



Shockmaster®

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THEORY and CHARACTERISTICS

WHAT IS A SHOCKMASTER® ?

Shockmaster® is a low cost, compact mechanical device which may be installed on delicate equipment to monitor excessive shock and vibration, thereby assisting in the detection of hidden damage. When a container is opened, following shipment, there may appear to be no damage. However, if the Shockmaster® is found to be in a "tripped" condition (with a bright red signal band exposed in the dome), it is evident that *excessive shock has been experienced*. Accordingly, a thorough inspection should be made before accepting the shipment.

HOW DO SHOCKMASTERS® WORK?

The Shockmaster® consists of a spring-loaded weight with an integral trigger, which engages with a spring-loaded sleeve, the entire assembly being enclosed in a metal housing with a transparent dome. When a shock occurs, the weight is forced down against its spring. If the shock is of sufficient magnitude, the trigger is disengaged from the sleeve, which in turn is forced by its own spring to move along a rod, exposing a red warning band (see *Figure 1*).

HOW LONG WILL SHOCKMASTER® G-RATING STAY IN TOLERANCE?

Since the springs in the Shockmaster® are never elongated, it will remain in tolerance indefinitely, provided it is not subjected to continuous motion of the moving parts and is not contaminated internally with foreign particles. The Shockmaster® may be reset and used over and over hundreds of times with no change to its G- rating. Some Shockmasters® have been returned for recalibration after 10 years of use, and the units were still within the original factory tolerance.

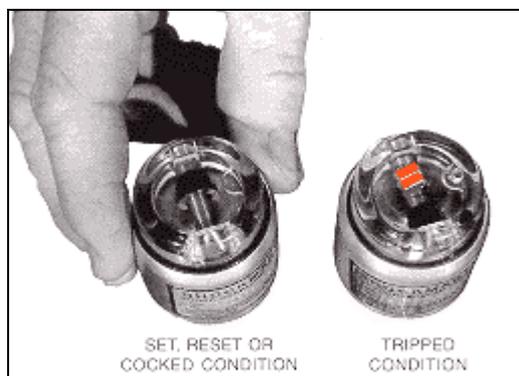


Figure 1

WHAT IS THE SHOCKMASTERS® AREA OF RESPONSE?

The Shockmaster® has a hemispheric response: it indicates shocks from all directions radial to the unit, axial shocks to the base from beneath, and shocks from all directions between these planes (see *Figure 2*). It will not register axial shocks applied to the dome from above. Models are also available with axial (base) response only. Two Shockmasters® are usually sufficient for even the largest of packaged items, and one may be adequate if there is no possibility of the equipment being shocked from above.

IS THE SHOCKMASTER® REUSABLE?

Yes! Shockmasters® may be used over and over again. After tripping, the indicator is reset by removing the screw from the threaded hole in the side of the dome, inserting a stiff wire or straightened paperclip in the hole (see cover illustration) and pushing the black sleeve back to its cocked position. For Shockmasters® with ratings of 25 G's or more, a plunger in the dome is depressed while the sleeve is pushed back as far as possible. The plunger is then released and the sleeve is allowed to return gently to its cocked position (see *Figure 3*, on page 3).

HOW ACCURATE IS THE SHOCKMASTER®?

Standard Shockmasters® trip within $\pm 10\%$ of their settings. On units set for 10 G's or higher, tolerances of $\pm 5\%$ are available at an extra cost. They operate from -800°F to 160°F and are resistant to high humidity.



Figure 2

THEORY and CHARACTERISTICS

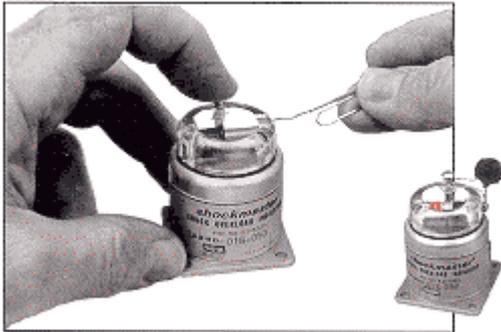


Figure 3

IS THE SHOCKMASTER® TAMPER-PROOF?

Yes! To prevent tampering with the indicator after it has been tripped, a safety wire with an inspector's seal attached can be placed through the resetting hole screws in the plastic dome. Or, inspector's decals may be affixed over the reset holes. Shockmasters® with ratings of 25 G's or more are made tamper-proof by re-inserting one screw, threading safety wire through holes in plunger and screw head and securing with an inspector's seal (see *Figure 3*).

HOW CAN SHOCKMASTERS HELP CUT SHIPPING AND HANDLING COSTS?

In three ways: (1) Shockmasters® can be used to detect rough handling of a product on assembly lines or in other areas of your plant. Corrective measures may then be initiated to improve material handling procedures. (2) The Shockmaster® is an invaluable tool for shock tests to determine proper packaging design and materials. A row of indicators -- each set for tripping at a different G-rating -- may be used in container drop tests, thereby detecting both overpackaging and underpackaging of a product. (3) Terminal inspection time can be reduced substantially, as only those shipments with tripped indicators need be re-inspected in detail.

HOW ARE SHOCKMASTERS® INSTALLED?

Shockmasters® may be mounted on the inside of the container or on the **packaged** item, depending on the information desired. There are four mounting holes in the base for rear mounting (see *Figure 5*, on page 4), or a mounting plate is available for front mounting of the units (see *Figure 6*, on page 4).



Figure 4

CAN SHOCKMASTER® BE INSPECTED WITHOUT OPENING THE CONTAINER?

Inspection may be accomplished by looking at the indicator through a hole with a removable cover in the container (see *Figure 4*). Or, a Shockmaster® with electrical contacts may be used (see *Figure 7*, on page 4). This model can be inspected by placing the leads of an ohmmeter or a battery and light bulb, on the contacts of a terminal board mounted on the outside of the container. If the Shockmaster® is tripped, the ohmmeter will indicate that the circuit is closed, or the light bulb will glow.

WHAT SHOCKMASTER SETTINGS ARE AVAILABLE?

Shockmasters® are available from stock in nominal ratings of 5, 10, 20, 25, 30, 35, 40 and 50 G's. Other settings are available upon request. The standard equal-G models respond equally to shocks along the longitudinal axis and in the transverse plane. The standard long axis models respond to longitudinal axis shock only -- side or transverse shocks have no effect.

SHOCKMASTER® RATED BEST

Independent test facilities have compared various mechanical shock -- monitoring devices. Each time Shockmaster® was rated the *most accurate and easiest to use!* Details available on request.



ORDERING INFORMATION

Part numbers consist of basic numbers, followed by a series of dash numbers designating configuration, nominal G-rating, and certified tolerance.

TA280 ----- [] ----- [] ----- []

Dash No.	Configuration
-016	Equal-G, Rear Mounting
-017	Equal-G, Rear Mounting, Electrical (Normally Open)
-018	Equal-G, Front Mounting
-019	Equal-G, Front Mounting Electrical (Normally Open)
-020	Long Axis, Rear Mounting
-021	Long Axis Rear Mounting Electrical (Normally Open)
-022	Long Axis, Front Mounting
-023	Long Axis, Front Mounting Electrical (Normally Open)

Dash No.	Nominal G-Rating
-005	5 G
-010	10 G
-015	15 G
-020	20 G
-025	25 G
-030	30 G
-035	35 G
-040	40 G
-050	50 G

(Other settings available)

Dash No.	Certification and Tolerance
----	± 10% tolerance, certified
-C5	± 5% tolerance, certified

Example:

TA280-018-015-C5 is an equal-G, front mounting Shockmaster®, set 15 G's with a ±5% tolerance, certified.

(Contact factory for other configurations)

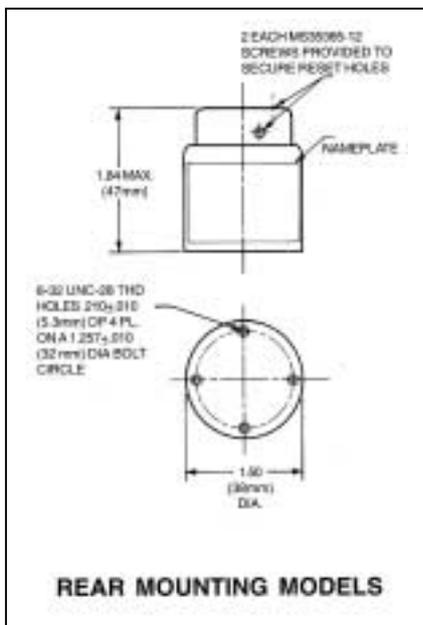


Figure 5

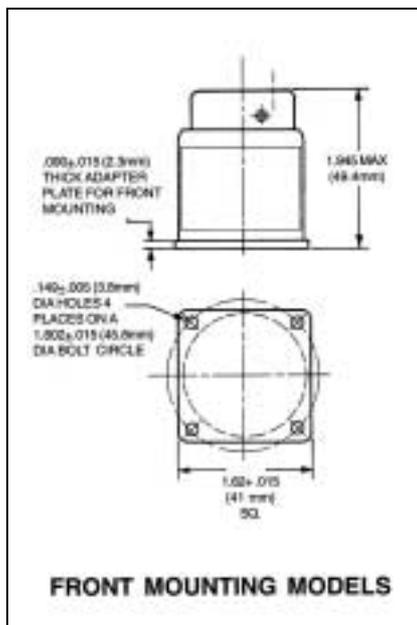


Figure 6



Figure 7

Weight:

Approximately 0.3 lbs. (136 grams), depending upon model.

Materials:

BODY: Aluminium, clear anodised, DOME: transparent polycarbonate.



Shockmaster®

INSTRUCTIONS FOR USE

The **SHOCKMASTER®** shock overload indicator is designed to indicate shock in excess of the rating of a particular Shockmaster® model. It is intended to be packaged with delicate equipment in boxes, crates or containers. If the indicator is “tripped” when the container is opened, it is evident that excessive shock has been experienced, and therefore the shipment should either be rejected or special inspection procedures should be carried out.

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE USING THE INSTRUMENT.

These instructions must be followed to ensure proper functioning and correct interpretation of the results.

1. MOUNTING

Models TA280-016, TA280-020, TA280-017 and TA280-021 can be mounted with 4 No. 6-32 machine screws from the rear (see *Figure 5*, on page 4).

Models having a square adapter plate, such as Shockmasters® TA280-018, TA280-022, TA280-019 and TA280-023 can be mounted from the top with 4 No. 6 wood screws or machine screws (see *Figure 6*, on page 4).

The indicator may be mounted **on the container** or **on the packaged item**. If it is mounted on the container, it will indicate the handling which the package as a whole has experienced. This way of mounting essentially checks on the handling methods. If the indicator is mounted on the packaged item, then the recorded shocks will be less severe due to damping by the packaging materials, such as isolators, foam cushioning, corrugated cardboard, etc. This type of mounting will indicate the amount of shock to which the packaged product was subjected.

Models TA280-016, TA280-017, TA280-018 and TA280-019 are **sensitive to all acceleration forces except those coming from the top** (i.e. passing through the hemisphere occupied by the plastic dome). Two equal-G Shockmasters® **mounted back-to-back** will cover shocks

from all possible directions. For long containers, it will be advantageous to have an indicator at each end of the package.

Models TA280-020, TA280-021, TA280-022 and TA280-023 have longitudinal response and will only trip if subjected to axial shocks applied to the bottom of the Shockmasters® -side or transverse shocks have no effect.

When mounting a Shockmaster® it is important to consider the direction of the anticipated shock. For example, a Shockmaster® with the plastic dome up will trip when banged on a table. In this case, the shock has come from the bottom of the indicator. This impact reflects what would occur if a box were dropped. On the other hand, if an indicator is installed dome-up in a vehicle which collides with an obstacle, the shock would come from the side of the indicator.

2. FUNCTION

The Shockmaster® consists of a spring-loaded weight with an integral trigger which engages with a spring-loaded sleeve. When tripped, this sleeve moves along a guide rod and **exposes a red band** on this rod. The upper periphery of the weight rests against a shoulder. The whole assembly is enclosed in a metal housing and transparent dome.

If the shock is applied to the unit along the long axis, the weight will be forced down against the spring. If the shock is applied from any side direction, the weight tips against the spring. Either movement disengages the trigger from the sleeve, which then moves under the action of its spring, exposing the red band. The indicator is now tripped. It can be reset by inserting a wire, such as a straightened paper clip, into the hole on the side of the dome and pushing the sleeve back to its cocked position. For models of 25G and over, a plunger in the dome is depressed while the sleeve is pushed back (see *Figure 3*, on page 3).

INSTRUCTIONS FOR USE

In most cases, it is advisable to **seal the resetting holes** after resetting. This may be done by inserting 2 No. 4-40 screws with drilled heads into the two holes in the dome, safety wiring them and sealing the wire with an inspector's seal. Shockmasters[®] with ratings of 25 G's or more are made tamper-proof by re-inserting one screw, threading safety wire through holes in the plunger and screw head and securing with an inspector's seal (see *Figure 3*, on page 3).

AGM's guarantee of proper functioning of the Shockmaster[®] under environmental conditions of dust, sand, moisture, etc., is dependent upon the proper sealing of the resetting holes. **CAUTION:** The transparent dome is easily damaged by solvents and thread locking solutions. RTV has been found to be suitable for sealing screw heads against dust and moisture intrusion.

3. SHOCKMASTER[®] INDICATOR WITH ELECTRICAL CONTACTS

Models TA280-019, TA280-021 and TA280-023 with electrical contacts can be used to check the Shockmaster[®] condition inside a package without opening it. If this type indicator is enclosed inside a box or attached to the packaged item, wires can be run to the outside of the box and terminated there, either in pigtailed or in suitable connectors. These wires must be crimped to the terminals on top of the dome. Polarity is immaterial. The condition of the indicator can then be determined from the outside by a simple continuity check with a portable ohmmeter, for instance, or with a dry cell and a light bulb. The contacts will be closed when the Shockmaster[®] is tripped.

4. TESTING

If the Shockmasters[®] have to be tested for conformance with performance specifications published here or elsewhere, the tests must be carried out in accordance with AGM's test specifications. These specifications will be made available on request.

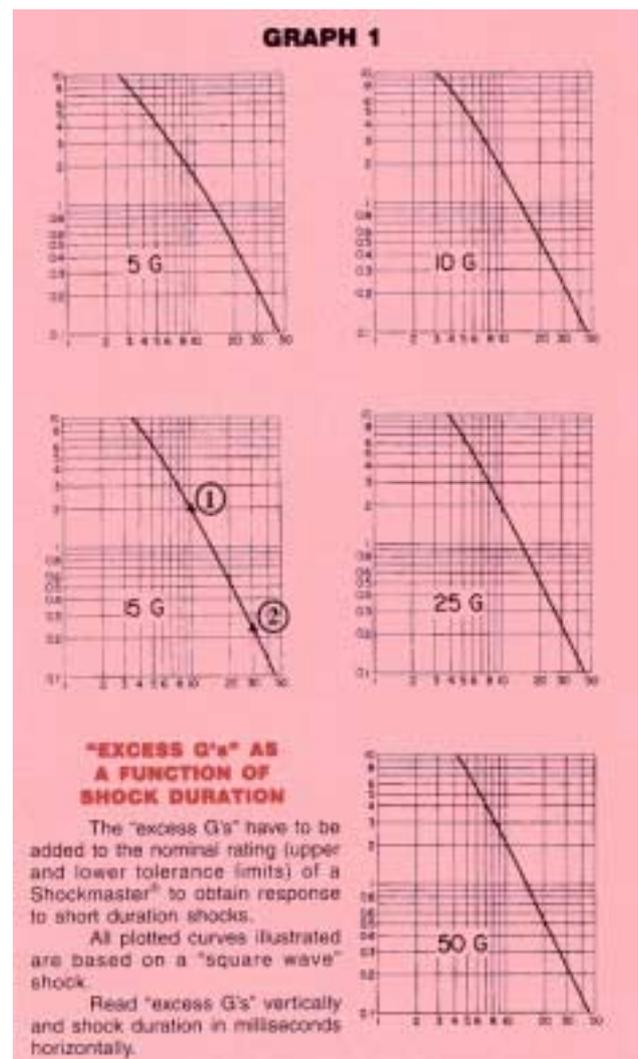
5. RESPONSE

The nominal rating is defined as the acceleration along the longitudinal axis (expressed in G's) necessary to trip the indicator mounted with axis vertical in gravity free space when applied for infinite time.

The response of the unit to a shock will vary with (A) the duration of the shock or (B) the effects of gravity and shocks coming from directions at an angle other than the indicator's longitudinal axis or transverse plane.

A. If the duration of the shock is short, say below 30 milliseconds, an acceleration in excess of the nominal rating will be needed to trip the unit. The following graphs approximate the "excess G's" required as a function of the shock duration for the most common G-ratings. These graphs are based on a "Theoretical square wave" type shock. The "excess G's" have to be added to the nominal rating to obtain the response to short duration shocks.

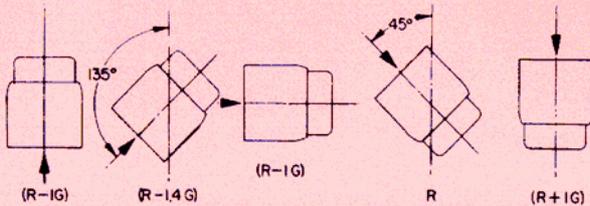
EXAMPLE: ① A 15G Shockmaster[®] exposed to a 10 millisecond shock impulse will require 17 G's (15 + 2) to trip, whereas ② exposure to a 30 millisecond shock pulse will require only 15.25 G's (15 + .25).



INSTRUCTIONS FOR USE

B. Due to the effect of gravity, the attitude of the unit to the vertical varies the magnitude of tripping acceleration required. The relation of the direction of the applied acceleration to the vertical and the unit axis, also varies the magnitude of the tripping acceleration.

Case 1. Assuming the shock is applied along the axis, the required tripping shock will depend on the inclination of the axis to the vertical due to the effect of gravity, as shown in the following diagrams. The effect of friction within the unit is disregarded for this illustration.

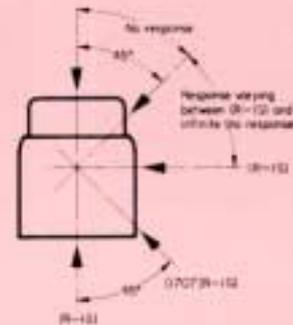


GRAPH II

R = nominal rating
 ↑ = shock direction
 G = unit of earth's gravitation

INFLUENCE OF GRAVITY

Case 2. If there is an angle between the direction of the shock and the axis of the Shockmaster®, there is a vectoring effect, and the shock necessary to trip the unit can be as little as .707 (at a 45° angle) of its nominal setting in accordance with the following diagram, which assumes the indicator axis to be vertical and includes the effect of the earth's gravitation for this case. The values shown disregard the effect of friction within the unit.



GRAPH III

R = nominal rating
 ↑ = direction of shock
 G = unit of earth's gravitation

RESPONSE TO OBLIQUE SHOCK

Case 3. The effects of cases 1 and 2 may be combined and even further complicated by having the vertical, the longitudinal axis and the direction of the shock not in the same plane. Also, units with sensitivity only in one direction present a special situation. The effects of friction may be disregarded in settings of 10 G's or greater.

C. Tolerance of the rating $\pm 10\%$ or $\pm 5\%$ *. Indicators are certified to be inside the specified tolerances when mounted as shown in Graph III above. Tolerances and certification are indicated by the model number. For instance:

TA280-016-010 = Nominal rating of 10G,
 Accuracy $\pm 10\%$, certified.

TA280-016-010C5 = Nominal rating of 10G,
 Accuracy $\pm 5\%$, certified.

*5% tolerance not available on settings below 10G's