

NEW EXO-Skin™ Sap Flow Sensor

Patent Pending 13/155,369



EXO Sensor showing the different layers of insulation and shielding that comes with each sensor.

Lower Cost
Same Accuracy
Less Maintenance
-Intl. Pat. Pending

Benefits

- Easy installation
- Expandable Velstretch® attachment
- Sealed electronics

Features

Flexible sensor skin for

- Odd plant stems - shapes
- Growth

New innovative features

- New water shedding layer
- Wicks out water vapor
- Insulation and shielding provided

Applications

- Crops
- Understory
- Vines
- Trees
- Vegetables
- Research AND Commercial Monitoring

After 20 years of experience and a worldwide experience with sap flow sensor manufacturing and design, the Dynamax team brings you the latest innovations and sap flow sensor construction advancements. With continuous customer feedback over the years, and through several years of research, we solved many of the commercial and research needs for a more plant friendly and user-friendly sap flow sensor. We improved the longevity, reliability and accuracy with commercial irrigation applications in mind.

The new EXO-Skin Dynagage is based on tried and proven energy balance technology for sap flow measurement. The Dynagage has been the world leader in sensor shipments since 1990. Thousands of sensors have been fielded for research in agriculture, plant physiology, water relations, crop science and numerous ecological, hydrology and engineering studies. With the advent of sap flow monitoring in commercial vineyard applications, and the introduction of Low-Cost Sap flow systems, the Flow4 and Probe12, our customers needed an easier plant connection and a more economical sensor. Customers explained their needs for innovation and we designed the EXO-Skin sensor to solve some of the recurring issues with the well-respected Dynagage, the one piece integrated sap flow sensor.

Ordering Information

Each sensor is supplied with foam body and donuts, reflective bubble shield and a raincoat weather shield.

- SGEX-9** - 9 mm EXO-Skin Sap flow sensor
- SGEX-10** - 10 mm EXO-Skin Sap flow sensor
- SGEX-13** - 13 mm EXO-Skin Sap flow sensor
- SGEX-16** - 16 mm EXO-Skin Sap flow sensor
- SGEX-19** - 19 mm EXO-Skin Sap flow sensor
- SGEX-25** - 25 mm EXO-Skin Sap flow sensor

Accessories

Cable Kit for Loggers

EXOC-25 - Logger cable kit for Flow32 and CSI, EPIG-3 and EXQC-25 extension

AVRD - Controlled dual-adjustable regulator, 1.5 - 10 V, 2.5 A output

EPIG-3 - Logger pigtail - with voltage divider (3 ft.) to CPC Female

FL32-1K-SW - Flow32 logger software for CSI CR1000 loggers (requires Loggernet or PC400)

AM16/32 - 16 channel multiplexer to input 8 sensors to CSI logger

Individual extension cables for Flow32 (9 pin circular locking connectors sealed)

EXQC-25 25 ft. (7.6 m) Extension quick connect cable

EXQC-50 50 ft. (15 m) Extension quick connect cable

EXQC-75 75 ft. (22.8 m) Extension quick connect cable

EXQC-100 100 ft. (30.5 m) Extension quick connect cable

Eight EXQC-25's will convert a Flow32 to use any (8) EXO-Skin sensors to connect with 9 pin circular locking connectors.



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Improvements – New Solutions Provided

EXO-Skin is a simpler construction of the insulation body, separating a sealable electronic body from the insulation. The Exoskeleton approach consists of the heater and heat-sensing electronics prepared in one layered wrapping.

- Makes sensors more flexible and easier to install especially in non-uniform stems
- Manufacture the separate body with sealed electronics with low cost material.

EXO-Skin uses a stretch Velcro wrapping to secure the body to the plant. We apply a stretch Velcro (Velstretch®) wrapping in a spiral around the circumference to secure electronics to the plant.

- Reduce maintenance and installation issues required to accommodate growth
- Secure the sensor yet not constrict the stem growth
- Provides easier installation and maintenance
- Velstretch® is made of a breathable, porous nylon and Lycra® spandex
- Collects moisture and conducts water from the stem and sensor area

The EXO-Skin package includes a waterproof membrane cloth wrapped over the sensor insulation surrounding the electronics and heater-electronic exo-skeleton. The membrane cloth is made of Teflon impregnated synthetic fabric that is permeable to water vapor but impermeable to water drops.

- Blocks incoming water, and maximizes water vapor extraction from the stem and sensor area. Allow longer term, full season measurements on some plants.
- Reduces microbial damage to the plant and the sensor body, as well as prevent corrosion to electronics.
- The membrane surrounds the sensor and insulation wrap. The rain coat blocks rainwater, and extracts water vapor to the surrounding ambient, while reducing condensation build-up inside the sensor.

EXO-Skin sensors come with a flexible reflective sheath. The material is consists of two 96% reflective layers of flexible film bonded to two internal layers of heavy gauge polyethylene bubbles. This layer is required to block radiant heat, which is well known to cause errors in sap flow sensing applications.

- The “bubble shield” makes a reflective radiant barrier.
- Provides a conductive barrier.

EXO-Skin sensors have longer, easier to reach, lead wires with sealed (water tight) locking connectors. Gold plated pins prevent corrosion and conduct noise-free reliable signals to the data logger.

The EXO-Skin sensor internal thermocouple wiring is similar to Dynagage SHB sap flow sensors.

- No changes or reduction in accuracy using a proven stem heat balance (SHB) method
- Compatible with existing loggers, from high end Flow32 to low-cost loggers.
- All EXO-Skin sensors wires are coated with water proofing to provide long-term all-weather performance.
- With annual maintenance, lifetime expectations are 3- 5 years. All sensors are guaranteed for 1 year.



Velstretch® Wrapping



Waterproof Membrane Cloth



Reflective Shield

EXO-Skin™ Specifications



The EXO-Skin on an irregular shaped grape vine.



Finished installation on the grape vine.

Mechanical Specifications

Model	Plant Diameter (mm)	Min Dia. (mm)	Max Dia. (mm)	Min Installed Length (Axial) (mm)	Typ. Installed Length-Shield & Insulation (Axial) (mm)
SGEX-9	9	8	10	70	150-350
SGEX-10	10	9.5	13	70	170-360
SGEX-13	13	12	16	80	190-380
SGEX-16	16	15	19	90	210-400
SGEX-19	19	18	23	100	240-450
SGEX-25	25	25	29	120	280-500

Electrical Specifications

Model	Heater (Ohms)	Typical Voltage (dc)	Max Voltage	Typical Power (W)	Max Power (W)
SGEX-9	120	4.0	5.0	.13	.21
SGEX-10	140	4.5	5.0	.15	.18
SGEX-13	120	4.5	5.0	.17	.21
SGEX-16	100	4.5	5.0	.20	.25
SGEX-19	60	4.5	5.0	.34	.42
SGEX-25	42	4.5	5.0	.48	.60

Environmental Specifications

	Min (°C)	Max (°C)	
Operating Temp	0	50	Below freezing plants and sensor will not have / respond to transpiration.
Installation Temp	15	35	At temps below min, EXO skin is brittle, may sustain damage during installation.
Storage Temp	0	60	Store clean and dry, away from direct heat.

Wrap & Protection Specifications

	Color	EXO-Skin Sensor Size					
		9	10	13	16	19	25
Velstretch® (length in cm)	Black	60	65	75	90	110	170
Insulation Close Cell Foam (length in cm)	Black	15	17	19	21	24	28
Rain Coat Membrane (length in cm)	White	24	25	28	30	34	35
Reflective Radiant Barrier (length in cm)	Alum.	35	36	38	40	45	50

* all specifications are subject to change without notice

Dynamax Inc
 10808 Fallstone Rd. #350
 Houston, TX 77099 USA
 Tel: 281-564-5100 Fax: 281-564-5200
 admin@dynamax.com
 www.dynamax.com

