Taking the Guesswork **out of Truck Scale Design**

How well will your product be working 20 years from now? This is a question that haunts engineers involved in developing new products and is one of the toughest questions to answer. At METTLER TOLEDO, a unique machine was constructed to supply timely and reliable answers for the engineers who design truck scales.

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This machine, the Module Masher, is an accelerated-life-cycle test stand for truck scale modules. It can simulate 20 years of weighing within a matter of weeks, providing valuable test data quickly. First used in 1992, the Module Masher was designed and built by the engineering and manufacturing staffs at the Industrial Heavy Capacity manufacturing facility in Columbus, Ohio.

The base of the Module Masher is constructed of steel I-beams, with two beams overhead. The overhead beams support four hydraulically operated feet, which can apply forces up to 120,000 pounds. Attached to the bottom of each foot are two rubber pads, which allow each foot to apply a load, as two tires mounted side by side on an axle would distribute it. Tests are performed on an individual truck scale module, which is positioned on the base of the Module Masher.

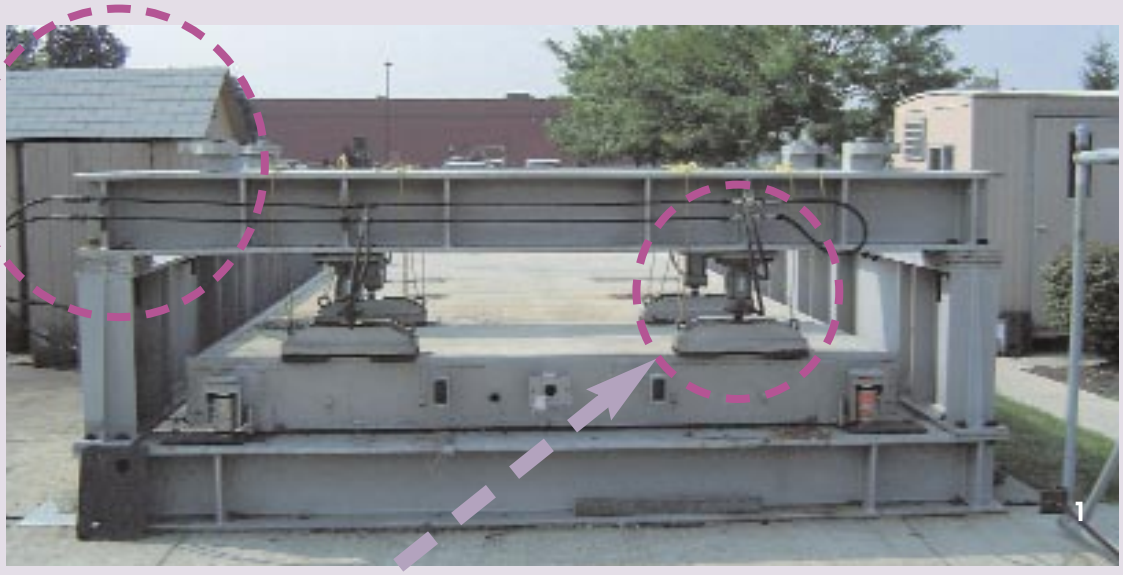
For a typical test, the feet are positioned to simulate the load applied by a dual tandem axle. That common arrangement consists of two axles spaced 4' apart, forming a rectangle measuring 8' by 4'. METTLER TOLEDO truck scales are designed with specific dual-tandem-axle ratings. If a truck scale is rated at 80,000 pounds, for example, it must be able to weigh a dual tandem axle that applies a load of 80,000 pounds. To reproduce the conditions of an actual installation, the module is supported only at the four points where it would normally rest on load cells. The Module Masher's feet are then set to apply a force equal to the scale's dual-tandem-axle rating. The standard test procedure consists of two stages, stress testing and life-cycle testing.

Stress Testing

The first test usually run on a prototype scale measures the amount of stress that a load places on the module. The engineers attach strain gages to the module at key locations on the deck plate, end plates, and ribs. Then with the load applied to the module, they take a reading from each strain gage. Loads can be applied in different locations to find out how the module reacts to a shifting load. Because the load does not need to be applied repeatedly, stress testing is a fairly quick procedure that can be completed within two days.

Life-Cycle Testing

The second test run simulates the amount of traffic that would pass over a scale during its expected service life. This requires applying a load repeatedly to the same location on the module. The feet press down on the module and are then raised until there is no load on the module. This simulates the action of a loaded truck driving onto the scale to be weighed and then driving off the scale. The Module Masher can complete one load/unload cycle in three seconds. The length of time that the load is on the module does not matter because the stress is the same whether the load is applied for several seconds or several minutes. With the Module Masher running constantly, a test of 1.5 million cycles can be completed in only



52 days. That means that the module can be subjected to the equivalent of 20 years of truck traffic in less than two months.

After the standard tests are done, the engineers can also perform destructive testing. These specific tests involve increasing the force applied by the feet and continuing the life-cycle test to find out when the module will fail. Another option is to move the feet so that they apply the load at a specific location on the module. For example, the feet can be positioned at the end of a module to test the strength of its end plate.

Test Results

The standard test results help the engineers evaluate the design of the scale and determine the potential for failure caused by metal fatigue. The strain gage readings indicate how much stress is being placed on the module at various locations. If there is more than the allowable stress at any location, then that part of the module will need to be reinforced and strengthened. On the other hand, if the stress level is significantly lower than the allowable stress, it might be possible to redesign the scale to reduce costs.

In extreme cases, the module could develop a crack during life-cycle testing. That would be a clear indication of a weak spot that needs to be strengthened. If the module meets all allowable stress requirements and shows no damage after life-cycle testing, there should be no need to change the scale design.

Because of the intense competition in the truck scale market, it is important to offer a range of products to meet the needs of customers in different market segments. By taking much of the guesswork out of the design, the Module Masher has helped METTLER TOLEDO develop a selection of distinct truck scale offerings that strike a balance between cost and durability, while offering the best guarantee in the industry.

Photo Captions

1. Shows the Hydraulically operated feet
2. Control panel
3. Entire Module Masher
4. One of the hydraulically operated feet
5. Shows a dual tandem axle on a truck. The feet on the Module Masher are spaced to simulate how this type of axle arrangement applies a load to a scale