# ATMS

## AUTOMOTIVE THERMAL MANAGEMENT SYSTEMS

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# Information on ATMS

ATMS has been developing new technologies which provide better mileage, less harmful tailpipe emissions, and longer engine life.

**Digital Rotary Control Valve:** ATMS has developed a Digital Rotary Control Valve (DRCV) along with a corresponding digital control strategy which replaces the last **100 years usage** of analog thermostat technology. Our patented Digital Rotary Control Valve (DRCV) and Digital Engine Thermal Management (DETM) System not only improve mileage and emissions, but increase engine life and oil life, by maintaining the optimal engine operating temperature.

# Information on ATMS

**Limited Thermal Management Competition:** ATMS patents cover both elements of the digital engine thermal management system:

- The important digital system control strategy, finalized during a joint three year development program with JAGUAR
- The DRCV design, that incorporates a unique "fluid bearing" concept

**Patents and Testing:** The Company holds 20 patents in the U.S.; and DRCV patents in: China, South Korea, Japan, Europe, India, and Canada. The DRCV digital control system strategy was completed during the successful three year JAGUAR development program. The next step is to complete the production development testing on the production prototype DRCV's, utilizing the new 5810 Sonceboz "smart motor."

# Information on ATMS

**Developing Production, Strategic Relationships and Go To Market:**

We are now in the process of establishing worldwide strategic business partners, such as our relationship with DuPont, where we utilize their special HTN 51G35 series high temperature materials. The production prototype samples were provided by the following companies: production molds from The Minco Group, molded components from the DuPont development lab, special seals from Parker Hannifin, and recently Sonceboz has agreed to provide their new 5810 BLDC “smart motor,” to digitally function our DRCV.

We have had initial discussions, which include some NDA's, with the following companies regarding licensing and sales: VW, Bosch, Borg Warner, Mahle/Behr, Denso, MPC, Porsche, Aston Martin, PSA Peugeot Citroen, IAV, Aisin, Jaguar Landrover, Chrysler, Audi, Toyota, and Ford.

Western Thomson (India) Ltd & ATMS have recently completed an exclusive license agreement for India, including a non-exclusive license agreement covering their present non-India customer base.

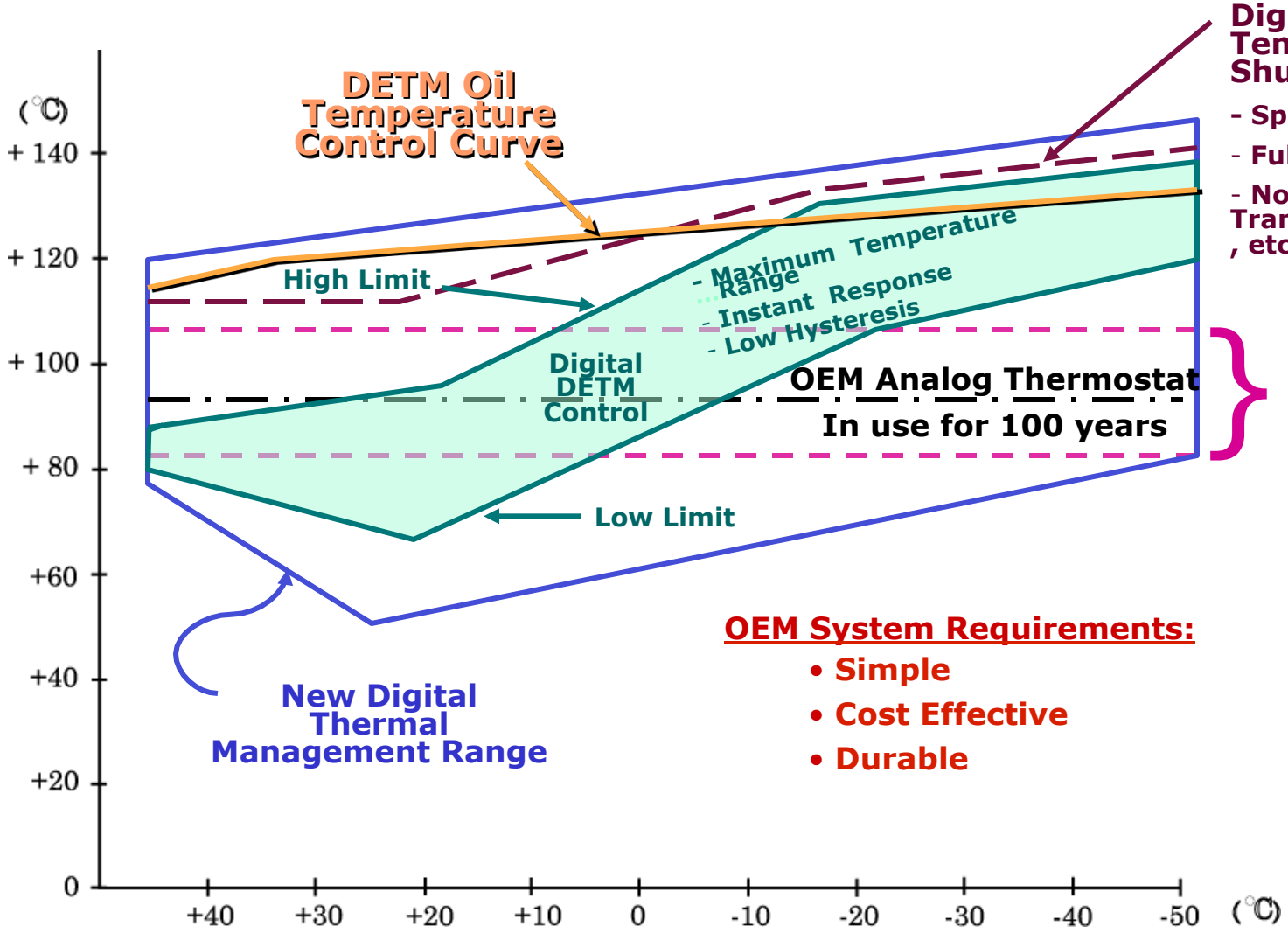
# DETM and DRCV

# Introduction to DETM Rationale

- The first section reviews the DETM (Digital Engine Thermal Management) system joint technology development program. This included Jaguar, Dura Automotive, and now ATMS. The program provided important empirical development background information and centered on "Waste Heat Recovery" from the existing radiator system.

- "Every BTU that exits through the radiator, provides ZERO heat energy value!”

# Powertrain Function Graph




**Digital Variable High Temperature Shutdown**

- Spark Retard
- Full Fan Operation
- No Transmission ..Downshift , etc.

**Modified Analog Electronic Thermostat**

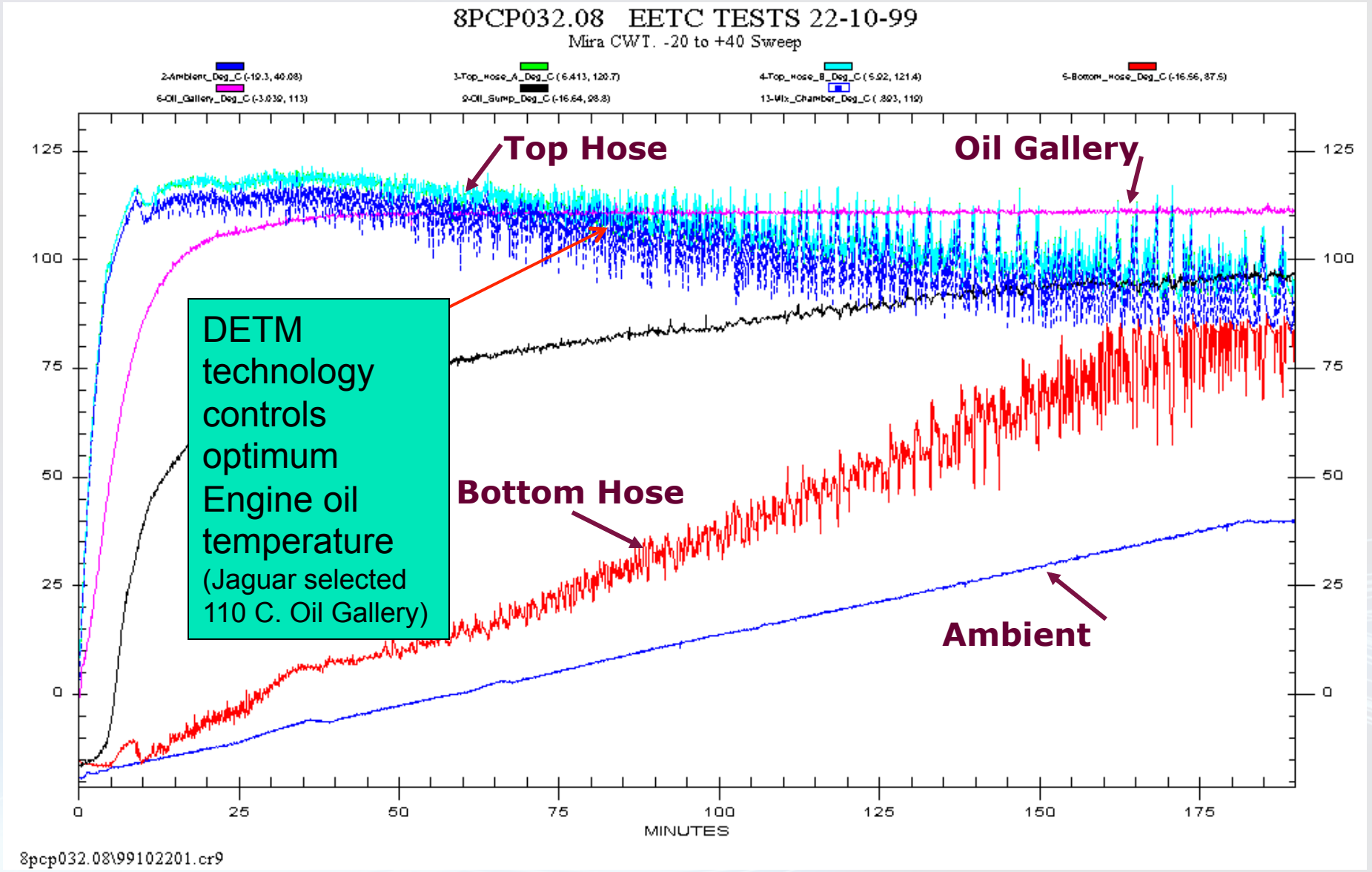
- Limited Temperature Range
- Slow Response
- High Hysteresis

**OEM System Requirements:**

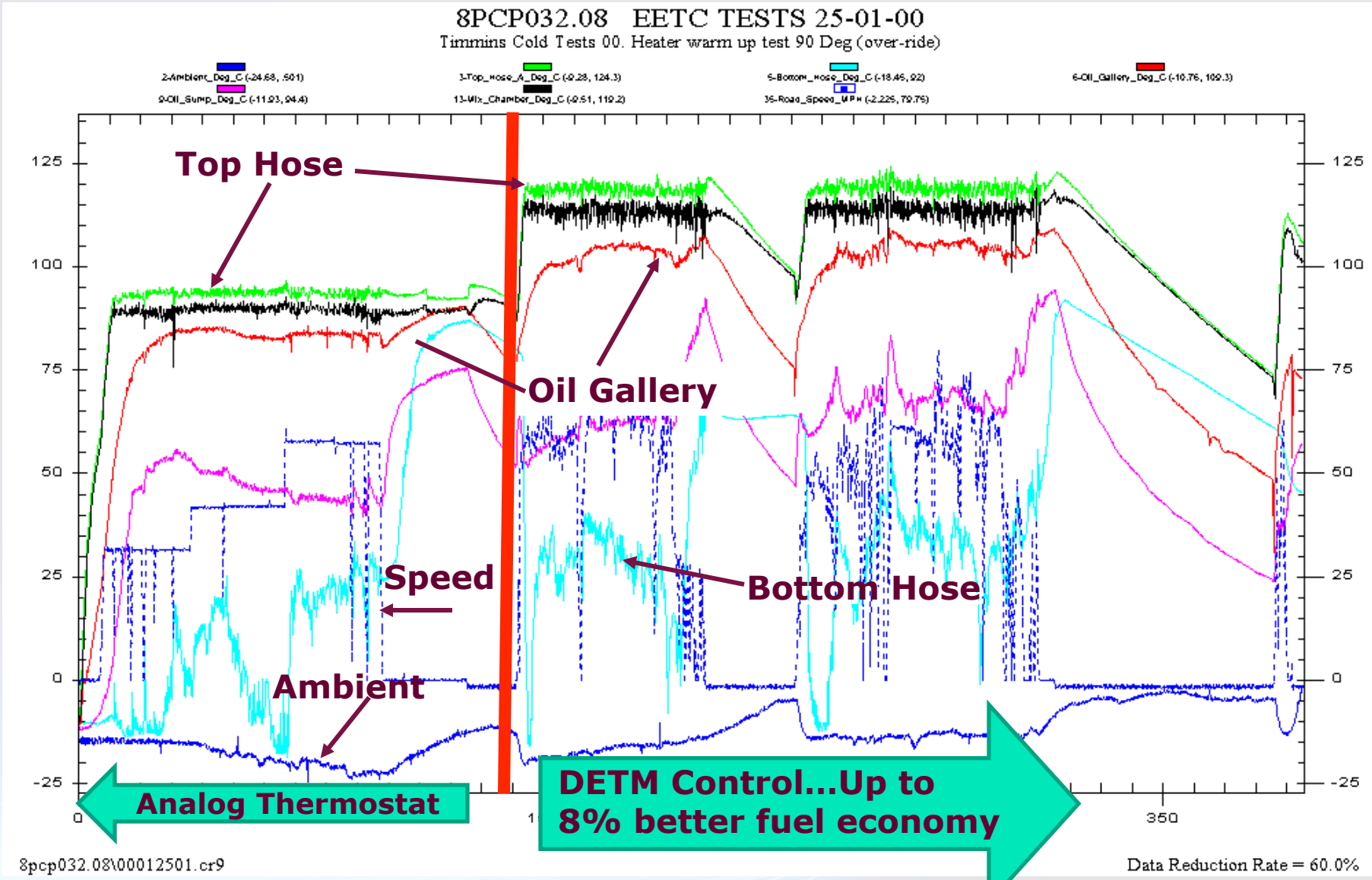
- Simple
- Cost Effective
- Durable

**DETM Control Temperatures – Engine Oil/Engine by-pass coolant**

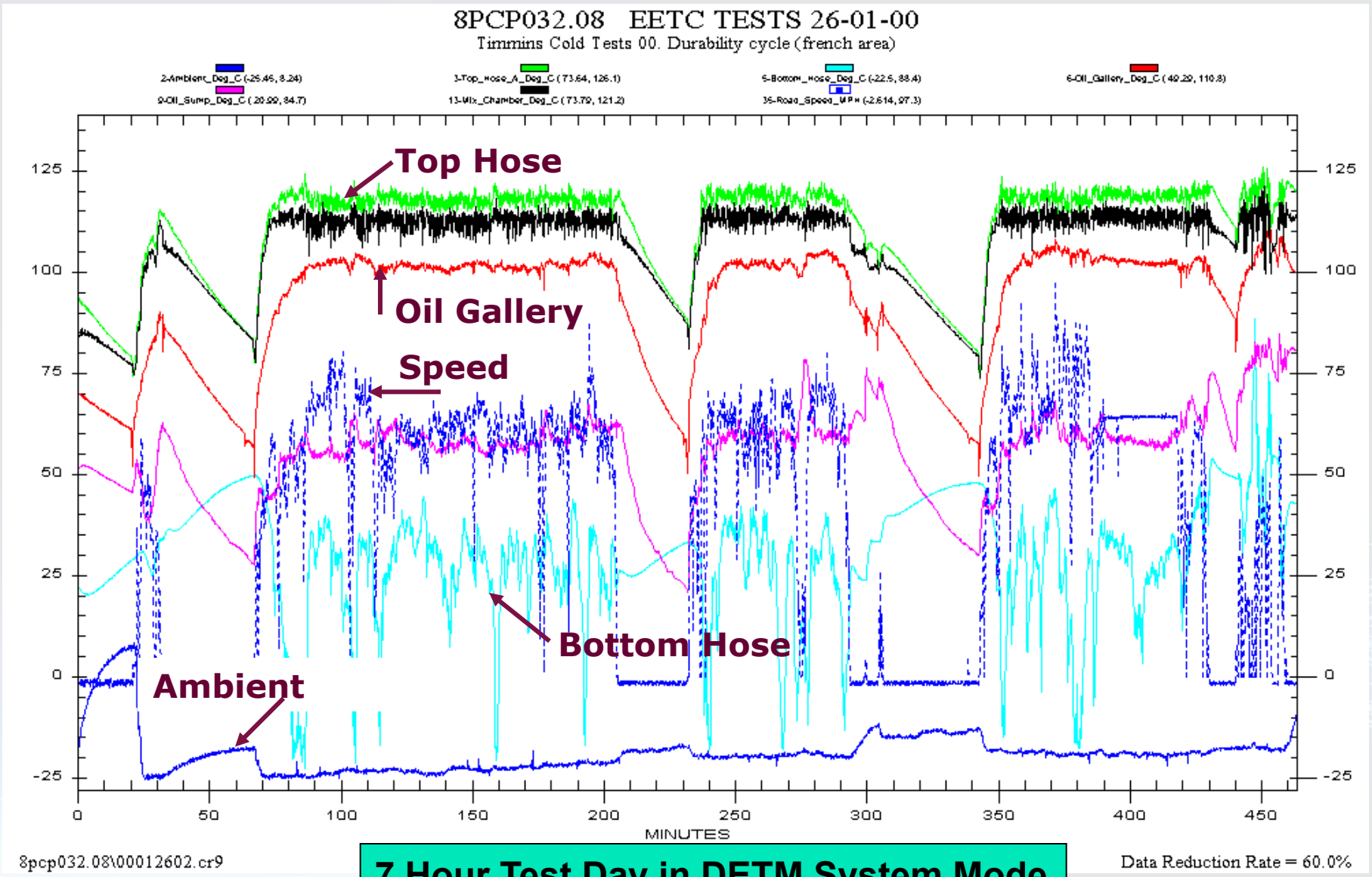
# Typical MIRA Temperature Sweep



# Thermostat/DETM Comparison

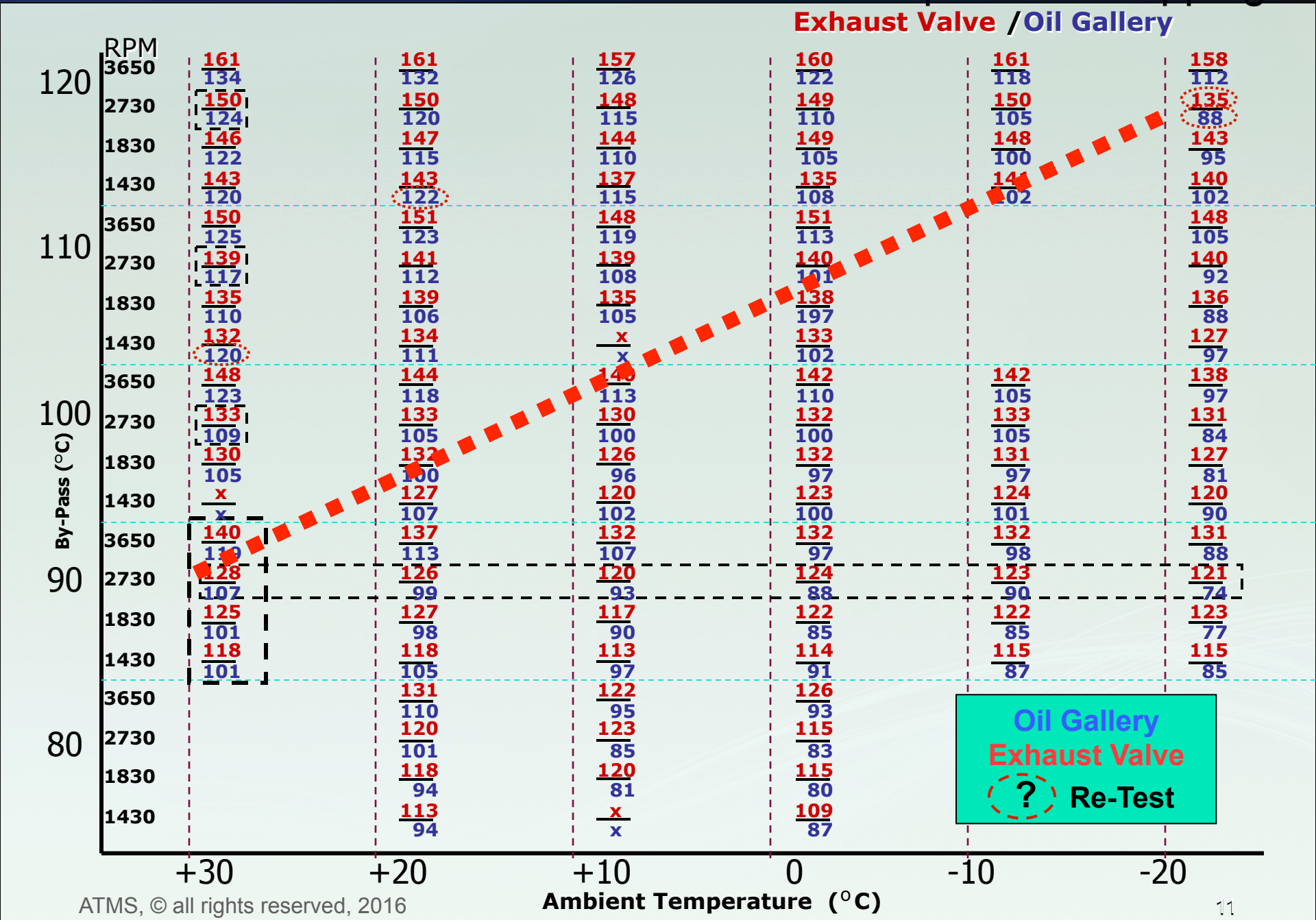


# Typical Road Test with DETM




**7 Hour Test Day in DETM System Mode**

# MIRA Combustion Chamber/Powertrain Temperature Mapping



# Timmons, Ontario

- The successful Jaguar DETM development program produced:
  - 8 % fuel economy savings during winter driving in Timmins, Ontario, Canada
  - Extended oil life to 20k miles, saving money and resulting in fewer oil filters in land fills – environmentally friendly

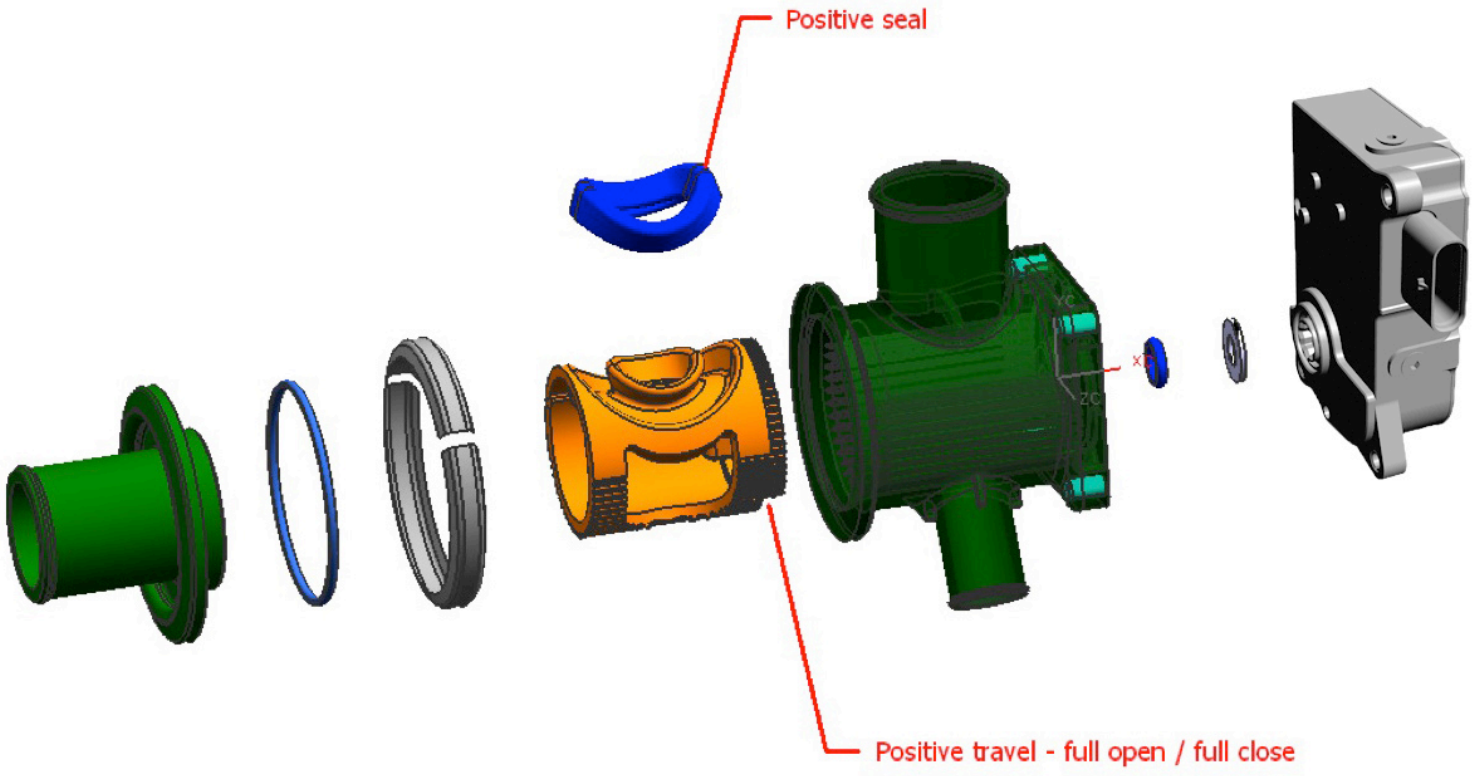
# New Digital Valve for DETM Program

- ATMS has developed a new digital rotary control valve (DRCV) as an "analog" thermostat replacement. This same DRCV design allows a fluid flow rate capacity up to 600 gpm.

# The new DRCV Design provides:

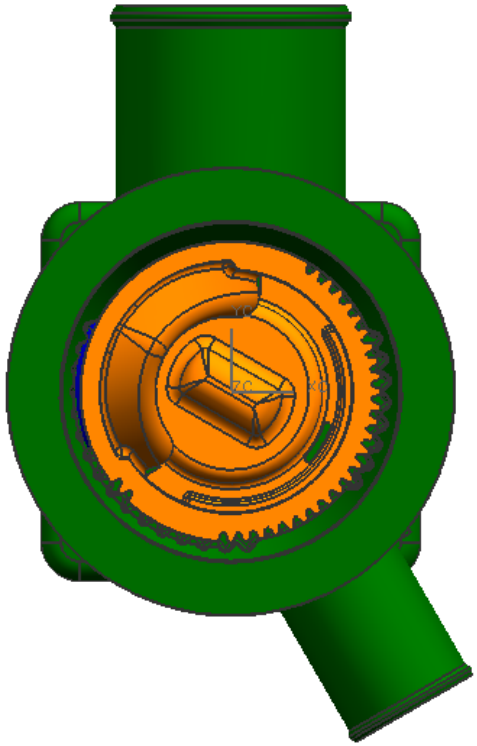
- Small size
- Minimal pressure drop
- Positive seal
- Good pressure balance
- All surfaces “always wet” to provide “fluid bearing” to prevent sticking

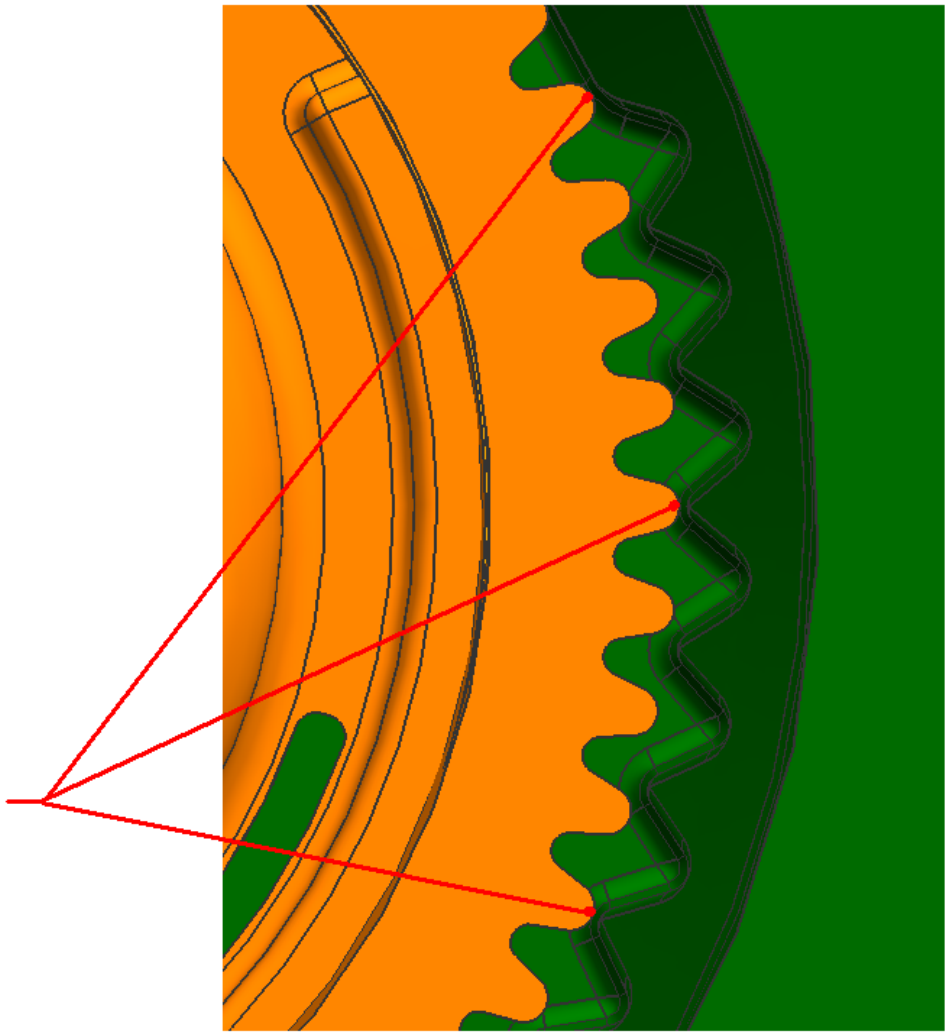
# Assembly Layout View – All DRCV Components




- Low pressure drop
- Uniform wall thickness for all components
- DuPont "Zytel" NTN - 150° C
- Complete pressure balance
- Precision linear flow control
- Serviceable for valve replacement

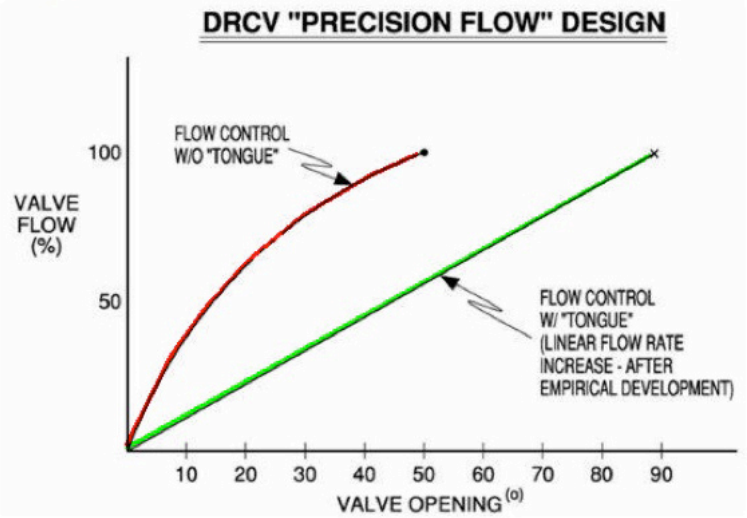
# Flow Grooves for Fluid Bearing Feature

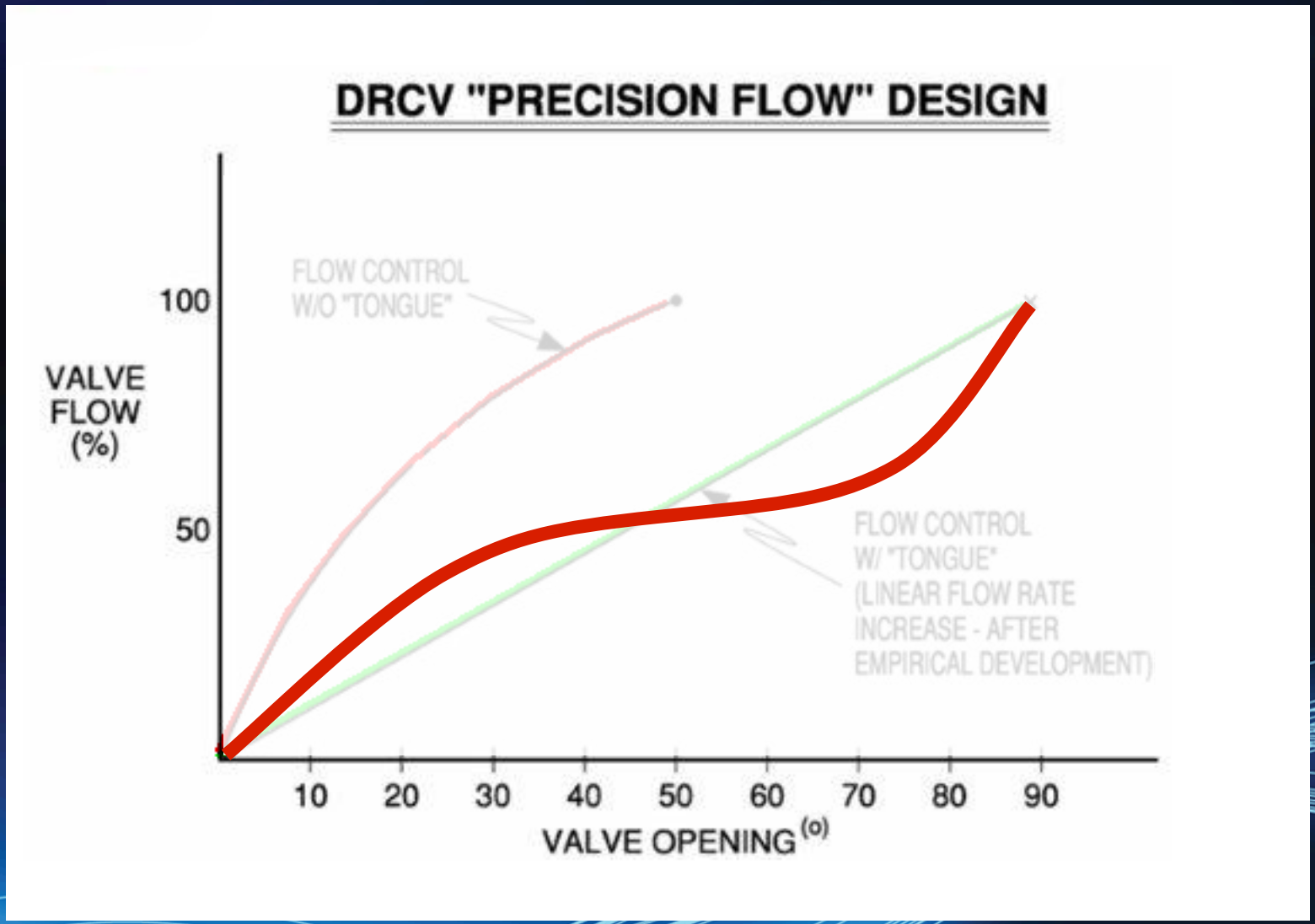


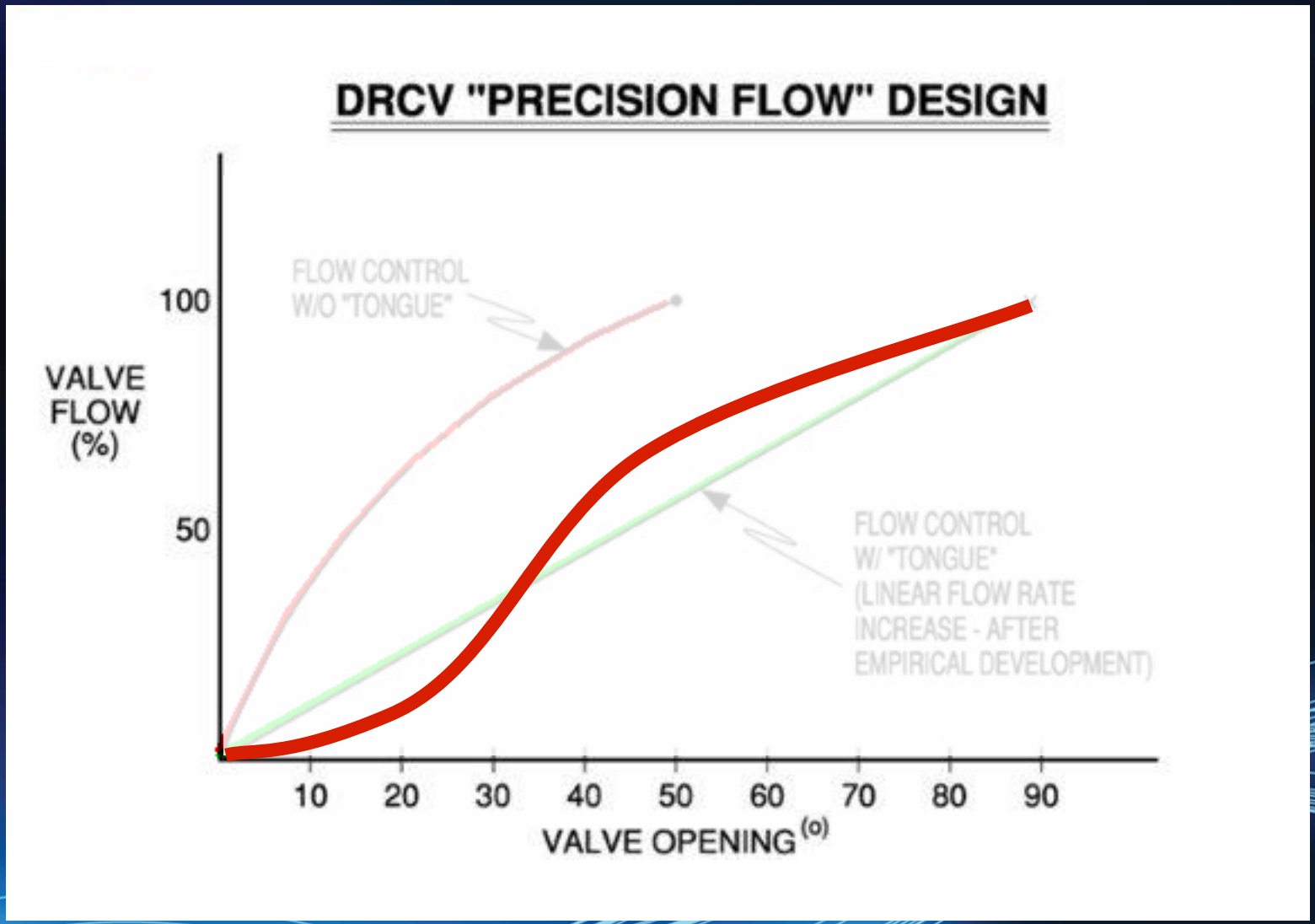


# Illustrates Empirical Flow Rate Design Capabilities

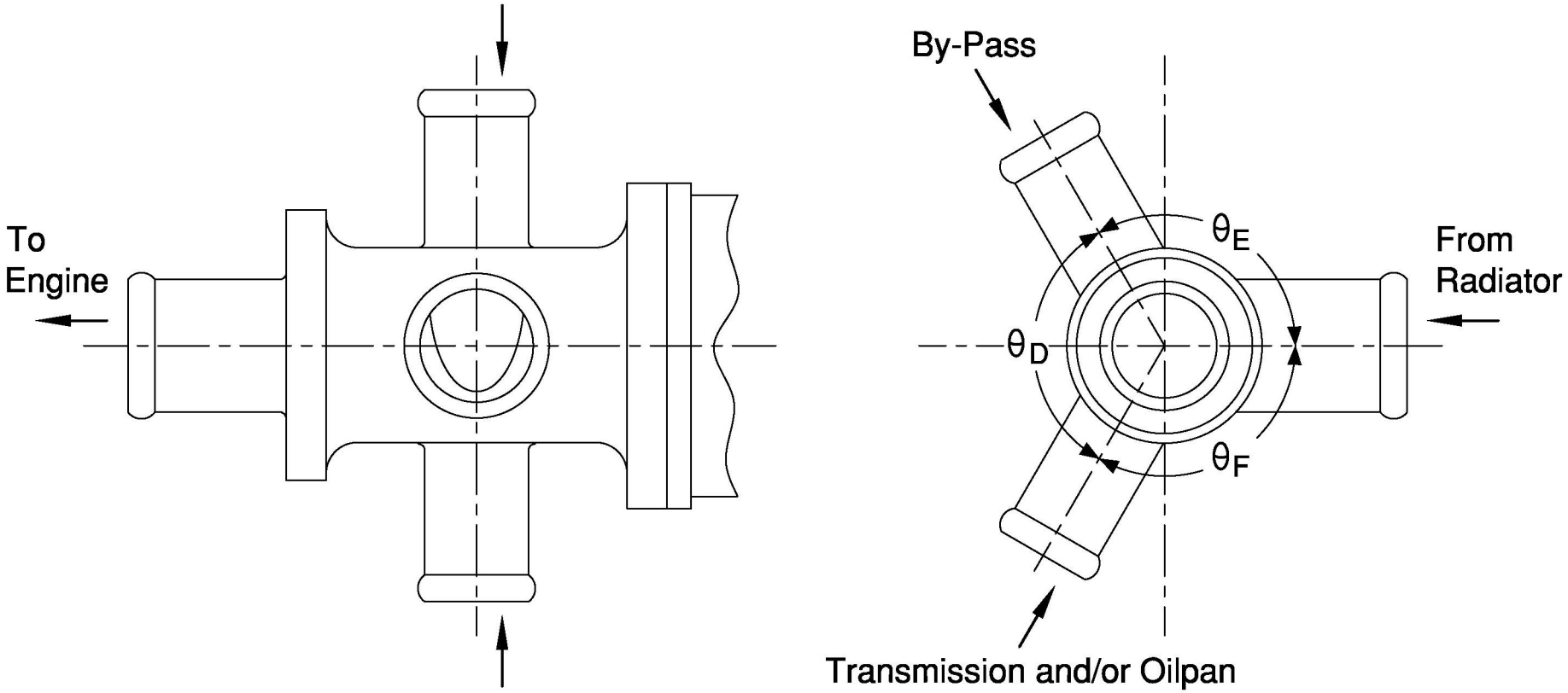
**DRCV with Sonceboz 5810 Actuator**



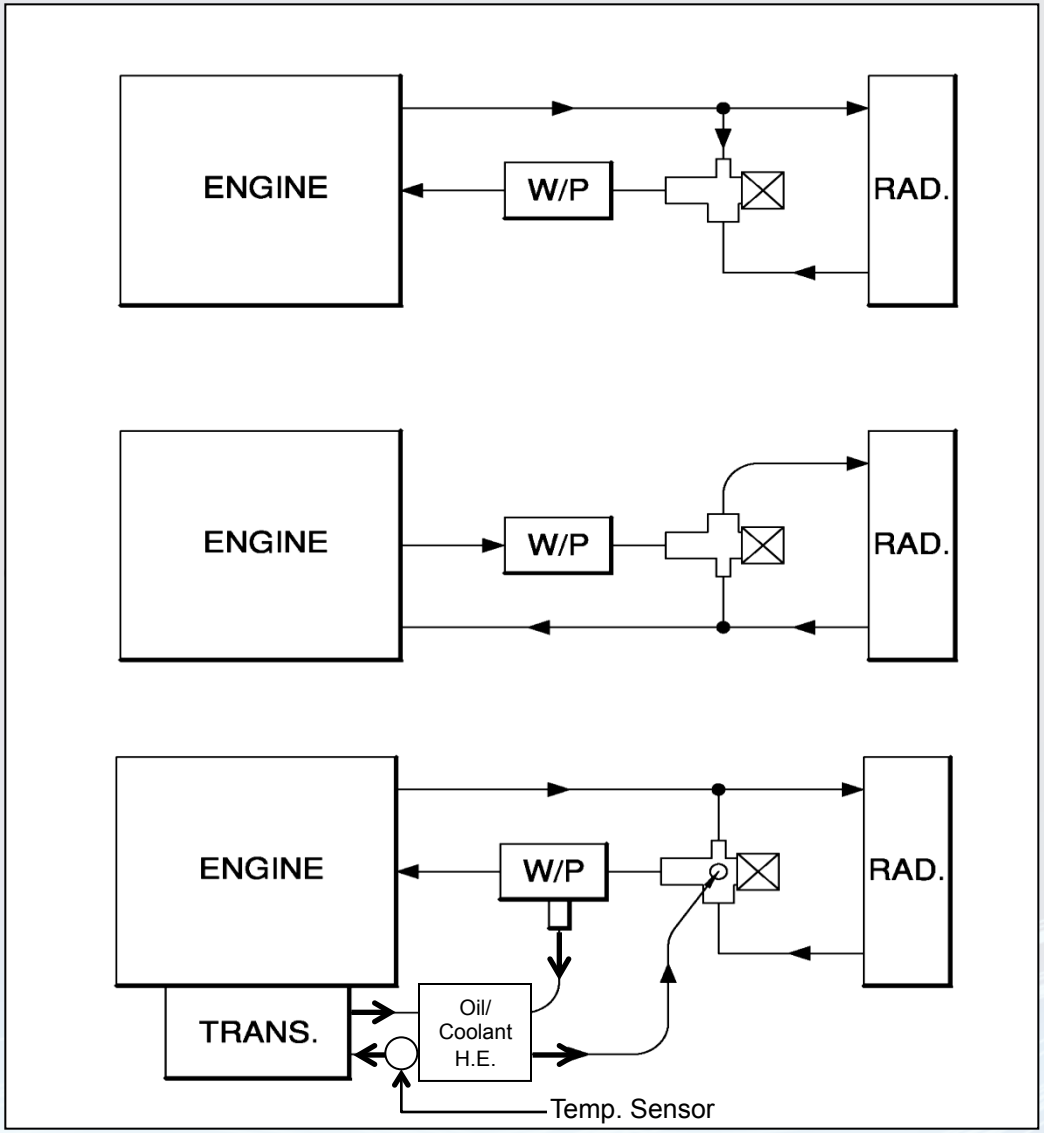




# DRCV Concept with both Powertrain & Transmission TM Capabilities



# Universal System Capabilities




**Engine In**

**Engine Out**

**Single DRCV & W/P For PT & Trans. TM**

# Summary: DETM/DRCV System Benefits

- Proven technology
- Computer regulated system maintains engine at set optimal operating temperature, through all ambient temperatures and engine load conditions, resulting in:
  - Improved fuel economy
  - Reduced engine emissions
  - Reduced engine wear
  - Reduced oil change frequency
- Adaptable to all water-cooled internal combustion engines
- Especially ideal for hybrid engines, including the heating and cooling of the battery system

# Opportunity:

- ATMS has been granted the interlocking US patents for the complete digital engine thermal management strategy, and holds the patents for the technology which operates the device. This includes the electronic communication between any temperature control system and the engine.

- ATMS is open to discussions on license agreements covering both the Digital Rotary Control Valve (DRCV) and the Digital Engine Thermal Management (DETM) system control strategy.

# Conclusion

- ATMS has the right product to deliver a high quality automotive technology, which will contribute significantly to the reduction of emissions, increase fuel economy, and prolong engine life.
- OEM's and Tier One suppliers have recognized the important value of advanced thermal management control as one of the last remaining areas for substantial improvement.
- There has been a great deal of research in the last three years in this area. This has convinced the OEM's and Tier One suppliers that this is the future, and more importantly, what the technology provides will be mandated on new vehicles.
- Based on our experience in the last 4 years with OEM's and Tier One suppliers, we believe that there is an opportunity for ATMS to capitalize on our patented technology in 2016.