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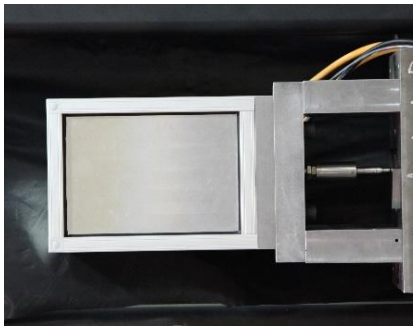
Technical Information
MPM Instrumented Indentation System (I2S)

MP Machinery & Testing, LLC (MPM) is pleased to provide this information package in response to your request. The MPM I2S is used to measure uniaxial yield stress (YS), ultimate tensile strength (UTS), and Brinell hardness (BHW) from a non-destructive surface indentation. It can be used to quickly and cost-effectively test in-service components and structures and it can be used in the laboratory for routine testing. One significant advantage is that the method does not involve machining of a test specimen, such as a tensile specimen. The test data are automatically acquired by indentation loading within about 20 seconds. The I2S applies the load, acquires the data, and provides results without any operator interaction. Several example applications follow.

Application to Steel Plate Mills

Steel plate is often produced from rolls requiring oxide breaking and shear cutting after thermomechanical treatment. The I2S-PM is being used in real-time on the production line to measure the tensile properties and optimize the oxide breaking and shear cutting variables plate-by-plate.



Application to In-service Components and Structures

The I2S-FA is being used to measure tensile properties of buried pipe to assess the effects of aging. The I2S-FA can also be used to measure localized tensile data in cases where damage has occurred as in railroad tank car collisions or bridge structure damage.



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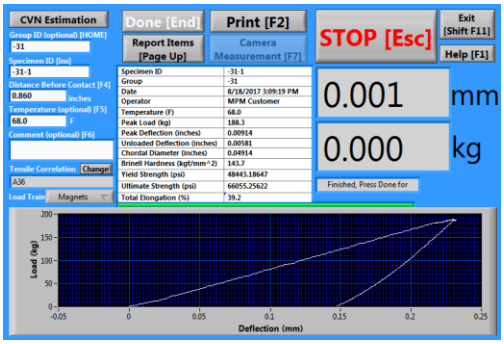
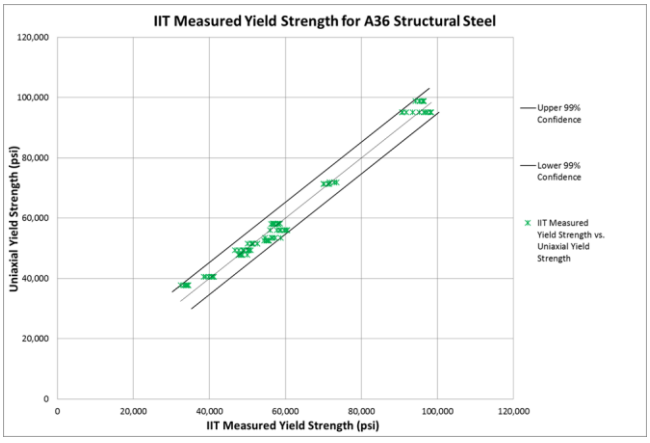
Laboratory Applications

The I2S-LM can be used in routine laboratory tensile data measurement and Brinell testing. The I2S-LM offers significant advantages over conventional Brinell testing which involves optical measurement of the indentation diameter. Material ploughing and sinking-in effects often do not provide a definitive boundary for accurate diameter measurement. The I2S-LM, on the other hand, has superior accuracy because the BHW is determined solely from applied load and deflection data. The laboratory system includes a hardened specimen support for test coupons of any size up to 3 inches x 3 inches. No special fixturing or clamping is necessary. If the system is ordered with the optics option (I2S-LM-OB), specimen supports are provided for automatic alignment of the indentation.



ASTM Standards and Precision

The MPM I2S fully satisfies ASTM Standard E2546, “Instrumented Indentation Testing,” and the applicable portions of ASTM Standard E10, “Brinell Hardness of Metallic Materials.” The Brinell measurements made with the I2S are within the precision data reported in ASTM E10. Further, it has been demonstrated that the I2S equipment yields data that are consistent with the scatter in uniaxial tensile measurements (ASTM E8). For example, data for an A36 structural steel alloy resulted in an uncertainty of about 5 ksi at the 99 % confidence interval, whether it is measured by uniaxial E8 testing or by the I2S indentation test.



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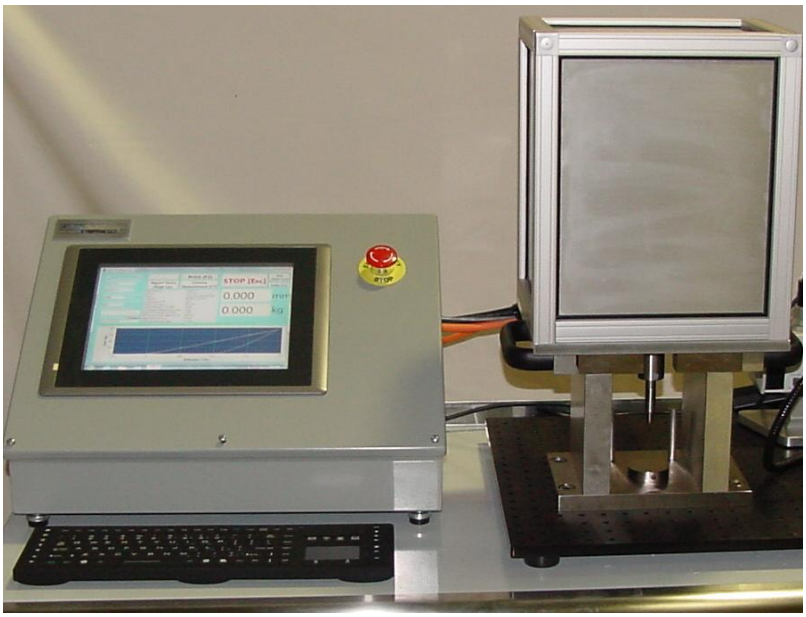
MPM I2S Models

Models I2S-LM (Laboratory Applications)

This system is used in laboratory applications to measure Brinell hardness, tensile yield stress, and ultimate tensile strength. These data are obtained from the I2S-LM load-deflection data. This has the advantage that optical measurements are not needed to obtain the Brinell hardness.

The following hardware and software are included with the I2S-LM:
- automatic load-deflection measurement module
- carbide indenter and holder
- hardened specimen support for test coupons
- table-top control consolette
- computer (software installation and configuration)
- software
- manual
- system calibration



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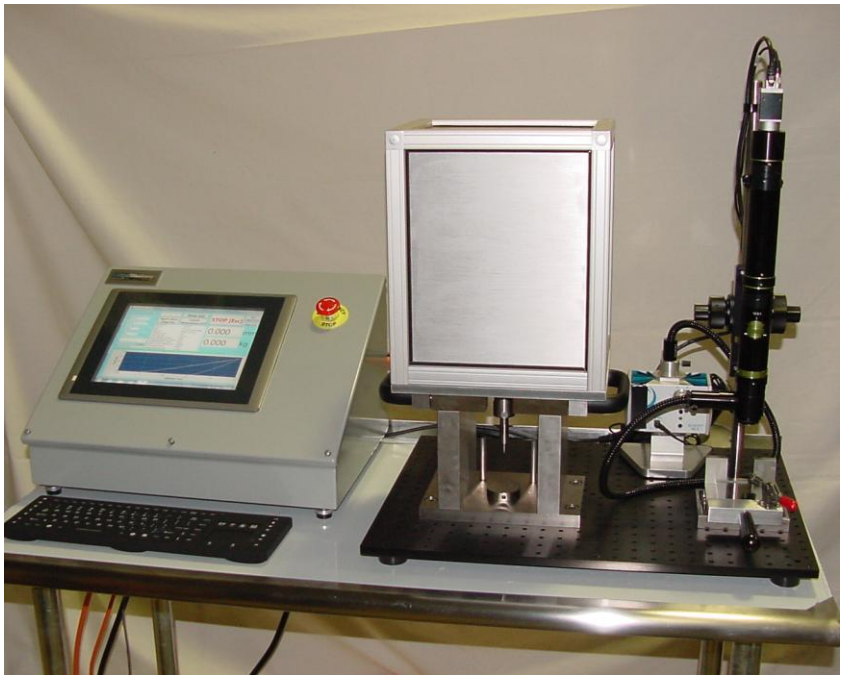
Models I2S-LM-BO (Laboratory Applications)

The I2S-LM can be ordered with a lens and camera system for measurement of Brinell hardness in the conventional manner which involves measuring the indent diameter optically. This option is useful for comparison of the optical method with the I2S load-deflection data method. The system has been designed for automatic alignment of the indentation with the center of the optical lens.

The following hardware and software are included with the I2S-LM-BO:
- automatic load-deflection measurement module
- carbide indenter and holder
- hardened specimen support for test coupons
- table-top control consolette
- computer (software installation and configuration)
- software
- manual
- system calibration
- lens and monochrome IEEE 1394 camera
- IEEE 1394 cable
- base, stand, and rack & pinion movement
- automatic indentation alignment fixture
- through-lens illumination



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Model I2S-FA (Field Inspections)

This system is used in field inspection applications. The system is powered by a rechargeable battery. It can be charged and/or run from an automobile cigarette lighter socket or standard 110 VAC outlet. The system is provided with a battery and control consolette on a hand truck for easy movement. Extra-long cables are provided with quick-disconnects for easy setup at the inspection site. A magnetic base is used for attachment to magnetic materials, and a mechanical attachment is also provided for non-magnetic material inspections.

The I2S-FA has been designed to operate from a pickup truck, or it can be transported to a pipe inspection location where it is not possible to drive to for the inspection. If truck access is possible, the power supply can be left on the truck in a secured position. If not, the I2S, power supply cart, and control computer can be maneuvered to the inspection location.

The following hardware and software are included with the I2S-FA:
- automatic load-deflection measurement module
- carbide indenter and holder
- high strength magnetic hold-down base
- hand truck with long-life battery and ruggedized control consolette
- ruggedized computer (software installation and configuration)
- software
- manual
- system calibration
- extra-long cables



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Model I2S-PM (Factory Production Line Applications)

This system is used in steel production line applications. The tensile data of the in-coming steel coil is measured and transmitted across the network to the plant programmable logic controller (PLC). These data are used to adjust the rollers to optimize the oxide breaking and/or for the shear cutting. Extra-long cables are provided along with a ruggedized control consolette. The system can be placed in automatic or manual mode. In manual mode, the measurement is initiated by the line control staff on the consolette touch screen. In automatic mode, the plant PLC issues a request to have the coil material tested and the I2S-PM performs the test and immediately returns the Brinell hardness, yield strength, and ultimate tensile strength to the PLC.

The following hardware and software are included with the I2S-FA:
- automatic load-deflection measurement module
- carbide indenter and holder
- industrial touch screen computer (software installation and configuration)
- software
- manual
- system calibration
- extra-long cables



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Models I2S-HU (Hybrid Unit for Laboratory and Mobile Applications)

Some customers prefer to use the I2S for tensile measurements from coupons and also need mobile testing capability. The I2S-HU is ideal for these applications. The system includes a docking station with easily removable screws to be able to remove the I2S load-deflection module from the docking station for attachment to the magnetic base harness. In this way the I2S can be quickly converted to a mobile unit.

The following hardware and software are included with the I2S-HU:
- automatic load-deflection measurement module
- carbide indenter and holder
- hardened specimen support for test coupons
- high strength magnetic hold-down base harness
- hand truck with long-life battery and ruggedized control consolette
- ruggedized computer (software installation and configuration)
- software
- manual
- system calibration
- extra-long cables



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