstances **Stop & go data collection:** measurements triggered when encoder detects that probe is steady – applicable under less favourable circumstances .
PC Reporting Software	Unlimited and license free copies of PC-based analysis software provided for Windows 10/ MS Excel 2019.
Report Generation & Language	Microsoft Excel Reports are generated both instrument software and PC-based analysis software. Report layouts can be customized. Languages: English, French, Spanish and other languages available.
Typical Performance Parameters	
Wall thickness range	2-65mm (0-1.97in) steel
Maximum Lift-Off range	0-250mm for WT ≤ 15mm (0-9.84in for WT ≤ 0.6in) 0-200mm for 15mm < WT ≤: 30mm (0-7.8in for 0.59in <WT ≤ 1.2in) 0-100mm for 30mm < WT ≤: 65mm (0-3.9in for 1.18in <WT ≤ 1.97in)
Minimum pipe diameter	0mm (0in) insulation: 25mm (1.0in) 50mm (1.97in) insulation: 75mm (3in) 50mm (2.0in) OD can be inspected with footprint around full pipe circumference.
Insulation Sheeting	Aluminium & stainless. Performance on galvanized (magnetic) sheeting depends on properties.
Footprint Diameter	Typically 1.5 times the thickness of the insulation, with a minimum of 25mm (0.98in).
Typical measurement accuracy	PECT measures steel thickness averaged over it's footprint area with a typical accuracy of ±10%.

Transport Case 1:
PECT instrument, optional tank floor probe, computer mouse, battery charger and AC adapter.

Transport Case 2:
Two NiMH batteries, four standard probes, connector piece and documents. Probe and encoder compartment.

Transport Case 3:
Contains two 8m long Signal cables, reference plate, encoder plates and a rucksack.

Applications include:

- Corrosion under fire proofing e.g. storage sphere legs
- Inspection of column skirts.
- Flow accelerated corrosion (power plants).
- Splash zone of offshore structures and risers.
- Subsea Pipelines, well casings, repair wraps.
- Ship Hulls.
- High Temperature wall thickness monitoring.

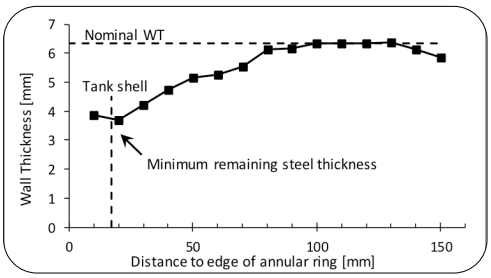
IN-SERVICE PEC INSPECTION OF STORAGE TANK ANNULAR RINGS

Maxwell NDT has developed a flat PEC probe that can be inserted underneath the annular ring of a tank floor for in-service inspection. Such inspection is of great value, as it can help to extend the intervals between out-of-service inspection.

The Maxwell PECT is it is powerful enough to measure through thick layers of corrosion products (iron oxides) underneath the tank floor, which is essential for annular ring inspection. The removal of corrosion materials is clearly unacceptable for in-service inspection, as this may trigger a leakage, but with the Maxwell PECT system this removal process is not required.

Advantages of the Flat PEC Probe

- Compact magnetic field increasing defect sensitivity.
- High range in WT, 2.0” (5.0cms), and insulation thickness so also suited for vessels, not just piping.
- Fast single pulse including at high insulation thickness.
- Scanning possible also at high lift-off.
- Powerful batteries, with hot-swap capabilities.
- Robust, designed for use outdoors, very easy to use in field.



The graph, to the right, represents an example result of an annular ring inspection with the MAXWELL PECT, showing severe wall loss close to the tank shell. The corroded area extends over a length of about 80mm (3.15ins) in this case.

Robotic PECT - including underwater ROV Specifications	
Robotic PECT	Compatible with probes, cables and software of portable PECT. Can be connected to maximum twelve (12) PECT probes; extension to maximum 48 probes is optional. Probes can record data in maximum four groups that are excited together. For example, the system can be configured to measure probes 1, 5 and 9 in cycle 1; subsequently probes 2, 6 and 10 in cycle 2; probes 3, 7 and 11 in cycle 3 and probes 4, 8 and 12 in cycle 4. Other grouping is possible. One on-board industrial computer for the data acquisition program. Connection to master computer with Ethernet communication. Two encoder inputs. Three digital out signals (TTL), which can e.g. be used for motor control. Is supplied with electronics board mounted on a frame, selected internal connectors are accessible to the user for (re)-configuration by the user. Full documentation of the electronics connections is provided with the set. Housing can be re-arranged to suit operator needs.
Optional Items	Same as portable topside MAXWELL PECT Underwater housing for different depth ratings
Data Acquisition Computer	POC 212. 8 GB memory, 250 GB SSD control via LAN network Option to connect to another data acquisition computer (requires Window 10); software key which is required will be provided for free.
Probes	Compatible with all MAXWELL NDE probes
Communication	Ethernet & RS485 (not standard)
Environment	The Robotic system is delivered on a frame, which is designed for placing in a pressure housing. Housing can be in pressure containers, depending on the customer requirements such as number of probes, application above or below water and depth rating. Temperature -20°C to +50 °C (-4°F to 122°F) Relative humidity < 93% Atmospheric pressure 70 – 105 kPa
Compliance	CE, FCC Part 15B.
Dimensions & weight	Standard system: 20ins (510mm) x 6 ins (150mm) ⌀6ins (150mm) Weight 28lbs (12.7 kg), including batteries and data acquisition computer.

PULSED EDDY CURRENT INSPECTION OF JETTY PILES

The tidal zone of jetty piles are commonly protected by a ‘splash zone’ coating. When this gets damaged, severe corrosion can occur, potentially undermining the structural integrity of vital harbour installations. Conventional inspections are hampered by the thick splash zone coating and build up of marine growth.

Pulsed Eddy Current Testing (PECT) measures remaining steel thickness without having to remove the coating, deposits and marine growth. The splash zone can be inspected by rope access techniques or from boats using jigs strapped to the pile. Divers are frequently used for inspection are greater depth.

The Maxwell PECT System has been developed with a strong magnetic field to overcome the challenges of an offshore inspection. As a result:

- No need to remove splash zone corrosion or marine growth, which can be as thick as 250mm (9.84 ins).
- The Maxwell PECT system is powerful enough to measure through thick layers of corrosion, which is a key requirement for reliable wall thickness measurements.
- Data is recorded in a single pulse, with thick marine growth, enabling reliable data collection, even if waves and sea currents make it hard to keep the probe steady during data recording.
- 250m (820ft) long underwater umbilicals are available to connect to a range of underwater probes. Depth rating is either 164ft (50m) or 3280ft (1000m).
- Right is an example of a colour-coded wall-thickness table of PECT measurements recorded on a jetty pile, showing areas of severe wall loss. These reliable data serves helps to optimize maintenance programs.

PECT wall thickness readings [mm] of a 36" jetty pile

		Position around circumference											
		12h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h
		0m	0.24m	0.48m	0.72m	0.96m	1.20m	1.44m	1.68m	1.92m	2.15m	2.39m	2.63m
Elevation relative to mean sea level	1	0.3m	11.9	11.8	11.9	12.6	12.0	11.7	10.6	10.6	11.0	11.5	11.5	11.4
	2	0.2m	11.7	11.7	12.5	11.9	11.8	12.2	9.9	9.4	10.4	11.9	11.8	11.5
	3	0.0m	11.5	11.7	12.2	12.7	12.0	10.0	11.2	8.3	9.3	11.9	12.2	11.7
	4	-0.1m	11.2	11.4	12.1	12.7	12.5	9.2	9.7	6.8	8.2	12.0	11.3	11.7
	5	-0.2m	11.4	11.5	11.7	12.8	11.8	8.3	7.2	3.8	4.1	9.9	11.7	11.6
	6	-0.3m	11.2	11.3	11.6	12.2	11.8	7.8	7.4	9.7	4.2	9.9	11.9	11.4
	7	-0.4m	11.5	11.4	11.5	12.3	10.7	8.9	11.0	9.8	6.8	10.7	12.3	11.5
	8	-0.5m	11.5	11.4	11.7	12.2	11.0	10.5	12.0	11.1	10.5	12.1	12.0	11.4
	9	-0.6m	11.9	11.3	11.6	12.0	12.0	11.6	11.8	11.3	12.0	12.3	12.1	11.3
	10	-0.7m	11.6	11.8	11.6	12.1	12.6	12.2	12.0	11.7	12.0	12.5	12.1	11.5
	11	-0.8m	11.5	11.8	11.6	11.9	12.1	12.5	11.9	11.4	11.4	12.5	12.5	11.6
	12	-0.9m	11.8	11.6	11.7	5.9	12.2	12.6	12.5	11.2	11.3	12.7	12.6	11.6
	13	-1.0m	11.7	11.6	11.9	11.9	12.2	12.7	11.7	10.4	11.4	12.5	12.2	11.8
	14	-1.1m	11.6	11.3	11.5	12.2	12.3	12.7	11.9	11.3	11.7	12.4	12.0	11.6
	15	-1.2m	11.5	11.4	10.7	11.7	12.4	12.8	11.8	10.7	12.2	12.6	13.0	11.4
	16	-1.3m	12.8	12.0	8.0	11.6	12.5	12.6	12.3	10.9	11.7	12.1	12.7	10.9
	17	-1.4m	11.9	11.9	6.7	11.3	12.4	12.3	12.1	11.6	11.9	12.5	11.7	7.3
	18	-1.5m	11.6	12.1	7.8	11.7	12.8	12.4	11.9	11.5	11.3	8.9	12.8	6.5
	19	-1.6m	12.6	11.8	6.6	11.9	12.4	12.4	11.8	12.1	11.7	14.7	6.8	6.4

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