



*From lab to production,
providing a window into the process*



On-Line Viscosity Measurement

ViscoSensor Continuous Melt Rheometer (CMR IV) Flow Characterization Rheometer (FCR)

A Window into the Process

The Benefits of On-Line Rheometers

- Provides a “window” into the extrusion process
 - Allows for in-process product adjustments
 - Reduces waste stream
- Eliminates the need for laboratory testing :
 - Increases production throughput
 - Reduced laboratory costs

Dynisco Online Viscosity Measurement

- ViscoSensor
 - Return Stream or “Zero Discharge” Rheometer
- Continuous Melt Rheometer – CMR IV
 - Single Capillary Rheometer
- Flow Characterization Rheometer – FCR
 - Dual Capillary Rheometer
 - Calculate Extensional Stress, Rate and Viscosity
 - Optional Return Stream (FCRR)

Dynisco Online Viscosity Measurement

All systems provide

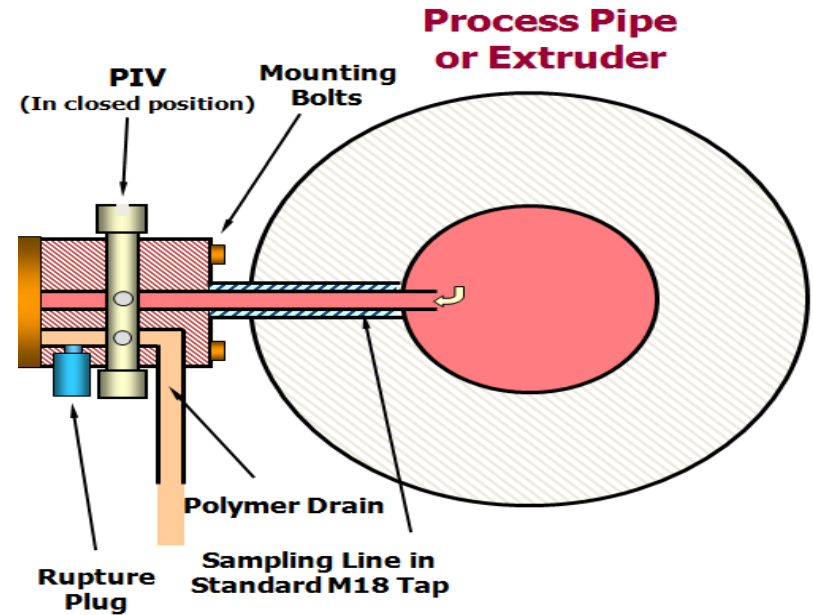
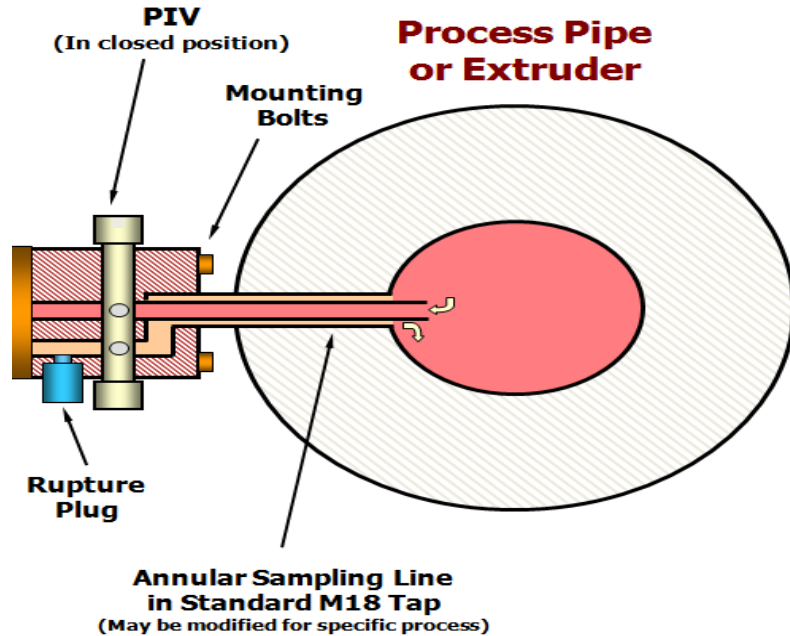
- Continuous, real-time, Melt Flow & Apparent Viscosity Data
- Correlation from Melt Index to IV for PET applications
- Modular capillaries for highest resolution
- DCS Communication & Control Integration
 - PROFIBUS
 - Modbus TCP/IP
 - Modbus RS-485

Process Isolation Valve - All Systems

All systems require a Process Isolation Valve (PIV)

- Allows the sampling head to be serviced or removed without interrupting the process
- All PIVs can be configured to:
- Offer bypass operation
- Interface to the process via a single, annular or dual hole (ViscoSensor) sampling port pattern
- Provide a drain for rapid Rheometer / sample line purge
- Interface to existing competitors Rheometers sampling port patterns

Process Isolation Valve – Visco Sensors



Rheometer Control Unit Communications Standard and Optional I/O

ViscoSensor, CMR IV and FCR

- 7 Analog Output Signals, 4-20mA DC
 - Pump Speed
 - Rheometer Pressure 1
 - Rheometer Pressure 2 (excluding CMR)
 - Rheometer Pressure 3 (FCR only)
 - Melt Temperature Average
 - MFR
 - Apparent Viscosity
 - PIV Temperature (Visco)
 - Optional: Pump Temperature, Capillary Temperature, Delta P, Shear Rate, Shear Stress, Intrinsic Viscosity, Relative Viscosity
- 2 Analog Input Signals 4-20mA DC
 - Pressure
 - Speed
- Optional: Capillary temp., Pump temp., Pressure
- 5 Digital Output, 24 VDC, 2A max.
 - System fault alarm
 - Warning Signal
 - Local / Remote Operation
 - Pump Status
 - Material Status
- 3 Digital Input Signals, 24VDC 10mA
 - Remote Heat ON/OFF
 - Remote Motor ON/OFF
 - Remote mode PRESSURE/SPEED

On-Line Rheometers Dynisco Rheometers at a Glance

ViscoSensor

- Max. temp.: 350°C
- 0.02 – 1,500 g/10 minutes range
- Return stream
- Horizontal or vertical mount
- Optional reaction vessel mounting
- Unique annular melt transfer line

CMR IV

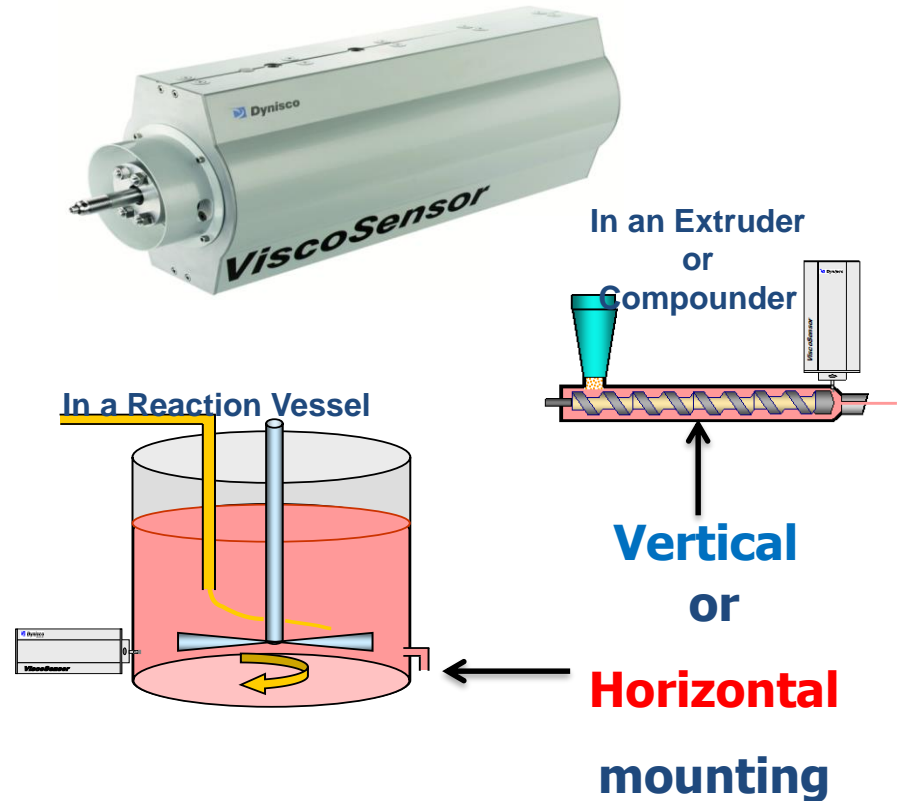
- Max. temp.: 400°C
- 0.02 – 5,000 g/10 minutes range
- Single capillary
- Quick and Easy-change capillaries

FCR

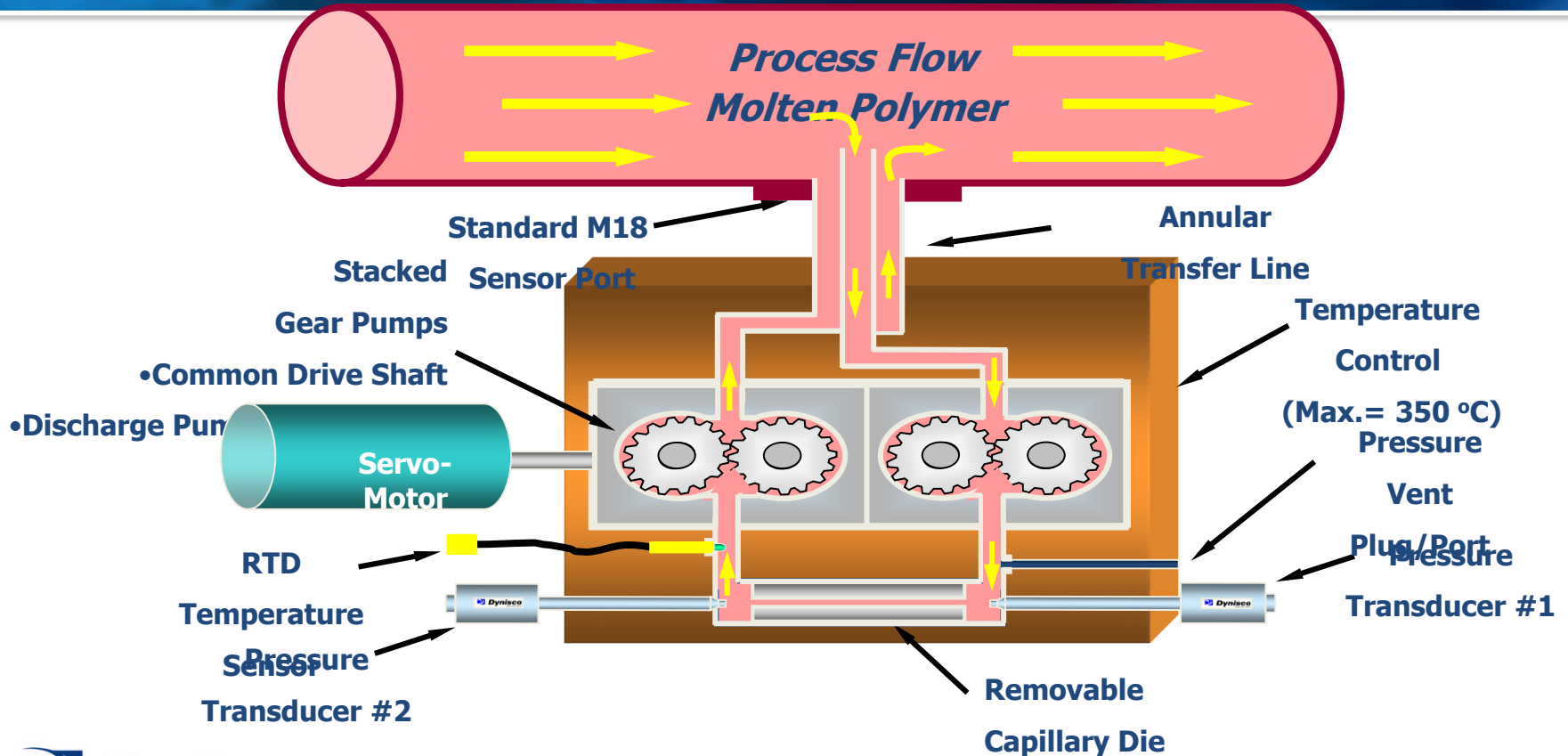
- Max. Temp.: 400°C
- 0.02 – 5,000 g/10 minutes range
- Dual capillary
- Optional return stream
- Largest shear rate range for single sample

ViscoSensor Zero Discharge Rheometer

- Designed specifically for thermoplastics resin industry
- No waste stream
- Applications:
 - Extruders
 - Compounders
 - Reaction Vessels
- Mounts either horizontally or vertically
- Mounts to an existing pressure port, M18 or equivalent

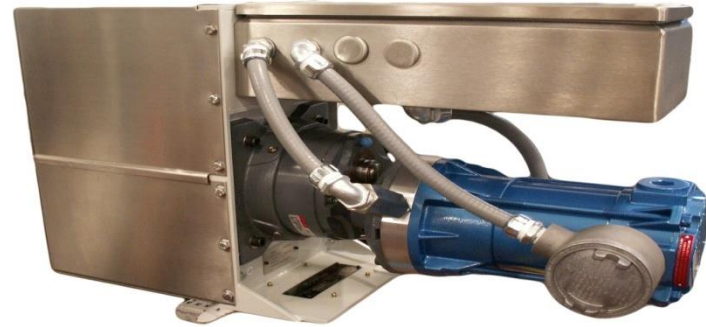


ViscoSensor Principal of Operation

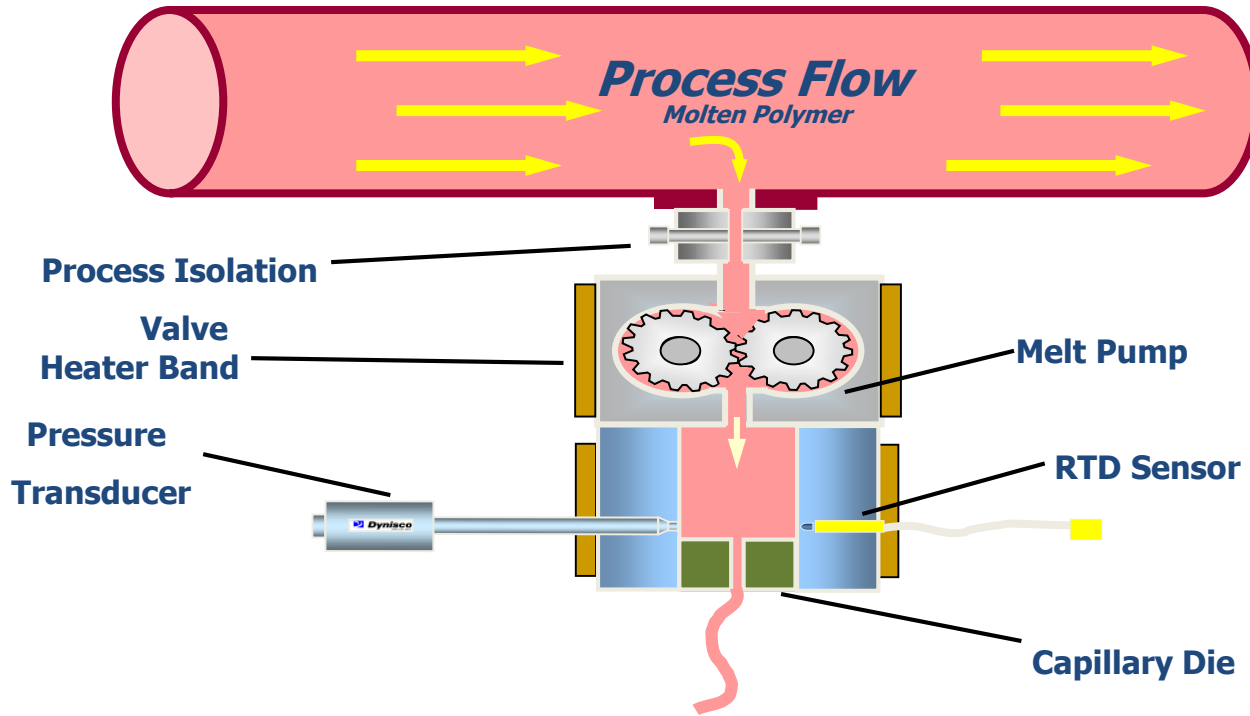


Continuous Melt Rheometer Single Capillary Rheometer

- Fast response time
- Easily change capillaries based on flow characteristics
- Single capillary extrudes to environment
- Applications:
 - Extruders
 - Compounders
- Mounts horizontally via process interrupt valve

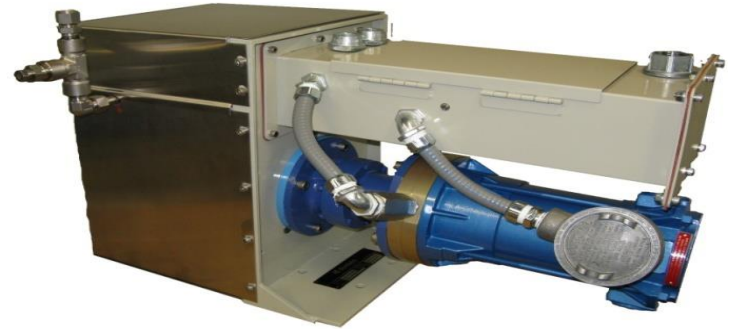


Continuous Melt Rheometer Principle of Operation

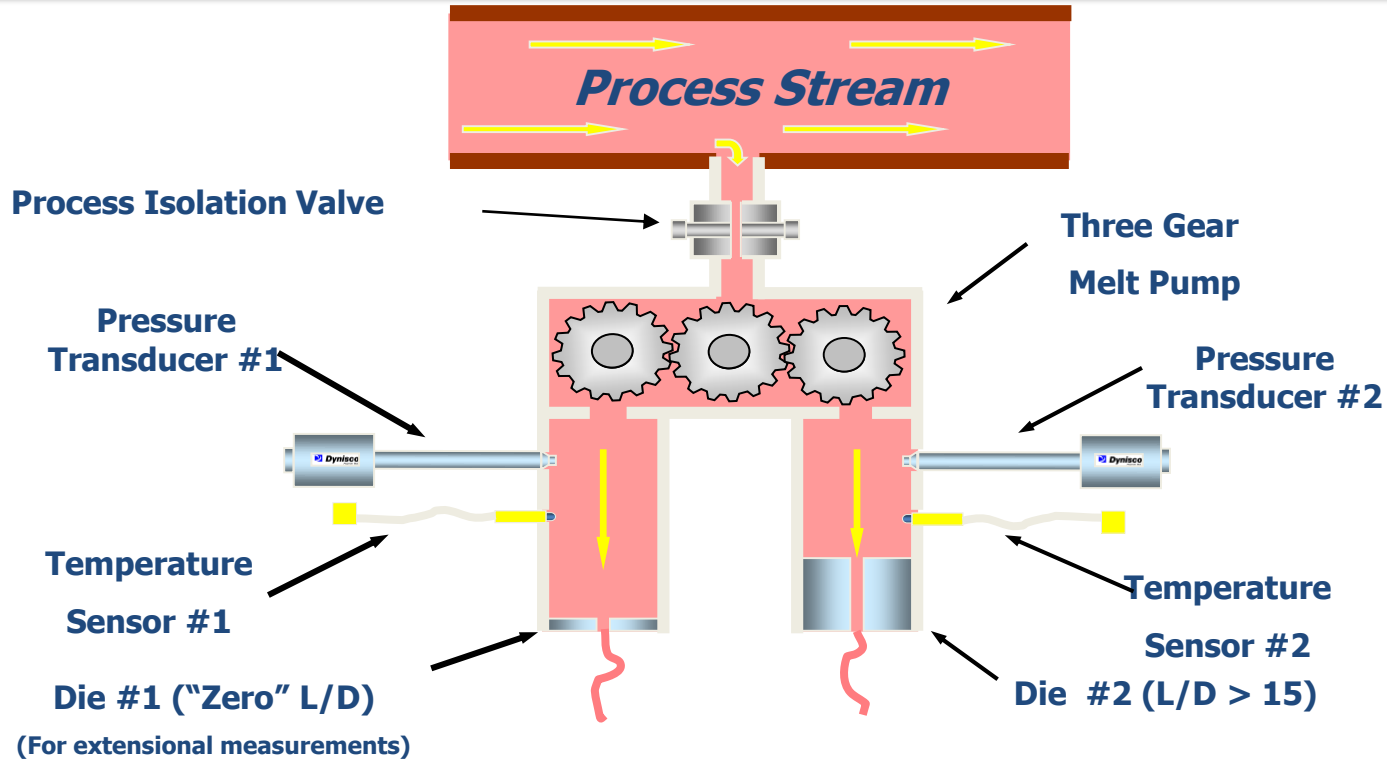


Flow Characterization Rheometer Dual Capillary Rheometer

- Dual capillaries extrude to environment
- Optional “return to process” in FCRR
- Applications:
 - Extruders
 - Compounders
 - Spandex / Elastane / Lycra
- Two capillaries allow for Rheology curves over more shear conditions
- Mounts horizontally using process interrupt valve



Flow Characterization Rheometer Principle of Operation



On-Line Rheometers: Typical Polymer Applications

ViscoSensor

- PET
- PE
- PS
- Adhesives

CMR IV

- PE
- PP
- PS

FCR

- PE
- Spandex
- Lycra
- Elastane

Return on Investment: Cost of Materials and Operation

A hypothetical plant processes PP on an extruder that runs 8 hours a day, 5 days per week, with average output of 1,000 pounds per hour:

8 hrs./day * 5 days * 1,000lbs./hour = 40,000lbs. / week

Incorporate three ingredients: cost of material coverage to \$4.03 per pound:

Material	cost/lb	% used	
Virgin material	\$ 4.00	85%	\$ 3.40
Recycle material	\$ 0.24	12%	\$ 0.03
Color and Additives	\$ 20.00	3%	\$ 0.60
		100%	\$ 4.03 cost/lb
			\$ 161,152.00 weekly material cost

**If the plant produces 40lbs of off-spec material a week
(0.1% weekly output), they are losing:**

40lbs. * \$4.03 = \$161.15 Lost per week in material costs



Return on Investment: Cost of Production Loss

If operational costs (labor, utilities, equipment) are calculated to be \$0.25 per pound of material produced, at normal operating conditions, the cost per hour of the extruder is as follows:

$$\text{\$0.25/hr.} * \text{1,000lbs./hour} = \text{\$250}$$

Idle extruder and re-stabilizing also needs accounted for. If the plant experiences 3 restores a day at 0.3 hours per restore, plus 1.5 hours to stabilize, the total loss on daily production time is:

$$\text{3 restores/day} * \text{0.3 hrs/restore} + \text{1.5hrs. Stabilization} = \text{2.4 hrs not producing product}$$

Thus, if the plant is down for 2.4 hours a day, 5 days a week:

Return on Investment: Savings Potential

Putting it all together:

	Off-spec material	\$161.15
+	Labor to produce	\$0.25 * 40lbs = \$10.00
+	Weekly Extruder loss	\$3,000
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	Total Weekly Lost Revenue	\$3,171.15

At this conservative rate of loss, an on-line rheometer will pay for itself in less than 6 months of operation!

Frequent Questions

- **How do I decide which system is right for me?**
 - Qualified representatives will work with you to determine which system is best suited to your application requirements.
- **Once a system is picked, how do I determine the right capillary for my process?**
 - Qualified product engineers will work with you to determine the most appropriate capillary (or capillaries) for your process.
- **I need CE certification for my plant. Is this possible?**
 - Dynisco offers many certifications such as CE, IS, CSA and more.
- **In order to better understand how this works, I need to see the system in operation; is this possible?**
 - All on-line systems are available for product testing and training at Alpha Technologies where these units are manufactured in Akron, Ohio.

Animation

