



MICHIGAN CUSTOM MACHINES, INC.

Product Highlight:
INJECTOR NOZZLE TEST

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The purpose of the MCM fuel injector nozzle test machine is to test a fuel injector nozzle assembly for mass flow, valve opening pressure (VOP) and leakage. Depending on the fuel system, the nozzle assembly could be a sub-assembly of the fuel injector an aerospace fuel nozzle or in some cases, the complete injector. Typical calibration fluid is Viscor 1487 (ISO 4113), C3112 type II, Skydrol, or other calibration fluids.



Background

A typical diesel injector nozzle is typically made up of a nozzle tip, a check, spring, spacer plate, stop pin, sleeve and case. Different manufacturers may use slightly different terminology, but the basic components are all there. Direct injection systems couple the pump directly to this assembly which would then make it the injector. Other systems take the nozzle group and attach it to another mechanism that or valve that make up the remainder of the fuel injector. When high pressure fuel enters the nozzle, it travels down through the sleeve to the area where the check seals the delivery orifices in the tip. The check is biased closed with a spring. As the pressure to the check increases, the force overcomes the spring and causes the check to lift, allowing fuel to exit through the orifices. Our machine measures the precise pressure point at which the check lifts. This is called Valve Opening Pressure (VOP). Once the check is open, it will remain open as long as the supply pressure remains above the VOP. During this time our machine also measures that mass flow rate through the nozzle. When the supply pressure drops below VOP, the check is forced closed by the internal spring to seal the nozzle tip orifices. Our machine also performs a leak tests to verify that this interface is working correctly. We call it a "tip leak" test. Lastly the machine checks for guide leakage in the nozzle group, which is the interface between all of the fuel delivery passages within the nozzle.

Machine Features:

- Accommodates several injector nozzle products with fixture changeover. Usually takes about two minutes for changeover.
- Calibration fluid to the nozzle is temperature controlled to ± 1 degree C in the range 27-40 Celsius.
- One or two head configurations for twice the throughput.
- Machine logs all test results to local storage.
- Machine performs mass flow, VOP, guide leak and tip leak tests selectively and in any order.
- Scanner option allows operator to easily enter serial number off of nozzle or injector. The serial number gets attached to the test results in the log files.
- Operator loads nozzle through sliding access door that lock during testing and automatically open when complete.
- All filters have two stage differential pressure switches to provide an early warning of filter failure.
- Automatic plant fill circuit, refills the calibration fluid from a plant feed, when the tank becomes low.
- Clamp load is programmable by product type.
- Zero leak masters allow quick verification of fixture seals.
- Low volume, Intensifier or high-volume pump styles available up to 10,000 PSI



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

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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 fixturing can be easily changed out to run a different 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. With “Tip Only” fixturing, the machine can also be set up to test mass flow on tips only.

Specifications

Controlled Feature	Control Type	Description
Fuel supply	Programmable through part parameters	The fuel supply is controlled in the range 5 – 58 MPa ±10 KPa during steady flow. Fuel pressure is controlled with a high-performance servo valve.
Clamp load	Programmable through product parameters.	This is the load that the part sees in the fixture when clamped. It is controlled from 8000 N to 32000 N ±10 N
Supply Temperature	Programmable through operator interface.	Controlled from 27° C to 40° C ±1° C based on 10 GPM, 55°F externally supplied cooling water. Depending on methodology option, intensifier-based machines will demonstrate higher temperature fluctuations at the part inlet.
Pressure ramp rate	Programmable/manually adjustable	The ramp rate used for VOP pressure is controlled precisely in hardware, but software adjustable through part parameters.

Measurements

Feature	Method	Min	Max	Resolution
Mass Flow	Positive displacement Mass flowmeter. Correction for specific gravity at different temperatures.	0.000 Kg/Min	8.500 Kg/Min	0.001 Kg/Min
Valve Opening Pressure (VOP)	MCM designed peak detection module. One or many measurements can be made in a short period of time. If many measurements are made, the standard deviation is also reported to give a “quality” to the measurement.	0 Volts	10 Volts	4 Kpa at 68, 900 KPa scale or 14 Bits.
Guide Leak	Leak decay using pressure transducer and controlled cavity volume.	0 MPa	68900 KPa	4 KPa
Tip Leak	Leak decay using pressure transducer and controlled cavity volume.	0 MPa	68900 KPa	4 KPa

Options

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

- High flow capability up to 14 Kg/Min
- One or multiple heads
- Cell control integration
- Badge reader for security ID rather than passwords
- Dual fluids
- Constant flow circuit replaces intensifier to provide perpetual flow measurement
- Tag printer prints failure report to be attached to test part.
- Robot loading with handoff fixture.

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