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ION PRODUCTS

Sensor Geophones



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ion

[CHARGED WITH INNOVATION]™

Sensor



ION's Sensor subsidiary is the leading designer and manufacturer of precision geophones used in seismic data acquisition and for industrial use. Sensor has access to the vast wealth of knowledge acquired and developed by the ION group of companies. This valuable asset base, coupled with Sensor's own specialized skills and knowledge, provides unmatched diversity of technologies and innovation.

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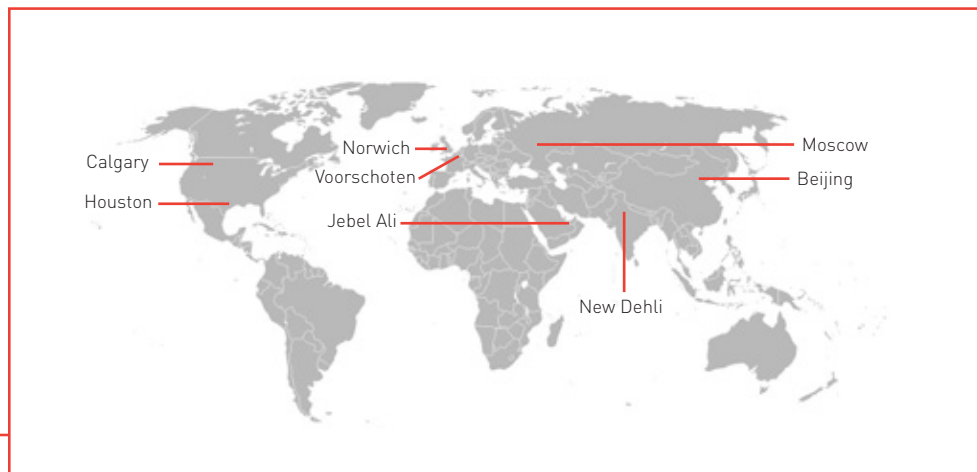
[CHARGED WITH INNOVATION]SM

"Sensor has access to the vast wealth of knowledge acquired and developed by the ION group of companies"

ION Sensor

Since 1967 ION Sensor has been providing geophysicists worldwide with exceptional quality precision geophones, testers and ancillary equipment. Our SM-24 rotating coil geophone is the industry leader with an installed base of well over 14 million elements worldwide. Sensor's dedication to quality is unsurpassed in the industry. Hard wearing, long lasting geophones save our customers millions of dollars every year in costly repairs and minimize crew down time.

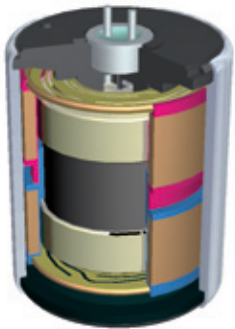
As market leader and a multisite ISO 9001: 2000 certified company, Sensor maintains production facilities and service support in The Netherlands, USA, Dubai, India, Canada, China, Russia and the UK. From our main plant in Voorschoten, The Netherlands and from our Dubai facility, we produce a geophone every four seconds, well over two million a year.



Maintain Your Specifications

Measurements of vibration can be traced back many centuries to the Chinese and Egyptians who used devices that would allow marbles or pebbles to be rolled or cause objects to fall in order to determine levels of vibration. Today's geophones are sophisticated measuring devices and are based on a coil suspended by springs in a magnetic field, within a steel case. When vibration of any sort moves the case, the coil remains stationary due to its inertia. This movement of the case in relation to the stationary coil generates an electrical voltage proportional to the velocity of the coil with respect to the case (with displacements as low as nano-meters).

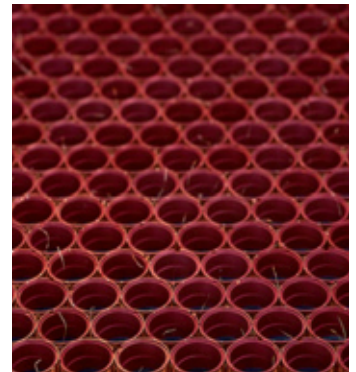
The seismic industry today demands tight specification tolerances in order to meet the exacting standards of a modern seismic survey and ION Sensor has set the industry standard. For example a geophone with a 10Hz natural frequency will operate within +/- 2.5% tolerance; harmonic distortion will be <0.1%, sensitivity and coil resistance both +/- 2.5% and the damping set at +5% and -0%. To achieve these specifications



The SM-24 geophone element is designed to offer the highest performance in seismic exploration based upon field-proven ION Sensor technology.

the product has been refined over many years and today's products are a far cry from the cumbersome geophones used in seismic surveys 40 years ago. Geophones of poor quality will provide equally poor data with the result that the map or section is no longer analogous of the earth's interior. In addition to tight specifications geophones need to be exceptionally rugged in their design: In the field strings are routinely stepped on, kicked around, thrown out of the back of trucks and in some case, even dropped out of helicopters.

Although some competitors specify their products to match the industry standard, many avoid the rigors of accelerated age testing. This results in high levels of field failure as products move out of specification and lead to a high total cost of ownership.



Geophone coils awaiting assembly



PE-3/C land case - Economical, field proven reliability for more than 20 years.

Sensor Geophones

Sensor's SM-24 geophones are the industry leading technology for analog seismic acquisition



SM-24 Rotating Coil Geophone

- Tight specification, low-distortion geophone
- Extended spurious over 240 Hz, allowing full bandwidth at 2-ms sampling
- Backwards compatible with SM-4, SM-4 Superphone™
- Horizontal element available for shear-wave and 3-C recording
- 3-year non-prorated warranty
- Lowest lifecycle cost of ownership in the industry
- Installed base of over 14 million worldwide (est.)

The SM-24 geophone element is designed to offer the highest performance in seismic exploration based upon field-proven ION Sensor technology. Low distortion, combined with excellent specifications, provide high-fidelity data in 2-D and 3-D surveys. The extended bandwidth allows the full potential of 2-ms/24-bit recording systems to be realized.

The tight specifications, unique element design, and exceptional quality of the Sensor SM-24 make it the lowest life cycle cost of ownership geophone in the industry.

Applications: 2-D & 3-D seismic exploration with bandwidth from 10 Hz up to 240 Hz.

Implementation: Can be installed in a variety of ION Sensor geophone cases.

Specifications: SM-24 Geophone Element

FREQUENCY

Natural frequency	10 Hz
Tolerance	± 2.5%
Maximum tilt angle for specified Fn	10°
Typical spurious frequency	>240 Hz

DISTORTION

Distortion coil to case velocity with 17,78 mm/s (0,7 in/s) p.p.	<0.1%
Distortion measurement frequency	12 Hz
Typical distortion (string of 12 in series measured at 12 Hz)	0.03 %

DAMPING

Open circuit (Typical)	0.25
Damping calibration-shunt resistance	1,339 Ω
Damping with calibration shunt	0.6
Tolerance with calibration shunt	+ 5%, -0%

SENSITIVITY

Sensitivity	28.8 V/m/s (0.73 V/pulg./s)
Tolerance	± 2.5 %
RtBcFn	6,000 Ω Hz
Moving mass	11 g (0.38 oz)
Max coil excursion p.p.	2 mm (0.08in)

COIL RESISTANCE

Tolerance	+/- 2.5%
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PHYSICAL CHARACTERISTICS

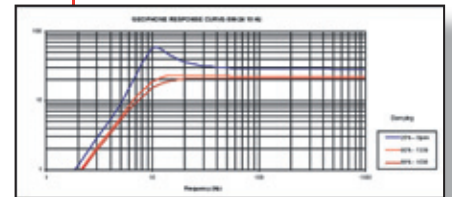
Diameter	25.4 mm (1 in)
Height	32 mm (1.26 In)
Weight	74 g (2.6 oz)
Operating temperature range	-40°C a +100°C (-40°F a +212°F)

WARRANTY PERIOD*

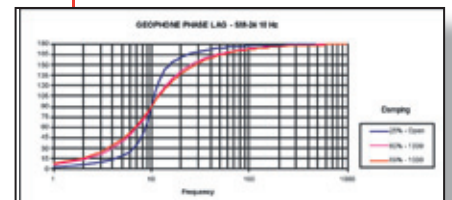
3 years

*Warranty excludes damage caused by high voltage and physical damage to the element case.

All parameters are specified at +20°C in the vertical position unless otherwise stated.

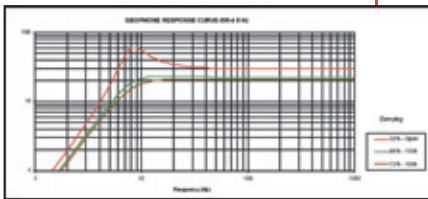


SM-24 10 Hz Response curve

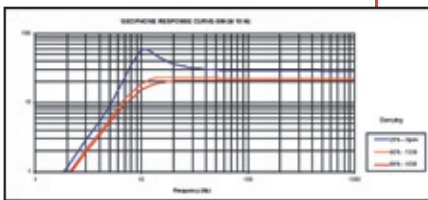


SM-24 10 Hz Phase lag

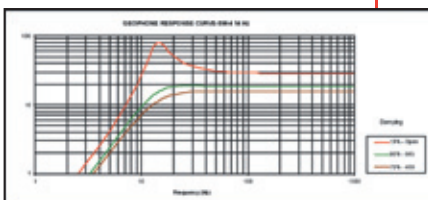
Sensor Geophones



SM-4 8 Hz Response curve



SM-4 10 Hz Response curve



SM-4 14 Hz Response curve

SM-4

- Precision machined, rotating coil design
- Precious metal contacts for consistent, reliable & prolonged field performance.
- Choice of three standard natural frequencies (8Hz, 10Hz and 14Hz)
- Vertical and Horizontal elements available for 3-C applications.
- 3-year non-prorated warranty

The SM-4 digital-grade geophone element is designed for low weight, long field-life, and ultra reliable performance. Precision engineered components and computerized test equipment ensure consistency in manufacture and operation throughout and beyond the replacement guarantee period of three years.

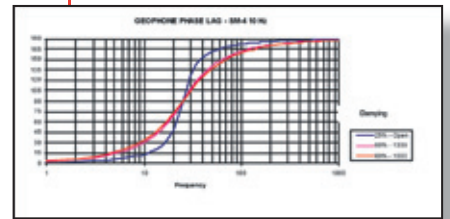
Applications: 2-D and 3-D seismic exploration with bandwidth from 10 Hz up to 190 Hz.

Implementations:

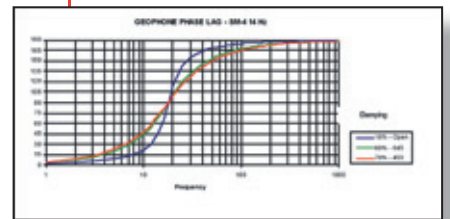
Can be installed in a variety of standard ION Sensor geophone cases.

Specifications: SM-4 Geophone Element

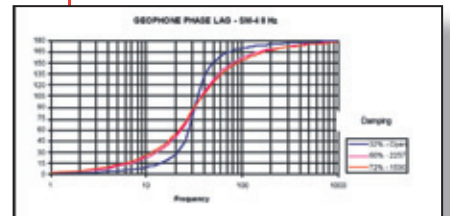
FREQUENCY	SM-4/U-B 8Hz	SM-4/U-B 10 Hz	SM-4/U-B 14 Hz
Natural frequency	8 Hz	10 Hz	14 Hz
Tolerance	± 6.3%	± 5%	± 5%
Maximum tilt angle for specified Fn	20°	25°	25°
Typical spurious frequency	160 Hz	180 Hz	190 Hz
DISTORTION			
Distortion coil to case velocity with 17.78 mm/s (0.7 in/s) p.p.	<0.2%	<0.2%	<0.2%
Distortion measurement frequency	12 Hz	12 Hz	14 Hz
Maximum tilt angle for distortion spec	15°	20°	20°
DAMPING			
Open circuit damping	0.315	0.25	0.18
Damping calibration-shunt resistance	2,257 Ω	1,339 Ω	645 Ω
Damping with shunt	0.6	0.6	0.6
Tolerance with shunt	± 5%	± 5%	± 5%
SENSITIVITY			
Sensitivity	28.8 V/m/s	28.8 V/m/s	28.8 V/m/s (0.73 V/in/s)
Tolerance	± 5 %	± 5 %	± 5 %
RtBcFn	6,000 Ω Hz	6,000 Ω Hz	6,000 Ω Hz
Moving mass	11 g	11 g	11 g (0.38 oz)
Max coil excursion p.p.	2 mm	2 mm	2 mm (0.08 in)
COIL RESISTANCE			
Standard	375 Ω	375 Ω	375 Ω
Tolerance	+/- 5%	+/- 5%	+/- 5%
PHYSICAL CHARACTERISTICS			
Diameter	25.4 mm	25.4 mm	25.4 mm (1 in)
Height	32 mm	32 mm	32 mm (1.26 in)
Weight	74 g	74 g	74 g (2.6 oz)
Operating temperature range	-40°C a +100°C	-40°C a +100°C	-40°C a +100°C (-40°F a +212°F)
WARRANTY PERIOD*	3 years	3 years	3 years



SM-4 8 Hz Phase lag



SM-4 10 Hz Phase lag



SM-4 14 Hz Response curve

*Warranty excludes damage caused by high voltage and physical damage to the element case.

All parameters are specified at +20°C in the vertical position unless otherwise stated.



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