

Development of a Frequency Weighted Portable Ride Meter—SAE J1225

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DEVELOPMENT OF A FREQUENCY WEIGHTED PORTABLE RIDE METER—SAE J1225

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Report of Joint Seating Subcommittee approved June 1978. Rationale statement available.

Purpose—The purpose of this report is to record the activities and recommendations of the Ride Meter Task Force assigned by the Chairman of the SAE Joint Seating Subcommittee to determine availability of instrumentation to measure operator ride on mobile equipment. The desired characteristics of the meter included relatively low cost, easy to operate, highly portable, and sufficiently rugged to withstand the vibration levels encountered on agricultural or construction machines. It is recognized that a ride meter type instrument with a single numerical output provides only approximate indication of ride vibration quality, but is useful for general field evaluation or overall ride comparisons. A narrow band analysis of the vibration frequency spectrum is recommended for more accurate and complete results.

Scope—The task force was assigned responsibility for the following activities:

1. Formulate a recommendation for an acceptable ride meter including features, functional performance, and design specifications.
2. Conduct a survey to determine if there is a commercially available ride meter conforming to the recommendation.
3. If an acceptable ride meter is not commercially available, work with an electronics supplier to initiate a design and build a working prototype of a meter conforming to the recommendation.

Conclusions

1. A compact, single channel, ride meter which provides the desired readout in frequency weighted RMS acceleration was developed by the task force in conjunction with Endevco. A block diagram of the ride meter is shown in Fig. 1. The general size and configuration of the meter is indicated in Figs. 2 and 3.

2. The ride meter provides the following features:

- (a) A simple to operate, mobile, self-contained instrument to measure acceleration at operator-seat interface.
 - (b) Readout of frequency weighted RMS acceleration directly in meters/second².
 - (c) Readout elapsed time of test in seconds.
 - (d) Manual or automatic test timing.
 - (e) Visual and audio signals are provided for indicating over ranging, low batteries, and end of test.
 - (f) Provide signal conditioned data to magnetic tape for use to generate narrow band, or 1/3 octave band spectra, or histograms with appropriate supplemental equipment. This data is available either unfiltered or filtered.
 - (g) Provision to inter-connect ride meters to provide multi-channel measurements.
 - (h) Plug-in interchangeable frequency weighting filters.
3. None of the commercially available ride meters met the task force requirement of a direct readout of the frequency weighted RMS acceleration per SAE J1013. They provided a readout of the voltage which was a squared function of the input signal over the accumulated time period for the test.

Procedure—The procedure used in establishing the availability of commercially obtainable units was to write to all known suppliers and sources of information on ride meters. Each member of the Ride Meter Task Force submitted a proposal on the electronics and functions of the ride meter to the Chairman. A meeting of the task force was then held and a mutually agreeable set of specifications on the ride meter was formulated. A conclusion from this meeting was that none of the known ride meters, available at that time, would meet the specification, nor were any available for evaluation. The specifications were reviewed with several electronics suppliers. Only one company would undertake the project.

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

Endevco reviewed the specifications and compiled a proposal using available components. The task force reviewed the specification proposed by Endevco, made necessary revisions, and asked Endevco to fabricate a prototype for evaluation. The prototype unit was evaluated by each of the task force members. Upon completion of this evaluation, the task force spelled out the final specifications for the ride meter. A second prototype conforming to the final specifications was then fabricated and submitted for approval. This unit has been reviewed by the task force and by the Joint Seating Subcommittee members.

Ride Meter Specifications

Readout—3 1/2 digits liquid crystal 0.5 in high letters¹:

(a) Frequency weighted RMS acceleration in meters/second² for the test duration.

(b) Test duration time in seconds.

Temperature—Operating—0–43°C; Storage—-40–+65°C;

Accuracy—5% of reading for a reading equal to or greater than 1.15 m/s² for vibration in the range from 1–80 Hz.

Weighting Filter—Meets SAE J1013 specifications for frequencies in the range from 1–80 Hz. Filter response for acceleration in the vertical (a_z) direction is shown in Fig. 4.

Maximum Run Time—Front panel selectable from 1–999 s.

Auxiliary Output—0.1 V/m/s² 3.3 crest factor unfiltered (BNC); 0.1 V/m/s² 3.3 crest factor filtered (BNC).

Full Scale—19.99 m/s².
Appears on display when system is in the run mode and data accumulating is above a threshold of 0.1 m/s².

Zero Adjustment—A locking potentiometer with a knob provides bridge balance.

Calibration—A locking potentiometer with a knob provides sufficient resolution and adjustment range for setting a 19.6 m/s² transducer turnover (2G) calibration.

Push to Test and Calibrate Switch—A momentary switch when pressed in one direction initiates a self test function and when pressed in the other direction initiates a calibration function. When the switch is released the instrument is in the run mode.

Buzzer—Sounds at 19.99 m/s² amplitude to indicate over range; sounds at 999 s to indicate that maximum time has been exceeded; sounds for 2 s at end of a data run when used in the automatic mode; sounds in 1 s tone bursts when battery charge is close to being insufficient for the electronics; shuts off when stop button is depressed.

Battery—Can be recharged from a separate charger on the bench. Cannot be recharged while installed in the instrument.

Versatility—Bridge completion resistors are placed on bifurcated terminals. The series limiting resistor in the bridge balance network is on bifurcated terminals.

Connectors to permit operation of many units from one master unit is provided. Any unit in the chain may act as a START-STOP master unit.

Diode protection on the battery power input lines is provided to prevent damage to the unit from inadvertently reversing power from a lab bench type 12 V power supply.

The ride meter frequency weighting filter is on a plug-in board which may be replaced with a jumper board permitting filter bypass, or a different filter.

Mechanical—Size 241 mm wide, 86 mm deep, 213 mm long. All switches and controls are dustproof. Start and stop buttons are separated for convenient operation.

Shipping container is provided which will protect unit during transit.

Battery Charger—To be provided with system; 115 and 230 V input.

¹ A 3 1/2 digit display refers to a display consisting of 4 distinct digits in which 1 digit, in this case the first, is limited to 0 or 1 readout. This has the effect of limiting the readout range from 0–19.99 m/s².