

# *EVA-625 Elevator Vibration Analysis system*

## **Ride Quality Measurement & Analysis for the Elevator/Escalator Industry**

PMT's EVA-625 Elevator Vibration Analysis system and [EVA Vibration Analysis Tools software](#) has quickly become the global standard for the measurement of elevator and escalator ride quality, and vibration & sound. Designed to meet international standards for the recording and analysis of elevator and escalator vibration and sound, only the EVA system allows all elevators and escalators to be measured, analyzed, and documented absolutely, easily and at a [Very Low Cost](#). Through continuous refinement & enhancement, the EVA system remains the product of choice for the measurement and analysis of elevator/escalator ride quality, and vibration & sound, while PMT has become the world's number 1 supplier of high accuracy instrumentation for the vertical transportation industry.



- **Quantify Elevator/Escalator ISO Ride Quality**
- **Measure Acceleration/Deceleration, Speed, Jerk**
- **Identify & Locate Rail & Joint Misalignment**
- **Diagnose Bad Roller Guides**
- **Document Pre/Post Modernization Changes**
- **Troubleshoot Sheave, Ropes, Counterweight**
- **Assess Drive & Controller Function**
- **Document Elevator Performance Baseline**
- **Year to Year Elevator Operation Comparison**

**Elevator & Escalator System Quality Control, Diagnosis, & Inspection** - Elevator ride quality is a first indicator of quality design, installation, and service. The EVA system includes powerful tools to assist in quality improvement in all areas of the elevator mechanical and control system. The highly accurate response of the EVA system, and the analysis capabilities offered by the EVA Vibration Analysis Tools software allow technician to engineering level personnel to rapidly identify problem areas and perform corrective actions. Only the EVA system provides the ability to measure the vibration and sound that people feel and hear and analyze the broad-band vibration and sound that is the result of the function of all dynamic aspects of the elevator system. With a little practice, problems with roller guides, rail joints, motor control systems, and other dynamic elements can be identified in minutes and repairs targeted precisely. Quality of installation and service can be improved dramatically. Because of the simplicity of the EVA system and the information that is returned, the EVA-625 offers unmatched capabilities as an inspection and fast survey tool. The condition of the elevator can easily be compared year after year.

**Field Operations with a Field Tough Instrument** - The EVA system is particularly easy to operate, both in the field and in the office. About the size of a notebook computer, operation is simple and fast. The system can be configured for use on site, without having to carry a PC with you. Simply place the EVA-625 on the floor of the elevator, turn it on, press the record switch, and 'take a ride'. The data is automatically stored in non-volatile memory with room for over 700 seconds of data. An entire bank of elevators can be recorded in minutes. The EVA system is rugged enough so that it can go anywhere at anytime with few concerns. Shipping and field operations with a high accuracy instrument are no longer a worry.

**Removable 3-Axis Acceleration Sensor** - An important EVA-625 design innovation is the removable triaxial accelerometer package (RSB). It can be left within the EVA case for simple ride quality analysis, or the sensor can be removed for attachment to specific elevator mechanical elements. This allows isolated measurements of the vibration response of specific elevator structural members and components such as roller guides, motors, and gear boxes.

**Warranty & Support** - The EVA system is provided with a full one year warranty. Software updates will be available to each registered user as new versions become available.

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## EVA Vibration Analysis Tools Software

### Science in the Software

- Operations under Windows 3.x, Windows 95 and Windows NT
- ISO Human Response, Acceleration, Sound Level, Speed, Jerk, Distance Time Histories Display
- Spectral Analysis Capability, Software Selectable Filters & Sampling Rate
- ISO Human Response Analysis & User Selectable Digital Filtering
- User Defined Units of Measure & Graphical Scaling, Box Zoom & Scroll,
- Project Specification Analysis, Data Base Compilation
- Multiple Report Printing including Peak to Peak Vibration, Max/Average, Sound Max/Average
- Elevator Performance Measurements

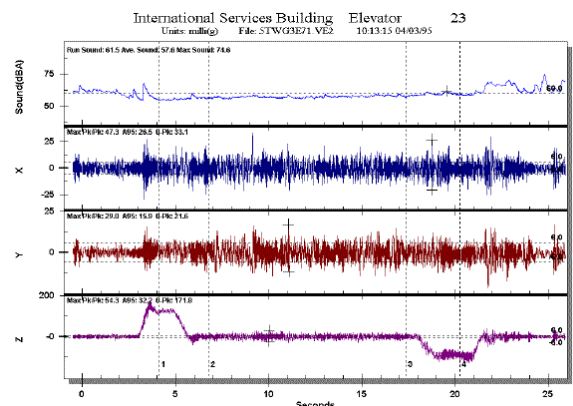
### Elevator Tools

The included EVA Vibration Analysis Tools software is a powerful suite of analytical tools for elevators and escalators in a fully integrated Windows™ based environment. It offers unmatched analysis of all elevator/escalator motion and sound levels, yet is easily used by the engineering or non-technical staff. Using PMT proprietary methods for automatically extracting information from the vibration recordings, ride quality levels, speed, elevator location, acceleration/deceleration, jerk, and sound levels can be evaluated in seconds. An extremely important feature of the software is the ISO Ride Quality Analysis. It must be remembered that ride quality is not measured by the vibration and sound that the instrument records, but rather by the vibration and sound that people feel and hear. PMT is the first and only company to apply ISO2631 based filtering of the vibration data to get a measure of the vibration that people feel. When diagnosing for ride quality purposes, it is important to improve the vibration that people feel. Analytical capabilities include time history zoom and expand with data measurement, elevator travel time measurement, comparison of data with respect to user imposed vibration limits, spectral analysis (FFT), and RMS vibration and sound level measurement (A-weighted, fast response). Of course, the EVA software also prints standard reports on your office printer.

### Escalator Tools

The EVA-625 and EVA Vibration Analysis Tools are also optimized to evaluate escalator vibration on hand rails and steps, as well as to meet the special requirements of measuring sound levels at the landings, incline section, and machine. It also leads the operator in measurement of ambient sound level. An optional extension of the EVA-625 is the ETCH01 Tachometer module. This is used for the measurement of handrail & step speed so that differences can be evaluated and addressed. An important feature of the ETCH01 Tachometer and the optimized EVA software is the ability to quickly and accurately measure stopping distances.

The graphical output on the right is actual elevator data as collected by the EVA-625 system. This is the raw, unfiltered data from which all analyses are derived. The graphs are divided into 4 windows. The top window is the sound level at every point in time during the recording. The second window (x channel, front to back) is the motion (in units of milli (g)s) at each point in time during the recording. The third window is the motion as recorded on the y channel (side to side), and the bottom window is the vertical axis (z channel).



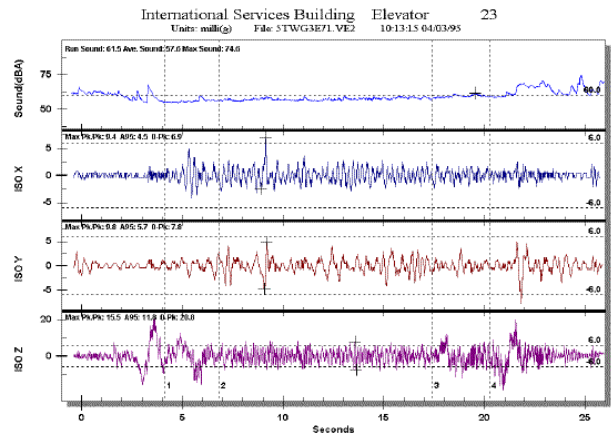
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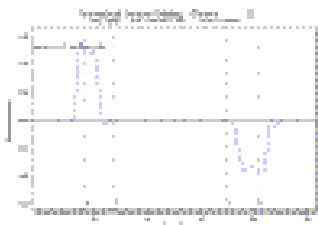
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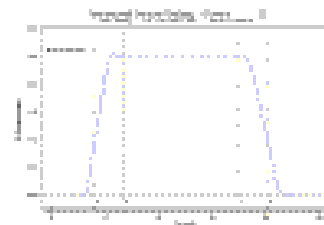
The graphical on the right output is the raw motion data after being filtered using the ISO standard. This is the analysis used for the measure of ride quality. An increase in the level as seen on the graphs corresponds directly with an increase in what is felt in the elevator. Note the bumps that stand out on the x and y channels at about 9 seconds. This is the result of a misaligned rail joint. Using the distance analysis, the problem was located at 12.5 meters (41 feet) above the first floor.



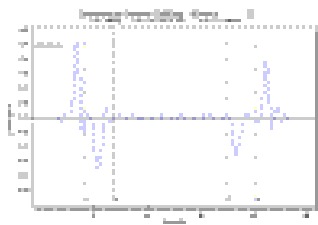
Below are Thumbnail sketches of the four Time Histories which can be derived from the unfiltered vertical axis time history. These are each a measure of elevator performance. While in the EVA Vibration Analysis Tools software, the information can be expanded for study in great detail. For instance, using the Distance Time History, "bumps" as seen in the above "ISO Filtered Data" graph can be located in the hoistway with a high degree of accuracy.



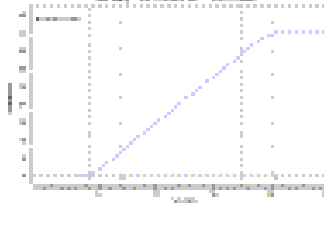
Acceleration Time History



Velocity Time History

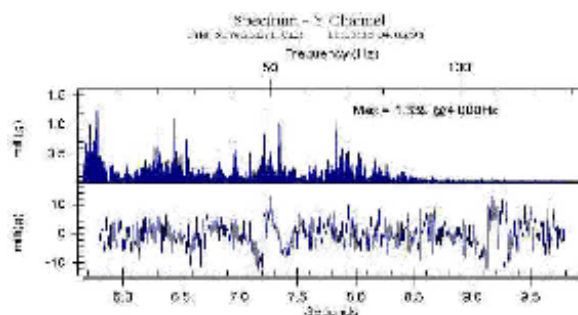


Jerk Time History



Distance Time History

Probably the most powerful tool for diagnosing problems is the Fourier transform. This allows the vibration to be analyzed with respect to frequency content. For example, 6 inch roller guides on a 2.5 m/s elevator will rotate about 5.3 times per second (5.3 Hz). If roller guides are creating a significant level of vibration, then this will show up in the spectrum (vibration level versus frequency) of the signal. The example below shows both a high vibration level at about 5 Hz (roller guides) and 26 Hz (gear mesh).



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## **EVA-625 Accessories**



**ETCH01 Tachometer Module** – Although the EVA system accurately calculates elevator velocity and distance in elevator systems without the need of a tachometer, there are times when speed must be measured precisely in constantly moving systems such as escalators. To meet these needs, the ETCH01 tachometer is an extension to all EVA-625 systems. This provides the ability to measure & record, or display in real time, direct drive speed measurements for escalator handrails & steps, escalator stops, elevator doors, or any moving system.

## ***IMD-1 ESCALATOR Step/Skirt Performance Index Device***

***The World's Standard of Measurement . . .***

### ***Escalator Step/Skirt Performance Index***

#### ***Escalator Entrapment Potential Evaluation & Analysis***

PMT's IMD-1 Step/Skirt Index Measurement Device is the standard for evaluating entrapment potential on escalator systems. The IMD-1, in combination with the EVA-625 (or MMC-1) system, and EVA Elevator & Escalator Analysis tools software, allows the complete evaluation of the newly defined step/skirt performance index (A17.1-2000). The index is meant to provide a quantitative measure of entrapment potential based on both the loaded gap and coefficient of friction.

- **Step/Skirt Index**
- **Loaded Step/Skirt Gap**
- **Coefficient of Friction**
- **Real Time Evaluation**
- **Recording/Documentation**



The Step/Skirt Performance Index was defined under a multi-year study with the purpose of establishing measurable parameters that affect the potential for entrapments on escalators. Entrapments in this case include finger/hand, calf, and shoes trapped between the escalator step and skirt. Based on empirical data, it was determined that the gap between the step and skirt, and the coefficient of friction (skirt panel and skin/shoes) were quantities that had a significant affect.

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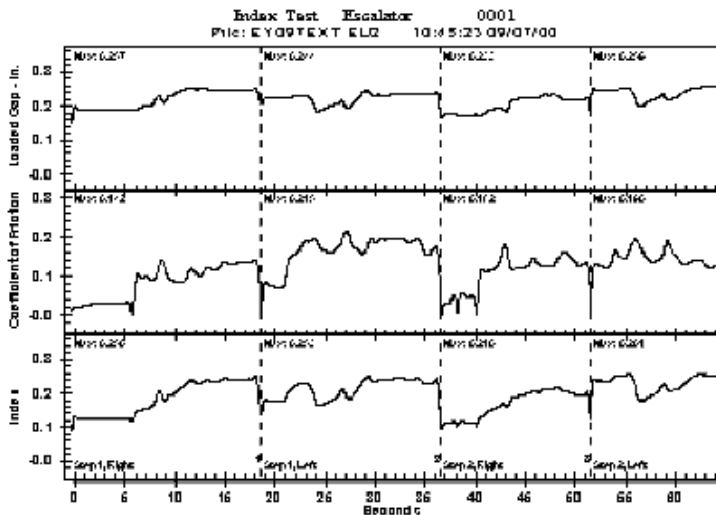
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## Step/Skirt Performance Index

The step/skirt performance index is calculated from the measurement of two quantities and is defined only for the inclined section of the escalator. The first quantity is the loaded gap ( $L_g$ ). This is the distance between the edge of the step and skirt, while the step is 'pushed away' from the skirt using a force of approximately 110 N (25 lbs). The second quantity measured is the coefficient of sliding friction ( $\mu$ ) between the skirt panel and a standard polycarbonate test sample (PMT supplied). The Index is defined as:



$$\text{Step/Skirt Performance Index} = e^y / (e^y + 1)$$

$$\text{Where: } y = -3.77 + 2.37(\mu) + 0.37(L_g)$$

$$e = 2.7183$$

$$(L_g \text{ in mm})$$

This is an example of an Index Measurement Time History (EVA Software). The values of loaded gap (upper graph) and coefficient of friction (middle graph) are used, at each point in time, to calculate the Step/Skirt Performance Index (lower graph) using the formula above. Measurements are made on each side of two representative steps (total of 4 measurements).

**IMD-1** PMT's IMD-1 is the first instrument commercially available, designed to accurately and reliably evaluate and analyze the Step/Skirt Performance Index. The IMD-1 is attached to the selected step and is connected to an existing EVA-625 system (v.6 firmware or later) or PMT's MMC-1 (Multi-Measurement Controller). The EVA functions as the data recorder/real time display for the IMD-1. When convenient, the data can be downloaded to your PC and analyzed using the EVA Elevator/Escalator Analysis Tools software.

**Analysis** Although the implementation of the Step/Skirt Performance Index is primarily designed to improve safety on escalators, the use and analysis of the Index measurements offers other significant advantages as well. The analysis of the recorded data offers the ability to vastly improve and document quality control procedures in the production and field service of escalators. The immediate feedback ensures that manufacturing and field personnel will adjust and maintain gaps properly.

## Specifications:

- Sensors: Linear Position/Cross Axis Force
- Range: Linear Position 7.6 mm (.300 in.)
- Cross Axis Force 111 N (25 lbs.)
- Resolution: Linear Position 0.04 mm (0.0015 in.)
- Cross Axis Force 0.04 N (0.008 lbs)
- Normal Force: 112 N (25 lbs.) +/- 9 N
- Friction Face: LEXAN® 100 Polycarbonate Equivalent
- Weight: 3.6 Kg
- Housing: Coated Steel

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