

## ShockWatch® MAG 2000 Technical Data Sheet

The ShockWatch® MAG 2000 impact indicator is a cost-effective, resettable and reusable device designed to monitor the handling of fragile goods and freight containers greater than 500 lbs. The device is also widely used on rail cars and trucking fleets to monitor for excessive impacts during humping or latching.

### Specifications

#### Features

- Resettable and reusable impact indicator
- Wide variety of sensitivities to match customer requirements

#### Key Specifications

<b>Indication Type</b>	Visual, Magnet displacement indicates that the threshold was exceeded and direction of impact
<b>Activation Method</b>	Armable
<b>Operating Temperature Range</b>	-20°C to 60°C / -4°F to 140°F
<b>Sensitivity Range</b>	0.5 to 20G
<b>Impact Duration</b>	5 to 50 msec
<b>Accuracy</b>	+10% at 20°C / 68°F, 1 ATM
<b>Responsiveness</b>	Responds to single impact, Planar
<b>Product Life</b>	2 years when stored at 20°C / 68°F, 1 ATM
<b>Dimensions</b>	2.5 in x 2.4 in (63.50 mm x 60.96 mm)
<b>Weight – Varies by Sensitivity</b>	31.3 g (typical)
<b>Security</b>	Tamper-resistant / Resettable using unique key
<b>Storage Conditions</b>	20°C / 68°F, 1 ATM, 0 - 99% RH Non-Condensing

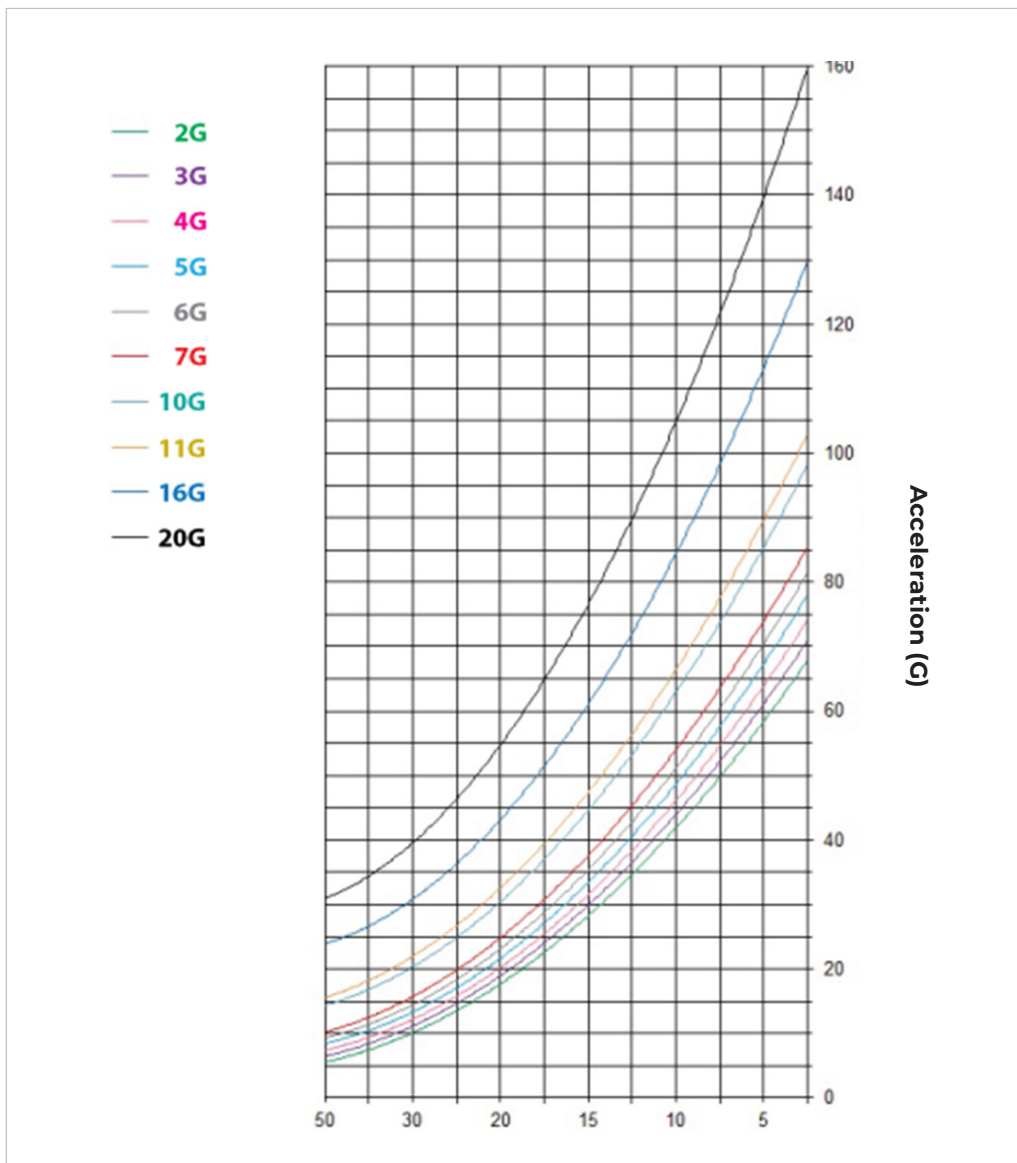
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### ShockWatch MAG 2000 Activation

Two components comprise an impact – amplitude of acceleration (G) and duration of impact (msec). These components are illustrated in the graph below. The area under the curve represents the change in velocity ( $\Delta v$ ).

ShockWatch MAG 2000 shock response curves are based on a half-sine shock pulse. A time, acceleration point on the half-sine curve can be correlated to the same point on the activation graph response curves.

**MAG 2000 G-Level vs. Duration (ms)**  
**5 to 50ms**  
**Activation Occurs +/- 10% of the Nominal Activation Value**



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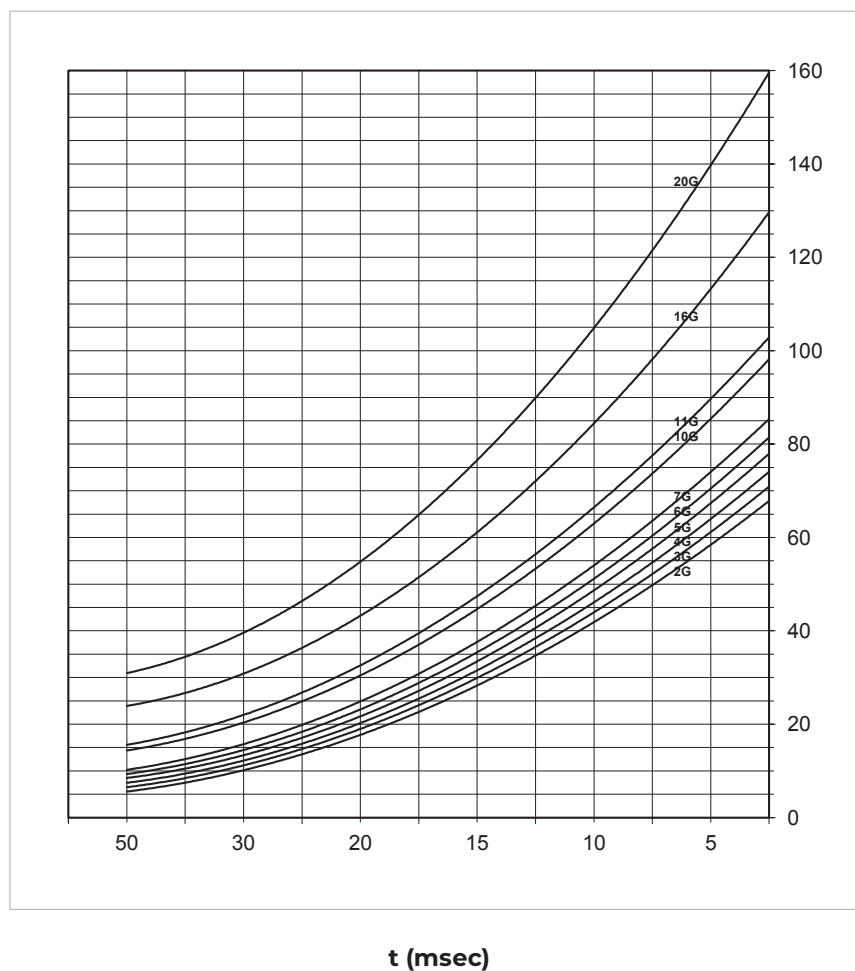
### Activation Graphs - Response Curves

The vertical axis of the Acceleration vs. Duration curve shows a linear scale and is titled “G” or “G-level.” This value is the acceleration scale. A “G” is a multiple of the acceleration due to gravity (32.2ft/s<sup>2</sup> or 9.8m/s<sup>2</sup>).

The horizontal axis of the graph shows a linear scale titled “t” and represents the time duration. The unit of measure for this scale is milliseconds.

The most critical thing to observe from the curve is that as duration decreases, activation acceleration increases. Each ShockWatch MAG 2000 has a minimum G threshold that must be exceeded before it will activate. The minimum G for each MAG 2000 is the left most G-level value on the curve (the G-value where the shock curve intercepts the left acceleration scale). If this minimum G is not exceeded, regardless of the duration or the  $\Delta v$ , the device will not activate. Response curves are measured with a drop system filtering at 3 kHz. Use of a different frequency filter will change the response curve.

**MAG 2000 Activation Graph  
Acceleration vs. G-Level (5-50 msec)**



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### Product Selection

#### Two things you need to select a MAG 2000:

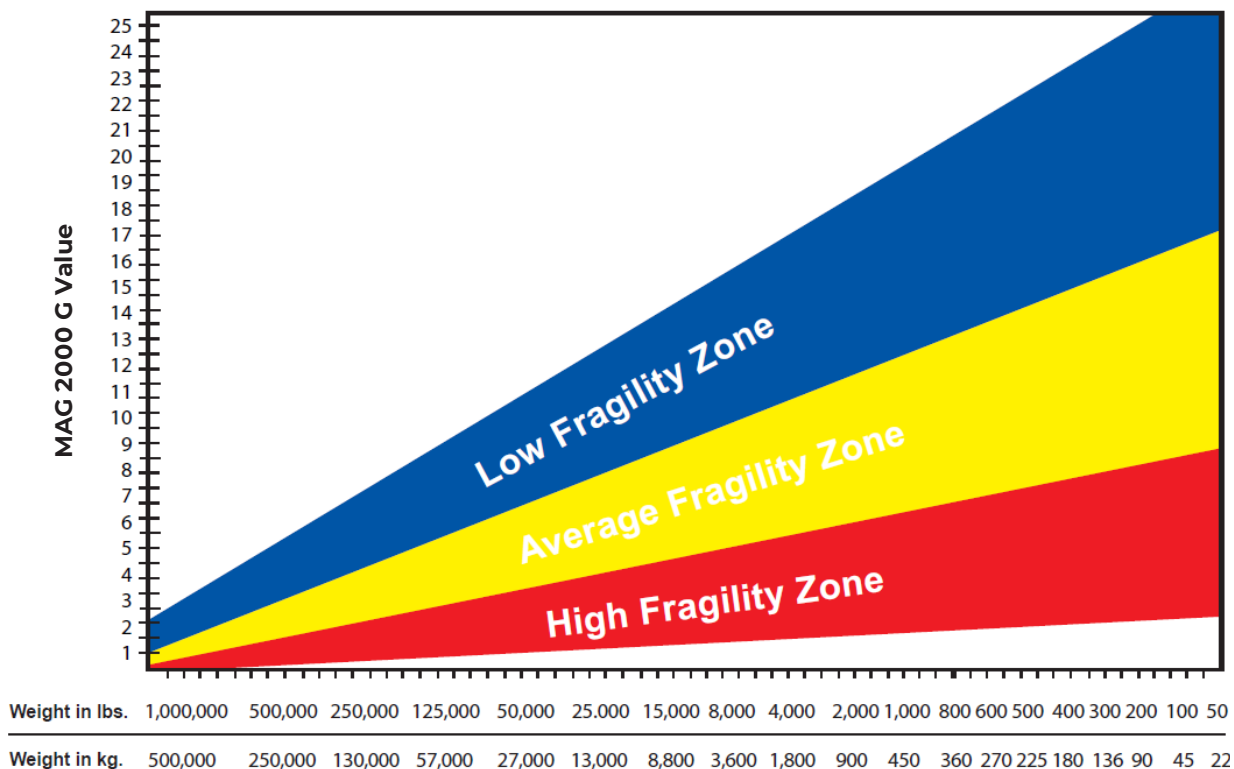
Know the weight of your shipment

Determine its fragility: Low, average or high

**Low Fragility Zone:** Applicable in situations where both visible and hidden damage are possible and a single extreme impact will cause damage to product. Pertains to products transported via a variety of modes.

**Average Fragility Zone:** Applicable in situations where there is a moderate degree of stability and survivability built into the product, and where a standard mode of transportation is used.

**High Fragility Zone:** Applicable in situations where hidden damage is the key concern. Typically, these products will be constructed of low-tolerance components, such as data storage drives, optical lenses, or any other products that require precise alignment. Pertains to most products that require specialized modes of transportation, such as air-ride vans or extended travel in hydro-cushion railcars.



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### How to Use the MAG 2000

The MAG 2000 visually alerts users when a mishandling event has occurred so that appropriate actions can be taken according to the company or industry guidelines. The MAG 2000's magnetic indicator will be displaced in the direction of the impact when an impact over the G-level amplitude / duration has occurred. See mounting details in the section "Best Practices for Mounting" for instructions detailing how to place the MAG 2000 on a shipment.

The MAG 2000 is available in three different response orientations (HH, VV, and VH). Please refer to the information below for details regarding HH vs VV vs VH sensors.

### How to Set a MAG 2000 Impact Indicator

The MAG 2000 visually alerts users when a mishandling event has occurred so that appropriate actions can be taken according to the company or industry guidelines. The MAG 2000's magnetic indicator will be displaced in the direction of the impact when an impact over the G-level amplitude / duration has occurred. See mounting details in the section "Best Practices for Mounting" for instructions detailing how to place the MAG 2000 on a shipment.

The MAG 2000 is available in three different response orientations (HH, VV, and VH). Please refer to the information below for details regarding HH vs VV vs VH sensors.



The MAG 2000 units may arrive activated upon delivery and should be set prior to use.

### How to Set a MAG 2000 Impact Indicator

The MAG 2000 is a cost-effective, resettable, and reusable impact monitoring device for fragile shipments over 500 lbs (266.8 kg). To set the units for use, please follow this procedure:

1. Affix the unit to the desired location using adhesive or the available mounting holes.
2. Unlock the cover using the round, black key that accompanied your shipment.  
Place the key over the MAG 2000 cover and insert the 4 prongs into the 4 slots in the MAG 2000 cover.
3. Press down firmly and turn the key to the left until the cover loosens.
4. Remove the key, grasp the cover and turn it to the left as far as possible.
5. Lift the cover off and put the red indicator magnet back in the center position of the MAG 2000 (red side up).
6. Place the cover back on the unit. Press down and turn it to the right until the cover clicks into place.



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### MAG 2000 Labeling Definitions

Each MAG 2000 is stamped with information that identifies the mounting orientation and the unit threshold setting when mounted according to that orientation.

### Orientation Definitions

A two-letter format is used to define the mounting orientation and configuration. The possible combinations are:

**HH - Horizontal mount, horizontal configuration:** For mounting on a horizontal surface, such as the top of a box. Configured to react to a horizontal impact at the activation value stamped on the device.

**VH - Vertical mount, horizontal configuration:** For mounting on a vertical surface, such as the side of a box. Configured to react to a horizontal impact at the activation value stamped on the device.

**VV - Vertical mount, vertical configuration:** For mounting on a vertical surface, such as the side of a box. Configured to react to a vertical impact at the activation value stamped on the device.

### Device Threshold Setting

Each MAG 2000 is set to activate at the value stamped on the unit when mounted as per the suggested mounting orientation. Because the MAG 2000 can respond to very low acceleration values, the effect of gravity must be taken into consideration. Each MAG 2000 is set to compensate for the acceleration due to gravity when mounted as per the suggested mounting orientation.

The MAG 2000 will also respond to acceleration values not defined by its setting when the mounting orientation is changed. An example: for a MAG 2000 labeled as 5G HH, it would respond to 5G in the horizontal plane when mounted on a horizontal surface. If this device were mounted vertically, it would then have 1G of acceleration due to gravity working against it, thus its vertical activation would be represented by the following equation:

$$\text{Vertical response} = \sqrt{5^2 - 1^2} = 4.89\text{G}$$

Mounting Operation	Response
HH	Used to sense horizontal impacts; mounted to a horizontal surface.
VV	Used to sense vertical impacts; mounted to a vertical surface.
VH	Used to sense horizontal impacts; mounted to a vertical surface.

### Mounting Best Practices

While the MAG 2000 can be used on either a product or the product packaging, it is generally advisable that the MAG 2000 be placed on the product since the impact experienced by the product itself is generally more important than the impact received by the packaging. However, the indicator may be mounted to the packaging. The placement of the MAG 2000 will affect the selection of the proper sensitivity.

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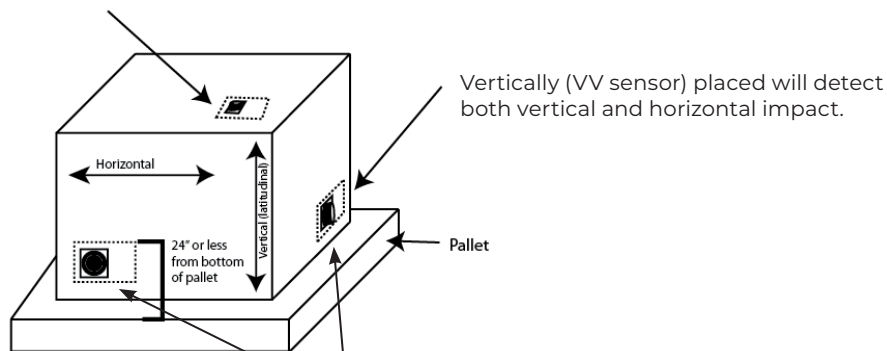
The MAG 2000 can be mounted using the adhesive on the back of the unit or with screws in the pre-drilled screw holes. A two-unit mounting bracket is available that will allow a MAG unit to be replaced or removed when necessary. If using an adhesive, apply to an oil-free surface in an environment above 10°C /50°F for best results.

If a MAG 2000 with a sensitivity of 2G or less is mounted on a vertical surface, guide bars must be implemented in order to prevent the Earth's gravitational force from activating the indicator. In such a configuration, the MAG 2000 will only be able to sense horizontal impacts.

### Shipment Mounting

#### FOR LARGE SHIPMENTS

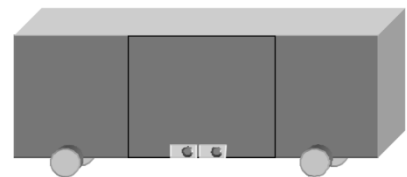
Horizontally placed (HH sensor) will detect horizontal shocks from any direction within that plane (ignores vertical shocks).



Place MAG 2000 on adjacent sides of inner crate or directly on equipment (if not covered by an inner container). For complete 360° monitoring, two MAG2000 units on adjacent sides will provide impact indication in all axes.

### Rail Car Mounting

The MAG 2000 is recommended for outside of the rail car, although it can be mounted on the inside. In either case, mount at the center, near the floor, on the main frame of the car (below the door area). The MAG 2000 will read all impacts in the same plane that the device is mounted. By placing the unit on the side of the car, it will read all impacts equally from both longitudinal (along the track) and vertical impacts.



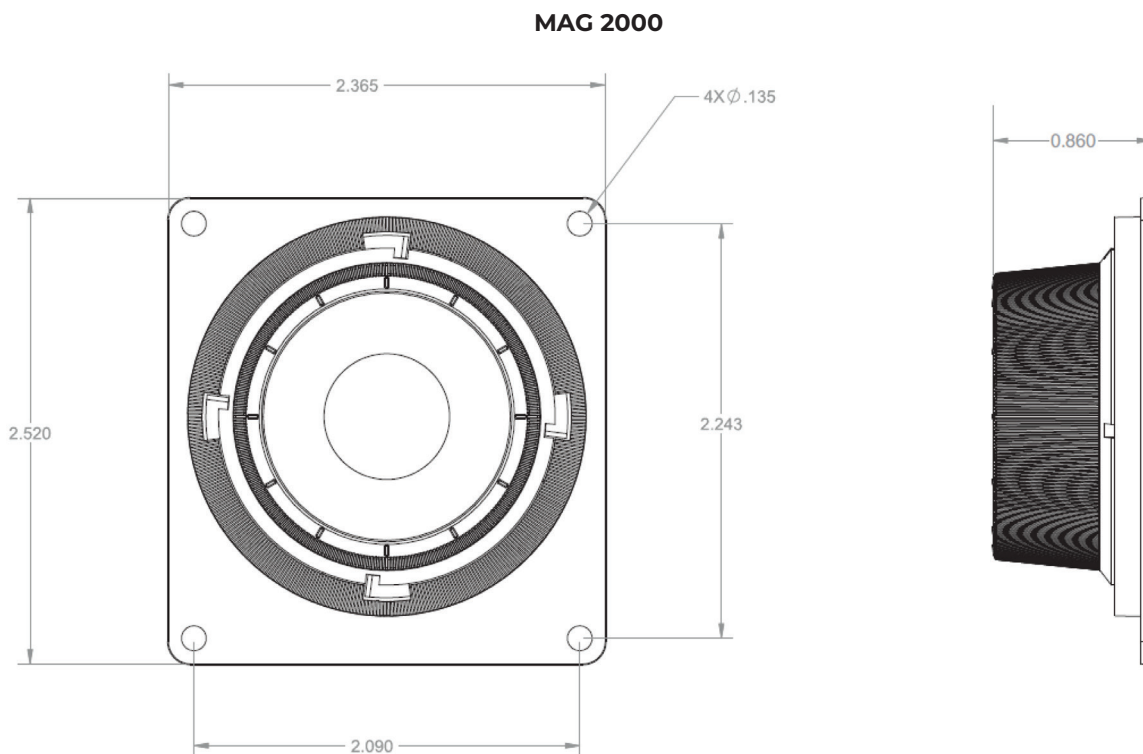
### Truck Mounting

Mount the MAG 2000 on opposite ends of the truck by the front swivel and back door (mounted vertically). This will monitor driving conditions on both ends of the vehicle.



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### Drawings



*Note: Dimensions in inches*

### Accessories & Related Products

A key to reset the MAG 2000 is provided with every order of 5 devices.

The MAG 2000, companion labels, alert stickers, and alert tape can be incorporated into an overall program for reducing product mishandling. Contact your ShockWatch Regional Manager or Local Distributor for more information.

### Quality

ShockWatch is an ISO 9001-2015 company, and as the global leader in supply chain damage prevention programs, ShockWatch's testing and inspection equipment is calibrated by an ISO/IEC accredited organization, traceable to NIST standards.

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### Ordering Information

The mounting orientation (HH, VV, VH) must be known when placing an order.

Part Number	Description	Min. Order Quantity
<b>MAG 2000 Single Units (No Adhesive)</b>		
M21-xG	"x" is the G value desired; 0.5G to 20G	5
<b>MAG 2000 Single Units with Adhesive Backing</b>		
M21A-xG	"x" is the G value desired; 0.5G to 20G	5
<b>MAG 2000 Single Units with Bracket</b>		
M22-xG	"x" is the G value desired; 0.5G to 20G	5
<b>MAG 2000 Single Units with Bracket &amp; Adhesive Foam Tape Backing</b>		
M22A-xG	"x" is the G value desired; 0.5G to 20G	5
<b>MAG 2000 Two Units with Bracket &amp; Adhesive Foam Tape Backing</b>		
M23A	Specify the two G levels at the time of order	5
<b>MAG 2000 Accessories</b>		
MG2210	MAG Guide Bars	1
MG2213	MAG Keys (1 free key with every 5 MAG 2000 units purchased)	1
MG2212-A	Bracket: Single Unit Bracket for M22/M22A Units	1
MG2203	Bracket: Double Unit Bracket for M23/M23A Units	1
MG2128	Foam Tape: 36 yards per roll	1

### Technical Support

If you are unsure of how to use or interpret the MAG 2000, please contact SpotSee Technical Support at (800) 527-9497 or (214) 736-4580. The SpotSee team is available to assist customers from 8 am to 5 pm Central Time.

### Warranty

If a product fails to conform to the specifications stated in this document, the product may be returned to SpotSee at any time prior to the product's specified expiration date or, if no expiration date is specified, within one year from the date of shipment. SpotSee shall either refund the purchase price (without interest), or repair and/or replace the product (or, in the case of services, re-perform such services) at no additional cost. The warranty is void if the defect has resulted from accident, misuse, abuse or misapplication. Any product which is identified as defective during the warranty period and is returned to SpotSee with a Return Material Authorization (RMA) number (which must be obtained from SpotSee prior to any return) within thirty (30) days after discovery of the defect with a written description of the defect will be replaced by SpotSee.