

FMVSS Part 581 Bumper Test System

Purpose

Federal Motor Vehicle Safety Standards (FMVSS) Part 581 specifies requirements to minimize damage to the front and rear ends of passenger cars in low-speed collisions. The equipment described will perform tests according to the FMVSS Part 581 specification, plus perform other Research and Developmental Testing.

Description

Two different test devices are required to perform Part 581 tests: A Pendulum Tester and a Barrier Impact Tester, described as follows.

Pendulum

The pendulum tester consists of a large steel frame that supports a swinging mass via a parallelogram linkage. The mass frame supports contact planes and an impact ridge conforming to the Part 581 Bumper Standard. The height of the impact ridge is infinitely adjustable by motor-driven screw jacks, located at the corners of the support frame, in a range of from 15 to 21 inches. Mass plates can be added or removed to adjust the pendulum mass from 1200 to 4500 pounds. Impact speeds of up to 10 mph (16 kph) can be obtained by drawing the pendulum pull-back cable to a pendulum angle of up to 45° before releasing the quick-disconnect holding latch.

Instrumentation, consisting of 8 ea 2,000 lb load cells, 3 ea 25,000 lb load cells and 4 ea 10 g accelerometers to record the inertia-compensated contact forces of up to 20,000 on each contact plane and to 60,000 lb on the impact ridge. Computer calculations include bumper contact force, pendulum and vehicle velocities, vehicle deflection, and energy transfer.

Computer, printer, and control electronics are housed in a vertical rack enclosure especially prepared for electronic instrumentation

Low-Speed Barrier

A 25 Hp programmable acceleration/velocity DC motor and winch cable system propels a test vehicle at speeds up to 10 mph along a 23.5 m guide rail. The vehicle is then released and impacts the 30 ton capacity load barrier. A laser optical speed trap measures the impact velocity. Impact force, vehicle acceleration and bumper (vehicle) deformation are recorded by the computerized data acquisition system (DAS).

The 25 Hp programmable motor is speed controllable to within $\pm 0.01\%$ error. Normally the maximum test speed is limited to 16 kph for all vehicle masses up to 3000 kg. Maximum system speed capabilities are

Vehicle Mass (kg)	Max Speed (kph)
1000	32
1500	30
2000	26
2500	23
3000	21

The barrier is made of a steel frame imbedded in concrete and measures 1.5 m high x 1.5 m deep x 3 m wide.

Optional Front-into-Angle-Barrier and Rear-into-Pole test fixtures are also available and are detailed in the following Insurance Institute for Highway Safety Report, "Low-Speed Crash Test Protocol."

Additionally, an optional test cart is available for mounting bumper systems for impact by either the Pendulum

TMSI

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or Barrier Testers. Cart mass may be varied using mass plates and impact data are recorded by load cells and accelerometers.

Control System

All electronic control and data acquisition systems provided by **TMSI** are integrated completely for control by a single PC with Windows® 95/NT-based software for intuitive operation with minimal operator training.

TMSI MicroTeStation™ housed in 20.5 W x 72 H x 24 D inch instrument rack enclosure. Includes:

- Intel 80686 Pentium® Based Microprocessor Industrial Computer
- Standard Hard Disk Drive
- Single 3.5 in. Floppy Disk Drive
- A Removable Disk Drive for Data Archival and Storage
- Random Access Memory
- SVGA Color Monitor
- Windows® 95/NT Operating System
- 32 Chnl A/D, DIO On-board data acquisition/reduction system
- 16 Chnl Anti Alias Filters
- Telephone Modem
- Color Printer

Data Acquisition/Control

Parallel CPU full-time data acquisition/control processing is accomplished by MicroStar Data Acquisition Processors (DAP) which feature on-board CPU and memory as well as Analog to Digital and Digital to Analog converters. Closed-loop digital PID control is achieved on-board the DAP unit for full software tunability of the DC motor drive in velocity and acceleration feedback control.

- MicroStar DAP 3000/16 Data Acquisition Processor to operate in parallel with the Pentium Based Microprocessor
- ComputerBoards CIO/DIO 24 SSR, Solid State Relays for sensing and controlling digital inputs and outputs

A single control console and computer operates both the Pendulum and Barrier Testers.

Software

ImpactTEST™ is **TMSI's** data acquisition/reduction program to operate the on-site MicroTeStation in Windows 95 presentation, control tests according to FMVSS Part 581; reduce and present tabular and graphical reports, and archive tests results to hard or floppy disk.

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