

# IMPACT REGISTER, INC.

PRECISION BUILT RECORDERS SINCE 1914

## G ENVIRONMENTAL MINI-MONITOR

"GEMM"

### DESCRIPTION

THE G ENVIRONMENTAL MINI-MONITOR "GEMM", IS THE SMALLEST, LIGHTEST WEIGHT, COST EFFECTIVE, ELECTRONICALLY DRIVEN, THREE AXIS IMPACT RECORDING DEVICE CURRENTLY AVAILABLE.

The G Environmental Mini-Monitor is an instrument that records the time, magnitude, and direction of shock and vibration. It may be used to monitor all phases of product distribution from the assembly line through customer acceptance.

### MAJOR JUNCTIONS

- Monitors vehicle movement via rail, truck, air, ship and/or fork lift trucks
- Monitors product handling - manual or mechanical.
- Facilitates laboratory tests of the product and package - drop tests, vibration tests, and/or conbur (incline impact) tests.
- Measures and permanently records the force and time of shock and vibration on all axis: side to side (X or lateral), fore and aft (Y or longitudinal), and up and down (Z or vertical).

### OPERATION FEATURES

- Records directly in units of acceleration (G's). Acceleration measurements can be converted to pounds of force and are identifiable as to time and direction of impact.
- It is driven by an Electric D.C. (Quartz) stepping motor.
- Can be used as a laboratory testing instrument. Especially valuable when used in conjunction with drop testing, conbur testing and vibrations (shake table) testing.
- With lower "G" setting the GEMM will indicate any change in the position of the product to which it is attached. Helpful with "This End Up" merchandise.
- Will indicate the *time*, *direction*, and *degree* of all mistreatment the package receives.
- Has a unique sensing system which is extremely rugged and accurate.

- Has an input-output accuracy response that is controlled on both a *static* and **dynamic** basis.
- Has a patented multiplication system for increased accuracy, frequency response, and linear response.
- Is durable:

Can be used continuously, at any input within the present range of the instrument, on the standard vibration (shake table) tester.

Will withstand the handling and transportation environment experienced in all modes of product distribution.

Will withstand repeated drop-testing within the range of the instrument.

- Is easy to use:

A new chart can be installed in the recorder, and the recorder installed in the package in a matter of minutes.

A specially designed wax coated recording chart allows for rapid and accurate chart analysis.

The static calibration can be checked in less than two minutes per axis.

- It is inexpensive.

PATENTS ARE APPLIED FOR:

- Rotating Sensing Masses – eliminated random cross talk.
- Adjustable and Interchangeable G settings and frequency responses.
- Stylus Arrangement – allows for 3 – 1” components to be recorded on 2” of chart.
- Multiple Spring Systems – produces accurate records on a dynamic and static basis, for both single and vibration inputs.

## "GEMM" SPECIFICATIONS

<u>MODEL</u>	<u>CHART DRIVE</u>	<u>LENGTH</u>	<u>WIDTH</u>	<u>HEIGHT</u>	<u>WEIGHT</u>
GEMM - 14E	14 - Day	5 1/4"	4"	3"	4 lbs.
GEMM - 33E	33 - Day	5 1/4"	4"	3"	4 lbs.
GEMM - 60E	60 - Day	5 1/4"	4"	3"	4 lbs.
GEMM - 90E	90 - Day	5 1/4"	4"	3"	4 lbs.
GEMM - 120E	120 - Day	5 1/4"	4"	3"	4 lbs.
GEMM - RO	Ratchet Operated	5 1/4"	4"	3"	2 lbs 9 oz

GEMM SPECIAL (Faster chart speeds available)

### CHART DRIVE

ELECTRIC CHART DRIVE ASSEMBLY The GEMM chart is driven by a (Quartz) Electric DC Stepping Motor. The ON/OFF switch is located on the lower right corner, facing the recorder. The chart will not move until the power switch is in the **ON** position. The power switch was installed on the inside to prevent an **UNAUTHORIZED PERSON** from turning the unit off. When the GEMM is not in use, turn the power switch **OFF** to conserve the battery. Power is supplied to the GEMM by one C-Cell Heavy Duty battery, (Part № 1235. 1.5 volt, Size C, EverReady™) located on the right back of the unit, after removing the top cover.

TO REMOVE AND REPLACE A BATTERY. After removing the top cover, you will notice the battery inside a battery tube, remove either screw from the bar which holds the battery in place. Loosen the other screw, turn bar 180 degrees and the battery will rise 1/4" so that it can be easily removed. When installing a new battery, put **PLUS END OF BATTERY DOWN INTO THE BATTERY TUBE**. We recommend that the battery be replaced every *four* to *six* months, although the estimated life is one year.

- Model GEMM - 14E will operate unattended for a period of 14 days, chart speed is 1" per hour.  
Uses chart type GEMM - 34 - 1" - 1/2".
- Model GEMM - 33E will operate unattended for a period of 33 days, chart speed is 1/2" per hour.  
Uses chart type GEMM - 34 - 1" - 1/2".
- Model GEMM - 60E will operate unattended for a period of 60 days, chart speed is 1/4" per hour.  
Uses chart type GEMM - 34 - 1/4".
- Model GEMM-90E will operate unattended for a period of 90 days, chart speed is .167" per hour.  
Uses chart type GEMM - 34 - 1/4".

- Model GEMM - 120E will operate unattended for a period of 120 days, chart speed is 1/8" per hour.  
Uses chart type GEMM - 34 - 1/4 ".

Please note: The chart speed for the GEMM 90E and GEMM 120E must be manually measured with a measuring device (i.e. tape measure).

### RECORDING CHART

Wax-coated, 2 1/2" wide, 34 feet long and resists temperatures to 180° Fahrenheit.

The length is divided into .050" spaces to allow for accurate chart analysis. The chart has a wax coating to facilitate easy and accurate reading and interpretation.

1" space for each axis. A unique stylus arrangement (patent applied for) make it possible to record 3- 1" components of acceleration on 2" of recording space.

Timing perforations are used to insure accurate chart movement as it moves over the actuating roll.

A "time remaining warning" is printed on the chart. This consists of a red strip printed along the right hand margin of the last 5' of the chart.

### CHART INTERPRETATION

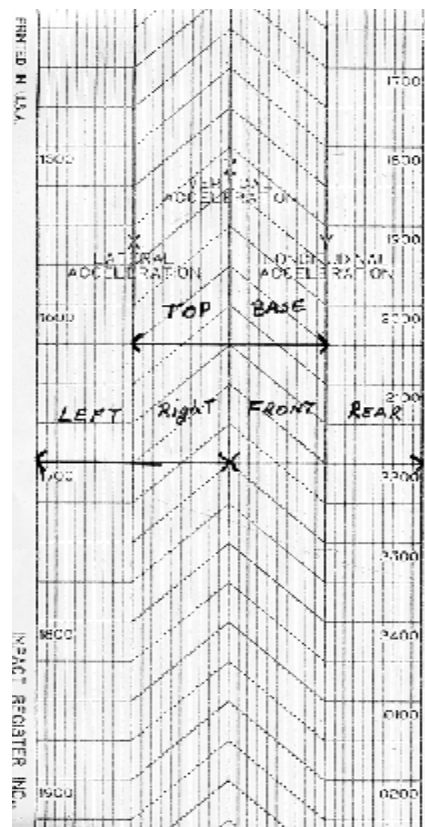
This piece of chart is a sample of the chart used in the Model GEMM.

Note that there is a 3" of recording trace on 2" of chart. This is accomplished by placing the vertical record exactly 1/2 " in front of the lateral and longitudinal record.

The wording on the chart "Base and Top", "Left and Right", and "Front and Rear" indicates how the GEMM will record when a shock is incurred. It is assumed that the GEMM has been placed in a package, for example, if the package (GEMM) was dropped on its front, the trace would be longer on the left side of the Y axis. If the package (GEMM) was dropped on its base, the trace would be larger on the right side of the Z axis.

If the GEMM has a maximum G sensitivity setting of ±100G on each axis, each 1/2" of chart equals 100G, therefore, 100G of each direction on each axis. For a 100G instrument each space equals 10G.

For a maximum G sensitivity setting of ± 50G, 1/2" of the chart equals 50G and each space on the chart for each axis equals 5G.



To determine what G's are incurred, regardless of the maximum sensitivity setting of a particular GEMM, divide the maximum setting by 10 (the number of spaces for each direction). On a  $\pm$  minus 25G GEMM, each space on the chart equals 2.5G ( $25 \div 10$ ). The heavy lines across the chart are  $\frac{1}{4}$ " apart. On the right side of the last 5' of the chart there is a red line which serves as warning that you are nearing the end of the chart.

## SENSING SYSTEM

- Each component of acceleration is recorded by a unique spring mass system. Each mass is 100% effective and, as a result, provides unusually high frequency response. In addition, this design has much less hysteresis error than the conventional system.
- The sensing springs are multiple coiled and cantilever. The sensing spring system for each axis consist of two primary coiled and two cantilever secondary springs. The springs are secured in such a manner that the G-range, frequency response, stylus pressure and zero setting can be changed. The stylus springs and spring retainers are designed so that a maximum restoring movement is provided.
- The standard sensitivity settings (G-range) available vary from  $\pm 2.5G$  to  $\pm 100G$  or higher.
- Each setting mass is uniquely mounted in two precision stainless steel ball bearings. The eccentric multiplier between each sensing mass and stylus is also bearing-mounted. In all there are six (6) miniature precision bearings used in the GEMM.
- A patented eccentric amplification system provides amplification between the sensing mass and the recording stylus. This system is the same one which is used in our more expensive accelerometers. This method increases the recording accuracy, provides the maximum amplification ratio, and virtually eliminates all unwarranted cross talk. The amplification ratio is 16:1
- The complete sensing head assembly is mounted in the GEMM by a unique method so that it can be "**tilted**" away from the timing roll. This added feature allows for easy chart installation.
- The three stylus arms are made from miniature tubing to provide low inertia effect without sacrificing ruggedness.
- The three stylus points are stainless steel and are spring loaded in such a manner as to assure constant stylus point pressure. This arrangement minimizes "skipping" of the stylus points at high recording speeds
- The frequency response, which is unusually high for a mechanical accelerometer, varies as the G range varies.

## **DAMPING SYSTEM**

- The sensing system is friction (coulomb) damped. This type of damping reduces the operation frequency range. However, the amplification system, the mass mounting design, and the use of four sensing springs on each axis provide for a much greater operation frequency range and accuracy response than the conventional system.

## **CHART SUPPLY, RECEIVING AND ACTUATING ROLL**

- The chart roll is held in place with the proper tension to insure foolproof movement of the chart over the actuation pins.
- The receiving roll has a special built-in, constant slippage clutch which provides proper chart tension regardless of the amount of chart stored on the receiving roll.

## **RECORDING MATERIALS**

- The brass sensing masses are mounted on a high precision,  $\pm .0002$  --  $.0000$ , eccentric.
- Six miniature, precision (ABES-3) stainless steel ball bearings are used at critical friction points.
- The recorder base is machined from  $\frac{1}{4}$ " magnesium plate. The top is aluminum.
- All gears are precision brass, machine cut, involute type.
- End and motor frames are tempered aluminum alloy which are anodized for protection.

## **MOUNTING DETAILS**

- The recorder has two mounting holes (.228" i.d. for #12 bolt) with brass bushings in the base. These extrude 1" L x 1" W x  $\frac{1}{4}$ " H from both ends of the recorder. Internal mounting holes, at no increase in cost, are available and other mounting arrangements can be provided upon request.
- The recorder may be mounted and operated in any position.

## **ACCURACY**

- The instrument is calibrated to within  $\pm 4\%$  of full scale deflection (.010") on a static basis. For use in recording individual impacts, the GEMM will give a peak acceleration reading within

4% full scale deflection. The input frequency must be within the operating range of the instrument.

### **“GEMM”**

The major function of the GEMM is to aid the packaging engineer and transportation manager in evaluation the various packaging materials and package designs available for a particular product, as well as to help determine the fragility.

It is possible to over-design packaging for a packaged product. A product packaged to withstand a  $\pm 75G$  force, but which never receives a shock in excess  $\pm 25G$  in the distribution process, is over-packed. The GEMM provides this type of information and thereby allows for correct packaging which could result in lower packaging costs.

In determining the best mode of transportation and handling conditions for a particular product the following points must be considered:

- Do freight forwarders, UPS, parcel post and the company's own packaging and shipping departments handle the merchandise according to “Fragile” and “This End Up” instructions?
- Are the shipments unduly delayed at any one distribution point?
- Are the railroads subjecting the cars to over-speed impact?
- What are the riding qualities of T.O.T.C. (piggyback) shipments?

The GEMM provides answers to these and many similar questions.

### **Setting up Controlled Laboratory Testing Procedures**

The GEMM allows the packaging engineer to readily and easily determine the degree of severity of drop and conbur (incline impact) tests. The GEMM may also be used in connection with vibration (shake table) testing for any given period of time, regardless of how long. This statement is not made by many other manufacturers of portable mechanical accelerometers.

Frequently, actual shipments are monitored. The tapes from these shipments are analyzed and the shock and vibration received during transit are duplicated in the laboratory. This allows the engineer to have a first-hand view of what happens to the merchandise during the time it is in transit, and to determine weak points, if any, in the package.

Determining the time, magnitude, and direction of all shocks incurred, as well as the approximate sustained, constant level of oscillation experienced on all three axis. This provides the engineer with a positive, analytical approach to his packaging problem. It also allows the engineer to take the offensive, where justified, when dealing with a carrier.

When the carrier states, "Your product was not properly packaged to withstand the normal shock and vibration environment of our mode of transportation", the packaging engineer has a tangible, concrete reply. With chart in hand he can state, "Our product can withstand the normal environment, but in this case the merchandise was severely mishandled. In fact, at 10:30 a.m. on 09/24/03 the package was dropped on its right side. The recorder indicated a 25G reading and this is equivalent to exerting 1,250 pounds of force (assuming the package weighed 50 lbs., therefore, 50 lbs x 25G) on the bottom of the package. To duplicate this type of reading I have to drop the package, on concrete, in excess of four feet." Laboratory test procedures can be, and often are, used to determine, as well as vividly demonstrate the severity of the shock.

The phrase, "where justified" must be noted. When the product will not withstand the normal environment, the above will not hold true. The GEMM will indicate the unjustified failure of the package and/or product.

The Association of America Railroads (AAR), American Trucking Association (ATA), and Freight Forwarders Institute have adopted rulings concerning concealed damage claims. These rulings vary from payment of only 50% on all concealed damages claimed, to an exposure principal.

The majority of these rulings were passed in the belief that the carriers are not the cause of over half of the concealed damage. It is believed that a considerable amount of concealed damage occurs during shipper's manufacturing, packaging, handling and loading processes, or is caused by the consignee's unloading, handling and storing procedures.

Under these claim procedures it is even more imperative that the GEMM be used to more accurately attribute responsibility for damages.

The GEMM is an invaluable tool in package testing because of its comparatively high frequency response, low rise time requirements, and resulting accuracy.



## HOW TO ORDER A G ENVIRONMENTAL MINI-MONITOR (GEMM)

WHEN ORDERING A GEMM BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

- Specify model numbers and thereby indicating the chart drive mechanism.

MODEL NUMBER	CHART SPEED	DESCRIPTION
GEMM - 14E	1" PER HOUR	14 DAY ELECTRIC DRIVE
GEMM - 33E	½" PER HOUR	33 DAY ELECTRIC DRIVE
GEMM - 60E	¼" PER HOUR	60 DAY ELECTRIC DRIVE
GEMM - 90E	.167" PER HOUR	90 DAY ELECTRIC DRIVE
GEMM - 120E	1/8" PER HOUR	120 DAY ELECTRIC DRIVE
GEMM SPECIAL		1"/MINUTE, 6"/MINUTE, 12"/MINUTE, 2"/SECOND

Battery operated (DC) or electrically operated (AC) Chart Drives are required when faster chart speeds are needed. This option allows for chart speeds of 1" or 2" per SECOND. These speeds produce a record which can be examined for the magnitude of the shock received, as well as the length of time the shock lasts, displacement, and rise time.

- Specify desired G-range for each axis.

X (lateral)            @     \_\_\_\_\_ G.  
 Y (longitudinal)    @     \_\_\_\_\_ G.  
 Z (vertical)         @     \_\_\_\_\_ G.

The recommended maximum sensitivity settings to monitor vehicle movement are:

VEHICLE:	(X) LATERAL	(Y) LONGITUDINAL	(Z) VERTICAL
TRUCK TRAILER	±5G	±5G	±10G
RAIL CAR - STANDARD DRAFT GEAR	±5G	±15G	±10G
RAIL CAR - LONG TRAVEL DRAFT GEAR/CUSHIONED UNDER FRAME	±5G	±10G	±10G

The maximum recommended sensitivity settings to monitor product handling either manual or mechanical are:

<b>OBJECT MONITORED:</b>	<b>"G" SETTINGS - ALL AXIS</b>
PACKAGES - Little cushioning (0 - 50 lbs.)	75 - 100
PACKAGES - Cushioned (0 - 50 lbs.)	50 - 75
PACKAGES - (51 - 100 lbs.)	50 - 75
PACKAGES - (Over 100 lbs.) Fragile with little cushioning	10 - 15
Other	25 - 50
Incline Impact (Conbur) Tester	70

These recommendations will vary depending on the type of product, degree of packaging, and mode of transportation. For example, if a 20 lb. Package was shipped via parcel post, a higher sensitivity rating would be recommended than one used for monitoring the same item being shipped via company-owned trucks.

It is often desirable to have different sensitivity settings for each axis of the GEMM. A large package, such as a refrigerator, will almost always be shipped according to "This End Up" instructions. Accordingly, the recommended settings would be ±15G Z (vertical) and ±10G X and Y (lateral and longitudinal).

All small and lightweight packages which are susceptible to being dropped and thrown should have identical and high sensitivity settings on all three axes.

The standard maximum sensitivity settings are 2.5, 5, 10, 15, 20, 25, 35, 50, 60, 70, 75, 100, 150 and 200G's.

3. Specify quantity of charts.

The 14 day GEMM, GEMM- 14E, has a chart speed of 1" per hour and uses GEMM-34 - 1"-1/2" chart.  
 The 33 day GEMM, GEMM-33E, has a chart speed of 1/2" per hour and uses GEMM-34 - 1"-1/2" chart.  
 The 60 day GEMM, GEMM - 60E, has a chart speed of 1/4" per hour and uses GEMM-34 - 1/4" chart.  
 The 90 day GEMM, GEMM - 90E, has a chart speed of .167" per hour and uses GEMM-34 - 1/4" chart.  
 The 120 day GEMM, GEMM-120E, has a chart speed of 1/8" per hour and uses GEMM-34 - 1/4" chart.  
 This chart has a blank side for use in the faster chart speed GEMMS (i.e. 2" per second, 1" per minute, etc.).

4. Each instrument has the name of the purchaser as well as the purchaser's "return to" address stamped on the nameplate of the GEMM. Include the desired nameplate information on the purchase order.

5. List all optional supplies and parts separately.

**\*\*Please note:**

- The GEMM recorder is NOT weatherproof, weatherproof containers can be purchased at an additional cost.
- The person that is activating the GEMM recorder should write their name-date and time-on the chart, someone at the destination should also write their name-date and time-on the chart.
- Impact Register, Inc. recommends the GEMM recorder be returned to the factory for inspection and recalibration, annually.

## **Impact Register, Inc.**

**1870 Starkey Rd.**

**Suite# 1**

**Largo, Fl 33771**

**Tele# 727.585.8572**

**Fax# 727.586.0532**

**[www.impactregister.com](http://www.impactregister.com)**

**e-mail: [info@impactregister.com](mailto:info@impactregister.com)**

