



## MICHIGAN CUSTOM MACHINES, INC.

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Product Highlight:  
**EUI INJECTOR  
CALIBRATOR**

The purpose of the MCM EUI fuel injector calibrator or test machine is used to actuate a fuel injector in the manner that it was intended while measuring its performance at specific points. The machine also performs a body leak test to establish that the seals will be adequate for the engine. Measured parameters are discharge, timing and peak injection pressure. Typical calibration fluid is Viscor 1487 (ISO 4133).



### Background

An EUI type diesel injector is typically actuated by a lobe on the camshaft either directly, through a pushrod or through a rocker arm. A solenoid on the injector, when energized, uses the energy from the cam to raise the internal fuel pressure in the injector nozzle to very high levels. This high-pressure fuel overcomes the spring on a check and exits the injector as atomized fuel into the engine cylinder. Our machine measures the discharge from the injector, the time from the moment the solenoid is commanded to the moment that the discharge is detected and the maximum force exerted on the injector tappet during injection. Most injectors are fed through a gallery in the cylinder head, requiring a seal to be intact.

### Machine Features:

- Accommodates several injector products with fixture changeover. Usually takes less than 10 minutes for changeover.
- Power purge circuit back flushes flow meter filter for extended life and faster purging of injector.
- Integrated tank and base plate absorb injector noise when operating.
- Oscilloscope built in to front cabinet allows easy viewing and diagnosis of injector discharge and peak injection pressure traces.
- Gas-assisted hood raises up for easy fixture maintenance.
- Machine logs all test results to local hard drive as well as transmitting through RS-232 port.
- Machine performs purge, four test points and body leak test yielding timing, peak injection pressure, discharge and leak decay results.
- Scanner allows operator to easily enter serial number off of injector. The serial number gets attached to the test results in the log files.
- Operator loads injector through clear, sliding access door that locks during testing.
- All filters have two stage differential pressure switches to provide an early warning of filter failure.
- Automatic plant fill circuit, refills the Viscor tank from a plant feed, when the tank becomes low.
- Test cycle can be timed or event driven, which proceeds to the next point when timing and discharge standard deviations fall below a threshold.
- Setup and timing height masters allow quick setting of rocker arm and cam position WRT timing wheel.
- Hydraulically released, spring activated disk brake stops flywheel within 1 revolution in emergency stop situations.
- Calibration fluid to the injector is temperature controlled to  $\pm 1$  degree C in the range 27-40 Celsius.

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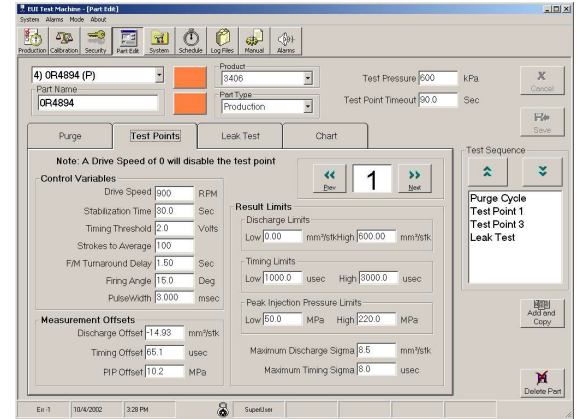
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## Production Friendly

In production our machines can be either robot or operator loaded and they interface directly with your production process. In most cases the injector has some form of identification on it that allows it to be tracked, such as a bar code. The operator scans in the bar code before the part is placed in to the machine so that it can be attached to the data. Test results are stored in the machine and communicated to the plant cell control real time. In fact, many of our machines allow the cell control to disallow the testing of certain parts.

## Flexibility

Our machines are designed so that the cam profile used can be easily changed as well as the fixturing for the product. Our machines are often purchased with tooling for three or more products, so production can shift to a product that has a sudden increase in volume. The R & D areas also like this flexibility to accommodate prototype parts and audit testing.



## Specifications

| Controlled Feature | Control Type  | Description  |
|--------------------|---|--|
| Cam speed          | Programmable through part parameters at each test point                     | Coupled to 400 Lb flywheel. Controlled from 300 to 1500 RPM $\pm 0.1$ RPM. Capable of parking on base circle at beginning or end of test.  |
| Fuel Supply        | Programmable through part parameters at each test point and for purge cycle | With the bypass open at 2 GPM so that fuel is flowing the gallery, pressure is controlled from 300 kPa to 1100 kPa $\pm 5$ kPa without the injector firing. Hydraulic noise suppression is used to reduce pulsations observed in the supply when the injector is firing. |
| Clamp load         | Programmable through product parameters.                                    | This is the load at which the part is initially retained in the fixture when clamped. It is controlled from 8000 N to 32000 N $\pm 10$ N   |
| Flow rate          | Manually adjustable   | The bypass flow is manually adjustable from 0 GPM (No bypass) to 3 1/2 GPM. The tolerance of this control is directly affected by the fuel supply pressure.  |
| Leak test          | Programmable through part parameters.                                       | This is the starting pressure for the leak test with the bypass closed. Starting pressure is controllable from 300 to 3000 kPa $\pm 7$ kPa . Leak decay is based on beginning at a programmable pressure over a programmable period of time.                             |
| Supply Temperature | Programmable through operator interface.                                    | Controlled from 27° C to 40° C $\pm 1$ ° C based on 10 GPM, 55°F externally supplied cooling water.  |

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## Measurements

| Feature   | Method   | Min                        | Max                         | Resolution             |
|---|--|----------------------------|-----------------------------|------------------------|
| Fuel Discharge with Standard deviation          | MCM positive displacement flowmeter. Alternate means using Ono Sokki capable of 5 splits per injection or EFS EMI2 which is capable of 3 splits per injection. Specs shown indicate capabilities of MCM meter. Capable of averaging 1-200 strokes. | 25 mm <sup>3</sup> /stroke | 850 mm <sup>3</sup> /stroke | 0.6284 mm <sup>3</sup> |
| Timing with Standard deviation                  | Start of logic to start of injection is measured with an MCM designed and built Timing measurement unit. Capable of averaging 1-200 strokes simultaneous with other measurements.  | 0 μ sec                    | 9999.9 μ sec                | 0.1 μ seconds          |
| Peak Injection pressure with Standard deviation | Load cell feeding an MCM designed and built peak detection module. Capable of averaging 1-200 strokes simultaneous with other measurements.  | 0 MPa                      | 400 MPa                     | 0.01 MPa               |

## Options

Although we can make anything to suit your needs, the following have been popular variations of this machine.

- High temperature capability
- Follower actuation (as opposed to rocker arm actuation)
- Cell control integration
- Badge reader for security ID rather than passwords
- Split Shot flowmeter – measures up to five injection splits from very low to 3000+ mm<sup>3</sup>/stroke
- MCM extended range flowmeter up to 1500 mm<sup>3</sup>/stroke
- Vertical orientation
- Fixture positioning capability with locking shaft clamps for dynamic setup of timing height on every cycle
- Solid camshaft for durability (does not support 10-minute cam lobe profile change)
- Communication directly with customer's engine controller for firing injector
- Optional pulse patterns and pickups for cam position to engine controller

*\*Note: We also make state of the art nozzle machines for measuring steady flow rates, valve opening pressure, leak down and tip leak in fuel injector nozzle sub-assemblies or "pump and line" injectors. These machines can be combined with one of our assembly cells to automatically assemble the part with the proper shims and spacers before the testing stage.*

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