Spring 2-2013

Electronically Controlled Turbocharging Systems

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ELECTRONICALLY CONTROLLED TURBOCHARGING SYSTEMS

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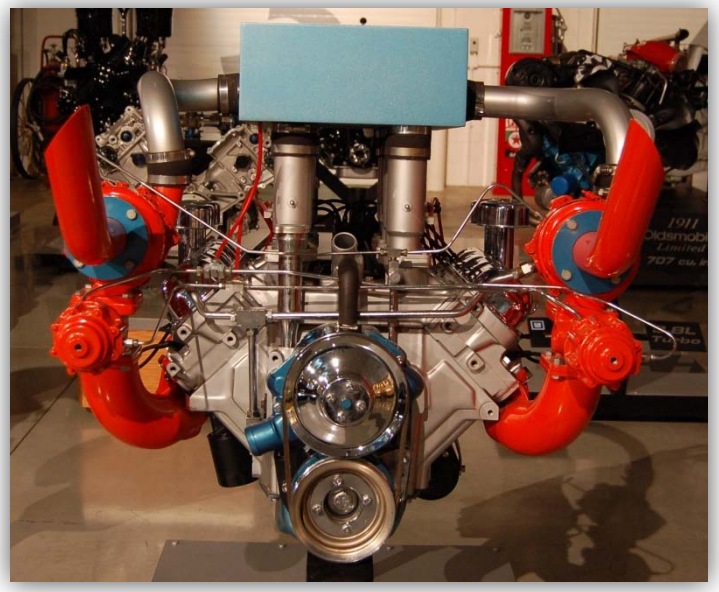
Automotive Technology
Southern Illinois University Carbondale

siucautomotive.com

ELECTRONICALLY CONTROLLED TURBOCHARGING SYSTEM

- System Operation
- System Parts
- Electronically Controlled Wastegates and Bypass Valves
- Service / Diagnostics



FUTURE TRENDS

- "25 percent of all light vehicles sold in the U.S. will be turbocharged."

  -J.D Power and associates

- Today: 1 million turbocharged vehicles sold (5%)
- Five year: more than 4 million (20%)

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9/22/2010

Honeywell Expects Turbocharged Engine Segment To Double By 2015

Fuel-Efficient Turbo Engine Launches Spur Growth In the U.S., China and Europe

TORRANCE, Calif., Sept. 22 -- Honeywell (NYSE: HON), the leading global developer of automotive turbochargers, expects the global turbo segment to double in the next five years, from 17 million new turbo vehicles in 2009 to 35 million in 2015.

That includes a rapid growth in the United States, where turbocharged vehicles are expected to grow from nearly one million (five percent) vehicles sold today to more than four million (over 20 percent) in five years. In China, turbocharging will grow from approximately 10 percent today to 20 percent by 2015. The company also expects the global turbocharged commercial vehicle engine segment to grow rapidly from 3.5 million engines in 2009 to six million engines in 2015. Honeywell's data is based on a collaboration of findings from industry analysts, including IHS Global Insight, J.D. Power & Associates, and R.L. Polk & Co., as well as customer forecasts, interviews, and discussions.

Tightening fuel economy and emissions standards worldwide, coupled with consumer demand for affordable, more fuel efficient vehicles, have automakers looking increasingly to turbocharging, which can deliver up to 20 percent better fuel economy on gas vehicles, and up to 40 percent better fuel economy on diesel vehicles, with no compromise on performance and at a significant cost discount to hybrid and electric vehicles.

"Despite the buzz around hybrid and electric vehicles, it is clear that automakers will be looking primarily at turbocharged engines to help "green" their fleets and meet the regulatory targets like CAFE in the U.S.," said Alex Ismail, President and CEO of Honeywell Transportation System. "We have witnessed a sharp increase in demand for our turbos on both passenger and commercial vehicles in the U.S. and China, and expect to grow in new sectors like small gas (petrol) engines in Europe, where turbo penetration is already very strong."

The growth in all regions is primarily driven by increased adoption of smaller, turbocharged gasoline engines. Honeywell will boost the engines of several of the world's most fuel efficient vehicles in each region including the recently launched 2011 Chevy Cruze in the U.S., the 2010 Volkswagen Polo in Europe, the world's most fuel efficient five-seat car the BMW X-6 ActiveHybrid, a turbo gasoline-electric hybrid engine, and two new gasoline engine developments in China for GAC-Fiat and JAC. In addition, Ford announced plans last year to offer a turbo-based EcoBoost engine option in 90 percent of its global nameplates by 2013, and recently launched its 2011 F-Series Super Duty diesel trucks, boosted by Honeywell's DualBoost turbos on its 6.7 liter Power Stroke engines.

"These new, high-performing, green turbo engines represent the beginning of a new era for our industry as the trend towards smaller, more fuel efficient vehicles kicks into high gear around the world," added Ismail. "Turbocharged engines are no longer just about performance, they deliver improved fuel efficiency and lower emissions on a far greater number of the engines today and even more tomorrow."

Honeywell Turbo Technologies is the leading automotive turbocharger developer in the world, and is a business unit of Honeywell Transportation Systems. As a leading automotive supplier, Honeywell Transportation Systems enhances vehicle performance, efficiency and appearance through state-of-the-art technologies.

Honeywell International (www.honeywell.com) is a Fortune 100 diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services; control technologies for buildings, homes and industry; automotive products; turbochargers; and specialty materials. Based in Morris Township, N.J., Honeywell's shares are traded on the New York, London, and Chicago Stock Exchanges. For more news and information on Honeywell, please visit www.honeywellnow.com.

This release contains forward-looking statements as defined in Section 21E of the Securities Exchange Act of 1934, including statements about future business operations, financial performance and market conditions. Such forward-looking statements involve risks and uncertainties inherent in business forecasts as further described in our filings under the Securities Exchange Act.

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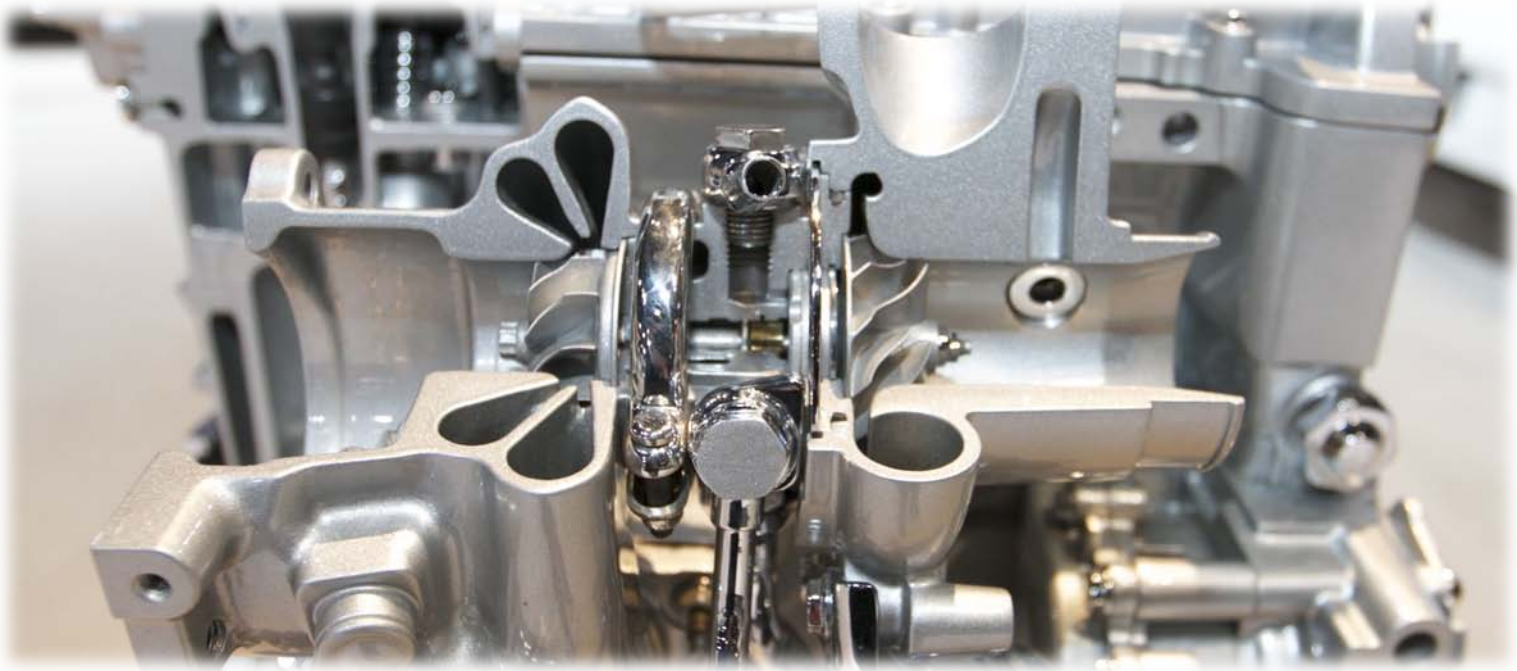
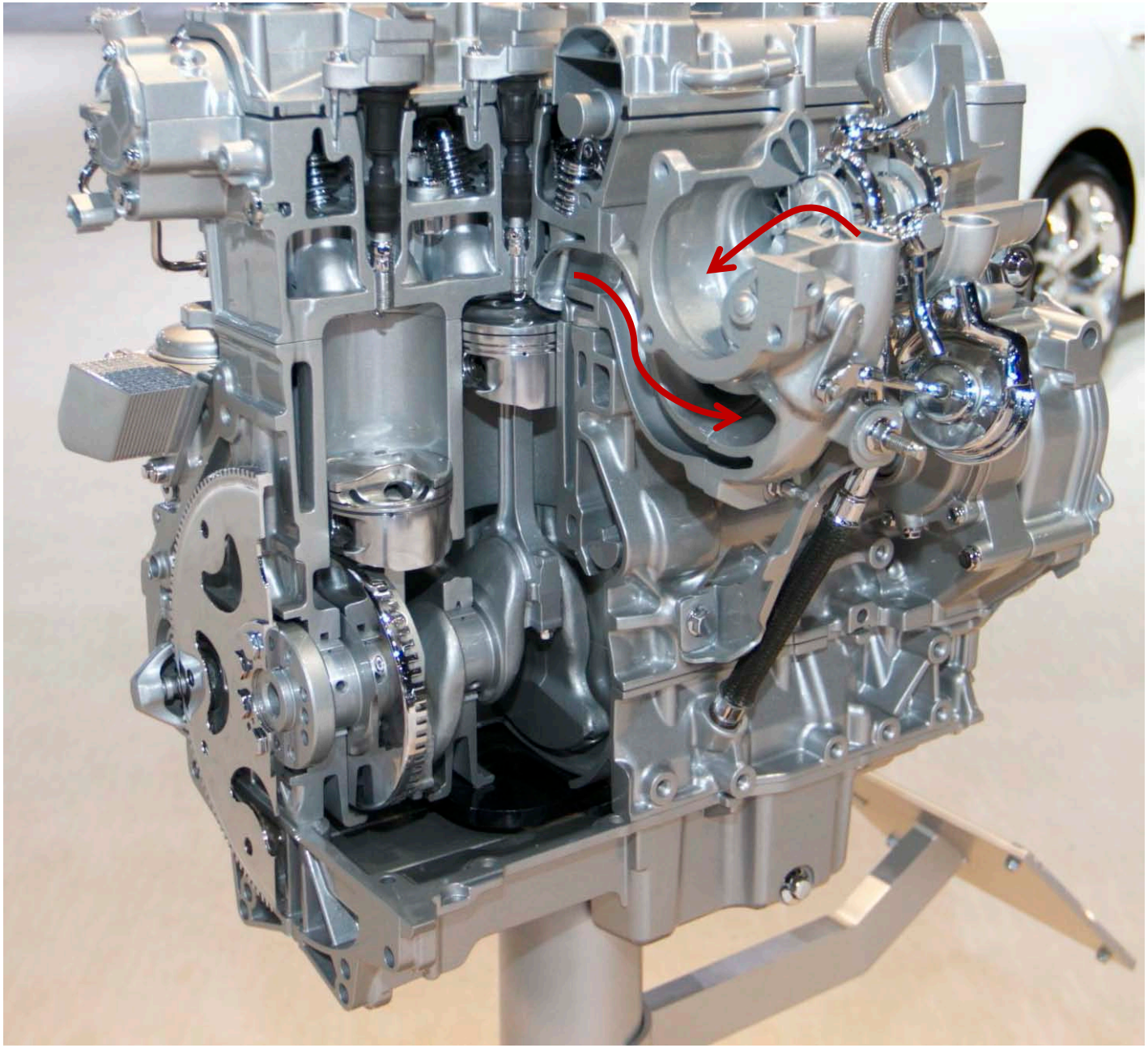
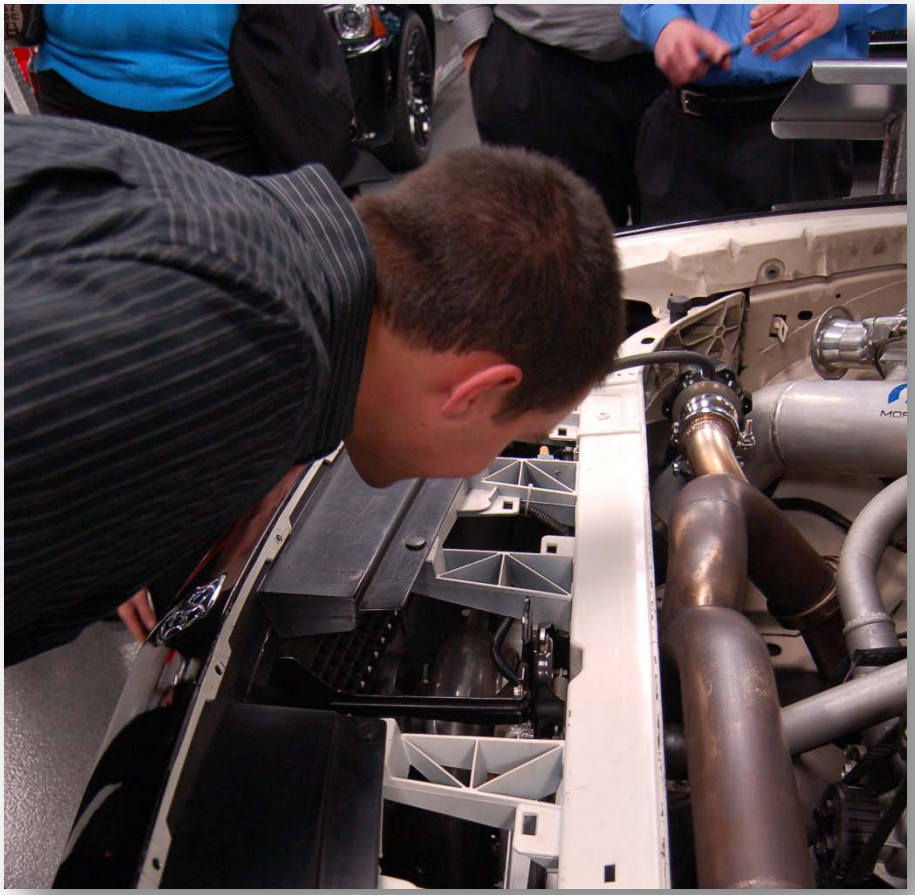
SYSTEM OPERATION

- Exhaust driven supercharger
- Boost pressure increases with load

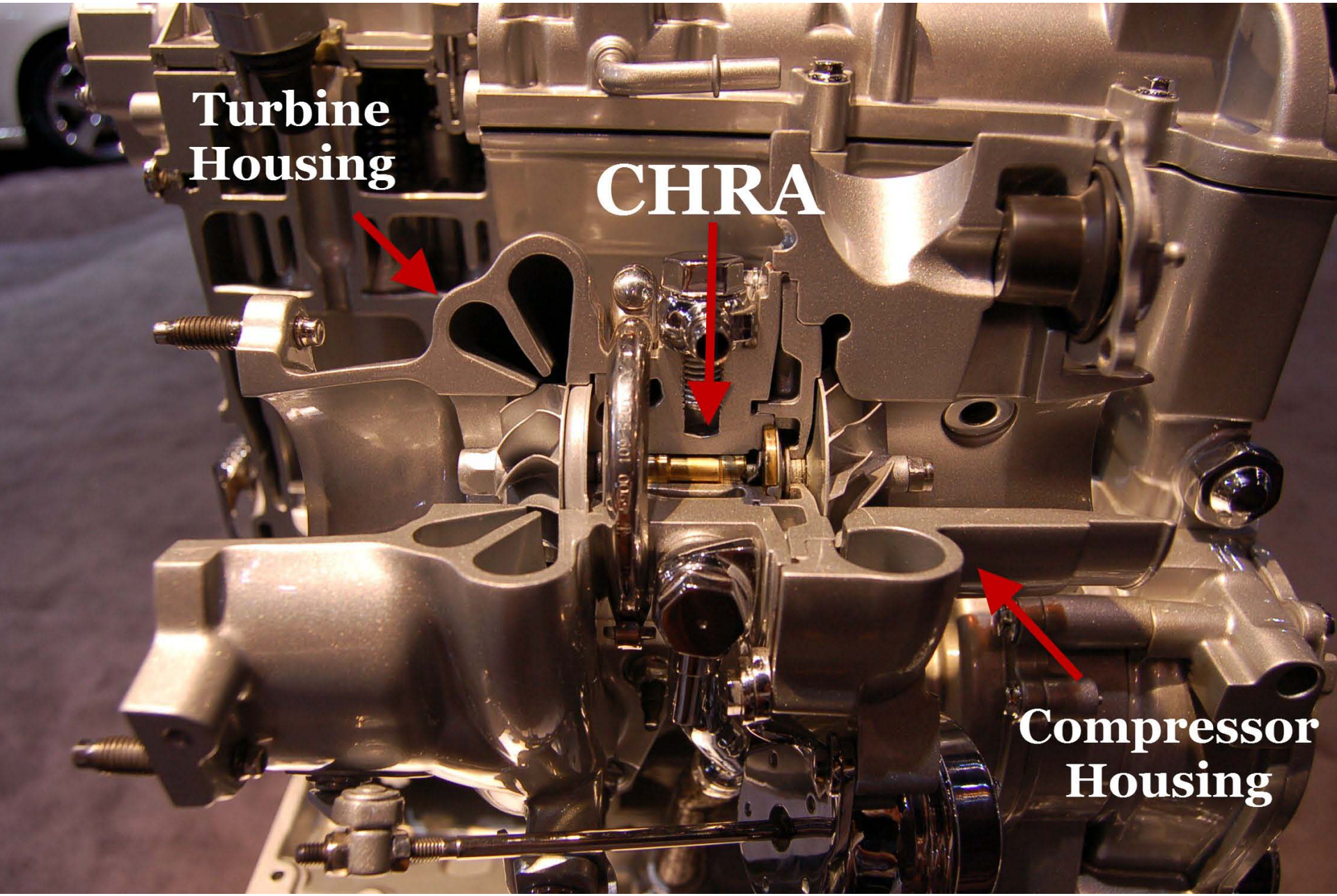




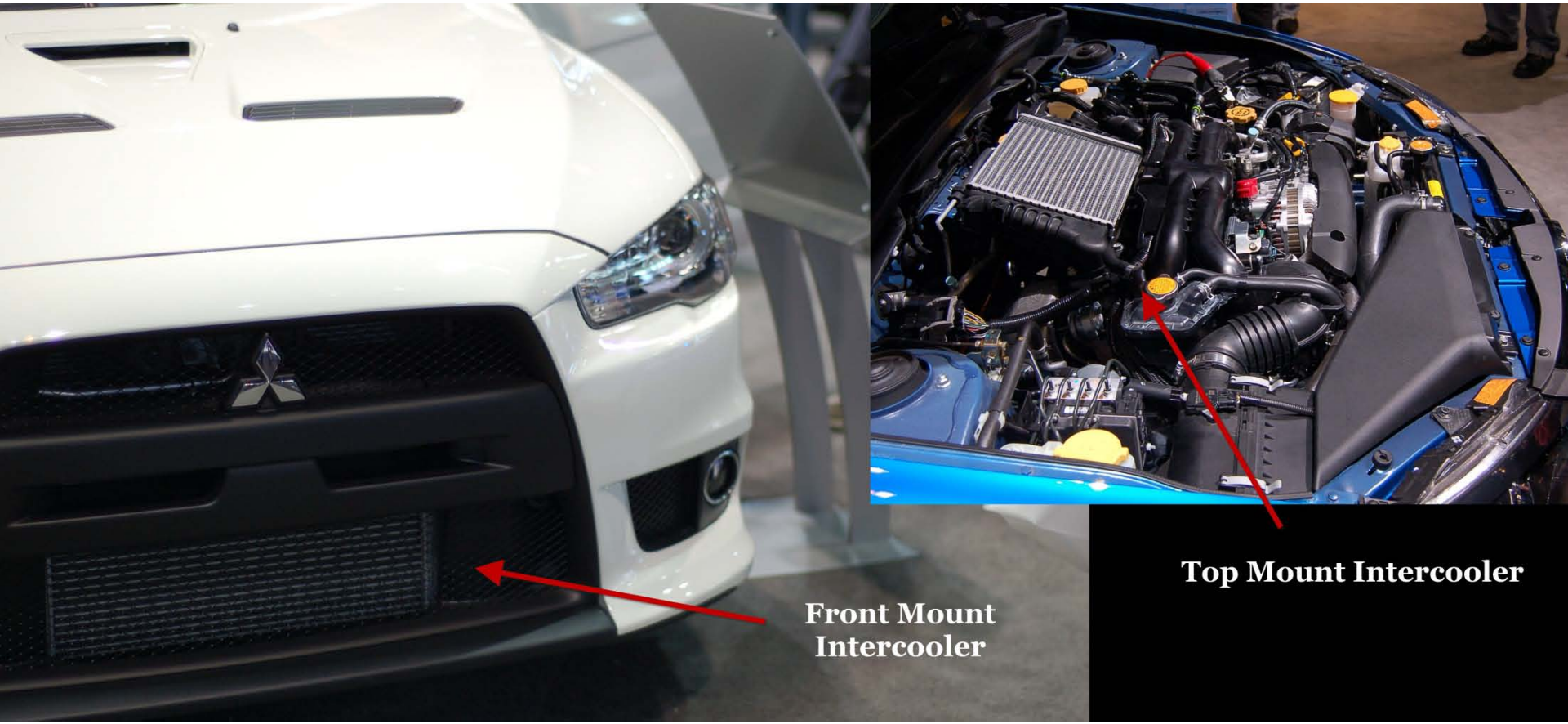
SYSTEM PARTS



- Turbocharger
- Intercooler
- Wastegate
- Bypass Valve

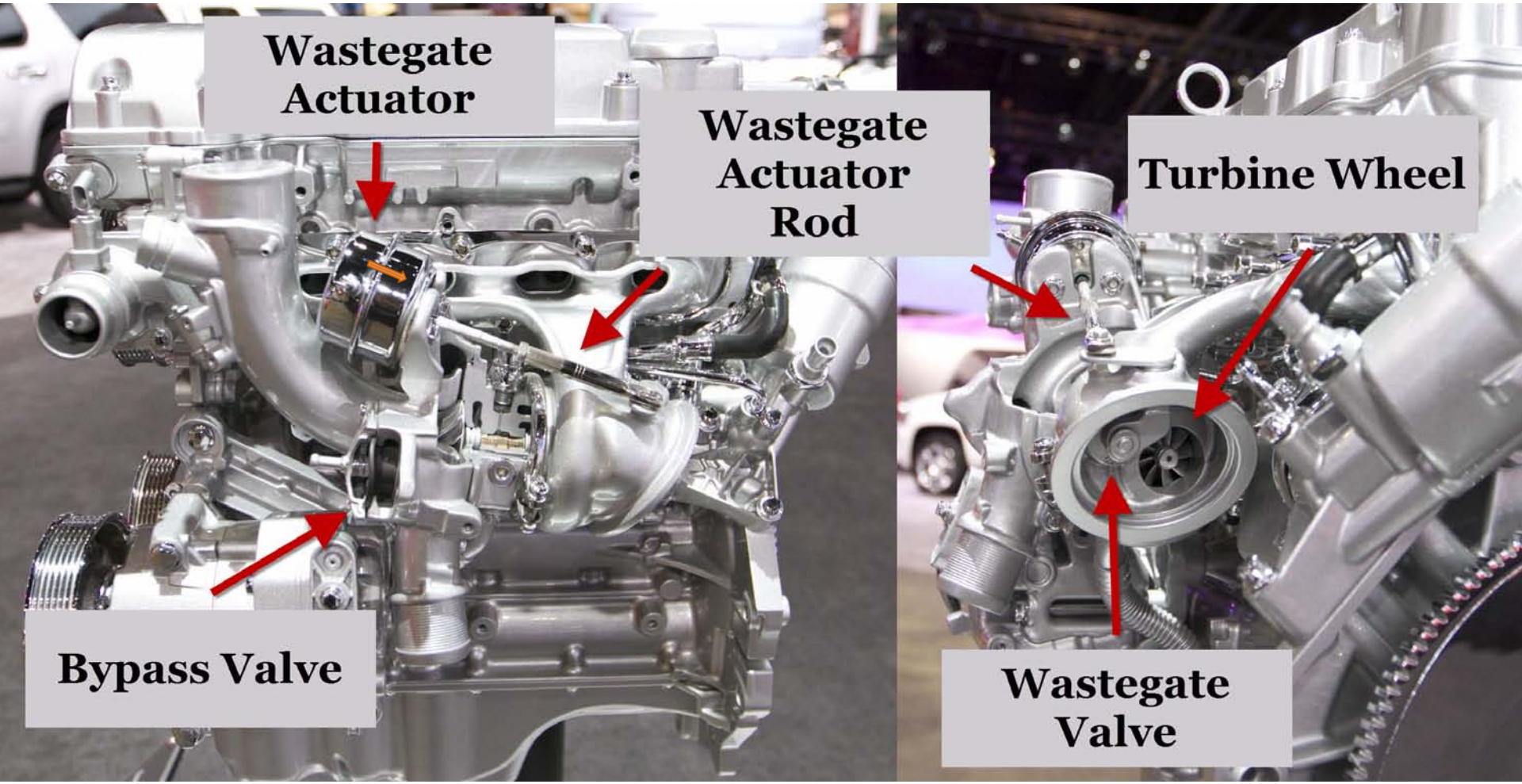

Turbine Housing
CHRA
Compressor Housing

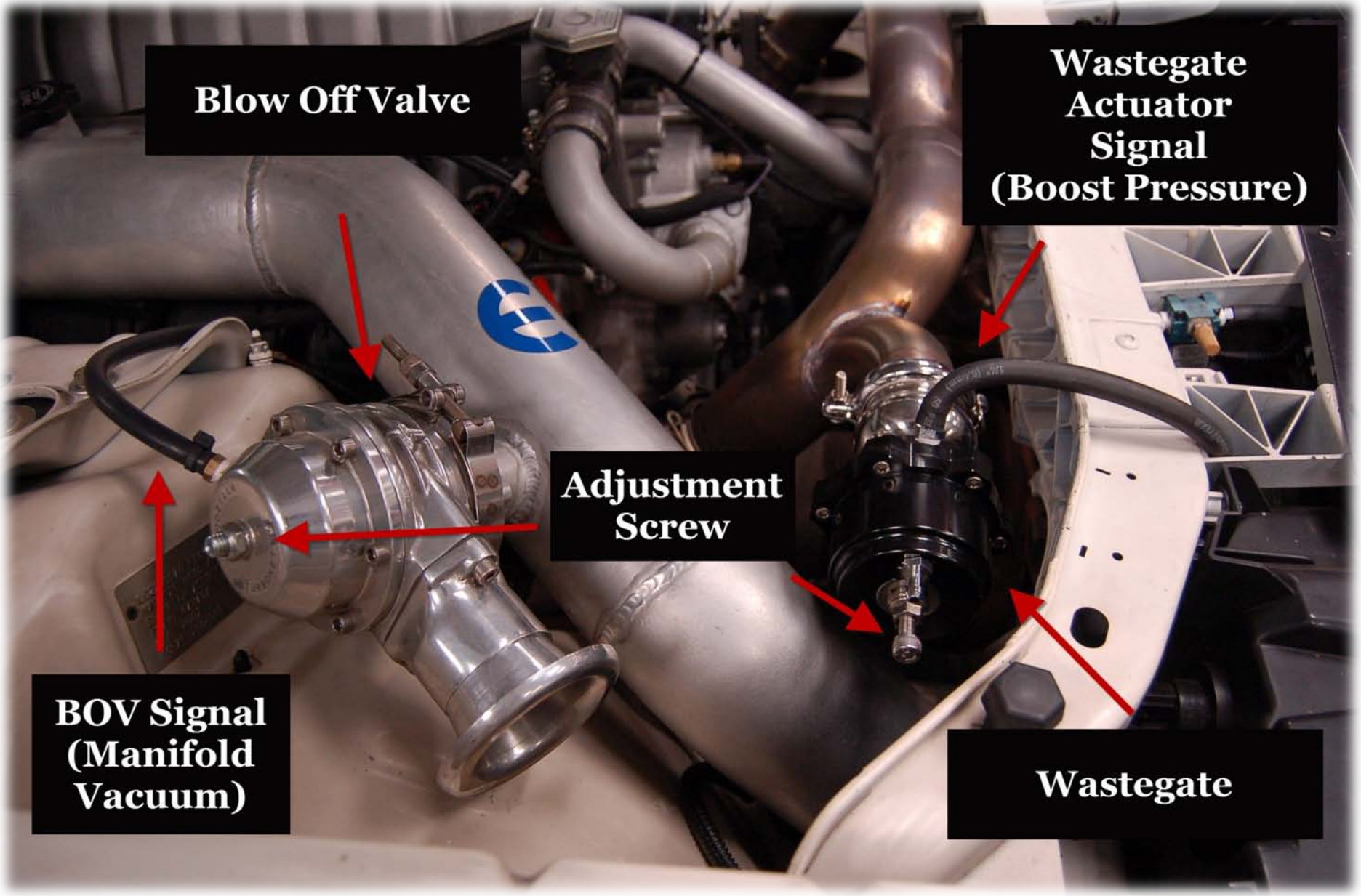
INTERCOOLER



WASTEGATE & BYPASS VALVE

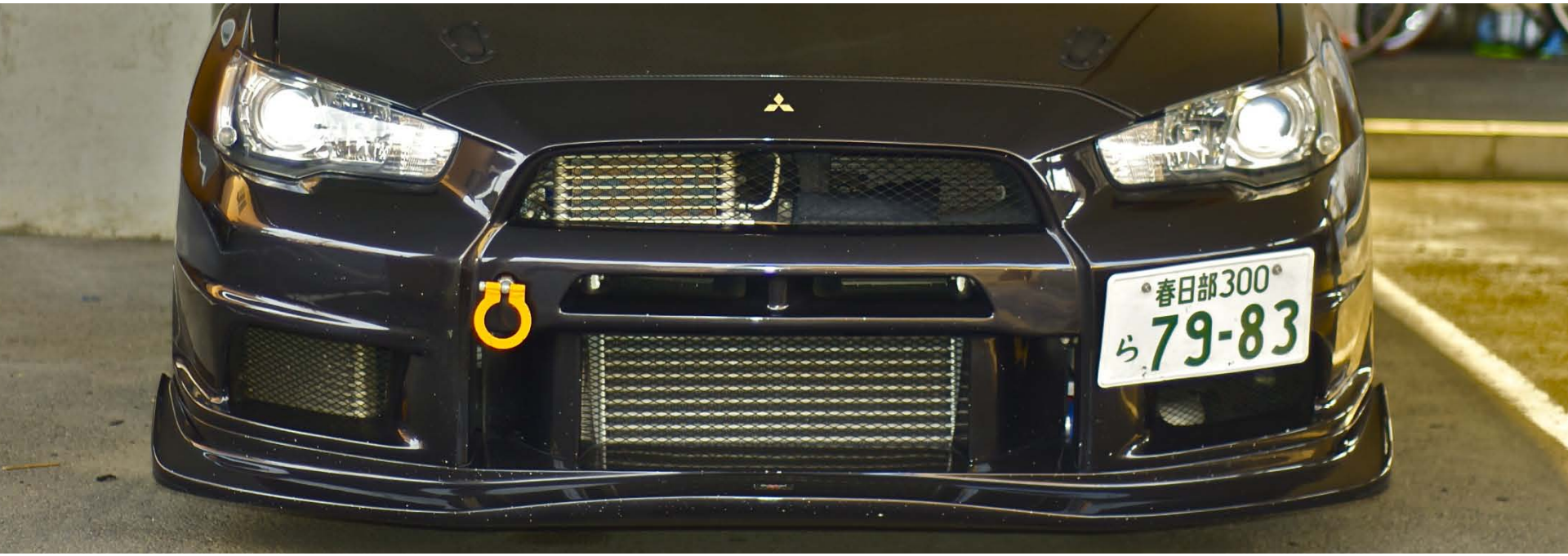
- Wastegate
  - Controls boost under load
  - Redirects exhaust gases around the turbine
    - Back into the exhaust system
    - Out to atmosphere
  - Controlled by boost pressure
- Bypass Valve: Blow Off Valve
  - Controls boost when the throttle is closed
  - Releases boost pressure
    - Back into the compressor inlet after the MAF
    - Out to atmosphere
  - Controlled by manifold vacuum


Wastegate Actuator
Wastegate Actuator Rod
Turbine Wheel
Bypass Valve
Wastegate Valve

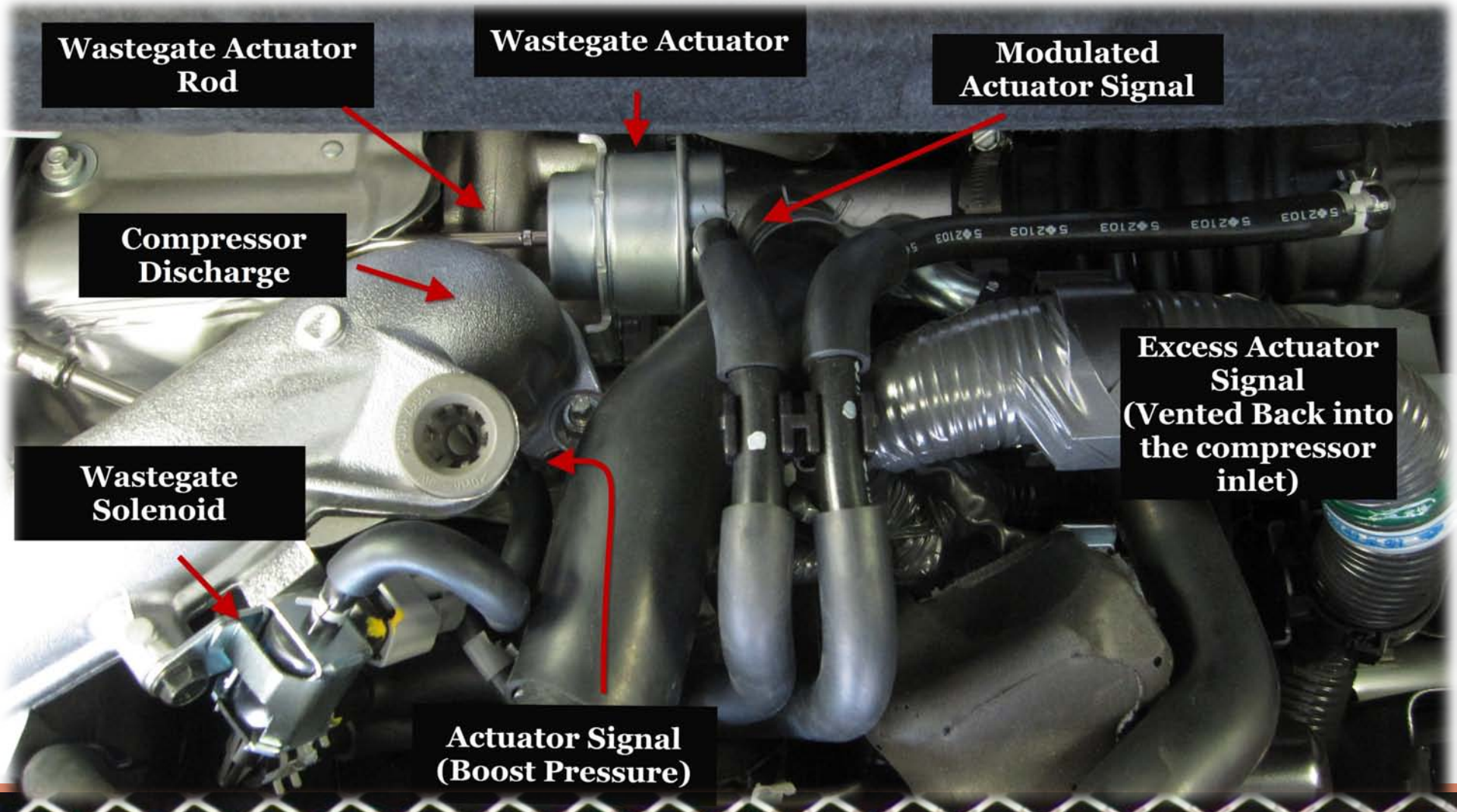

Blow Off Valve
Wastegate Actuator Signal (Boost Pressure)
Adjustment Screw
BOV Signal (Manifold Vacuum)
Wastegate

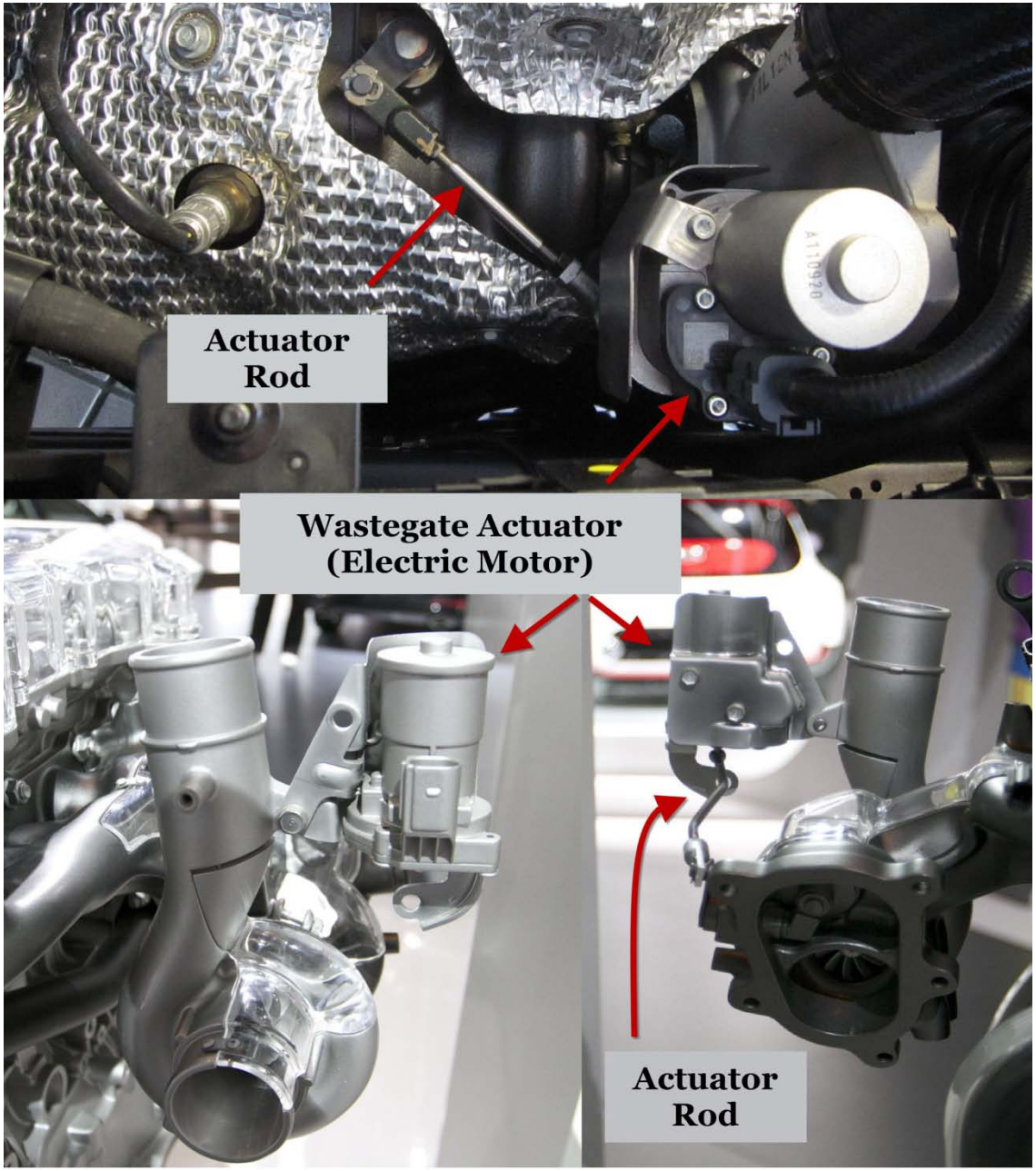
ELECTRONICALLY CONTROLLED WASTEGATE

- Solenoid Controlled
- Directly Driven



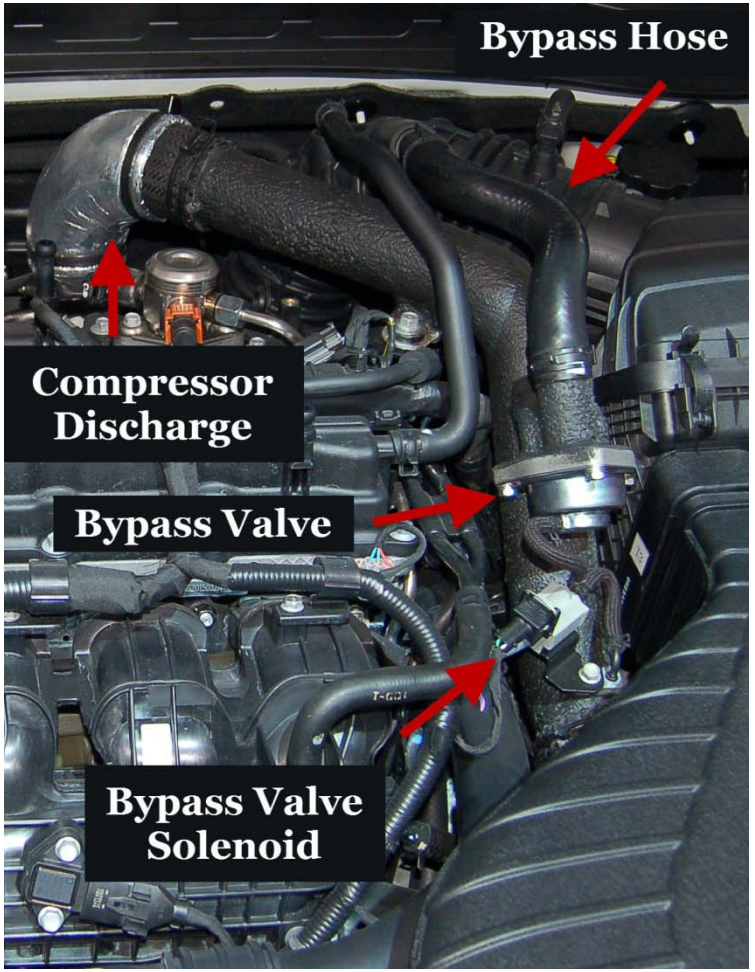
SOLENOID CONTROLLED

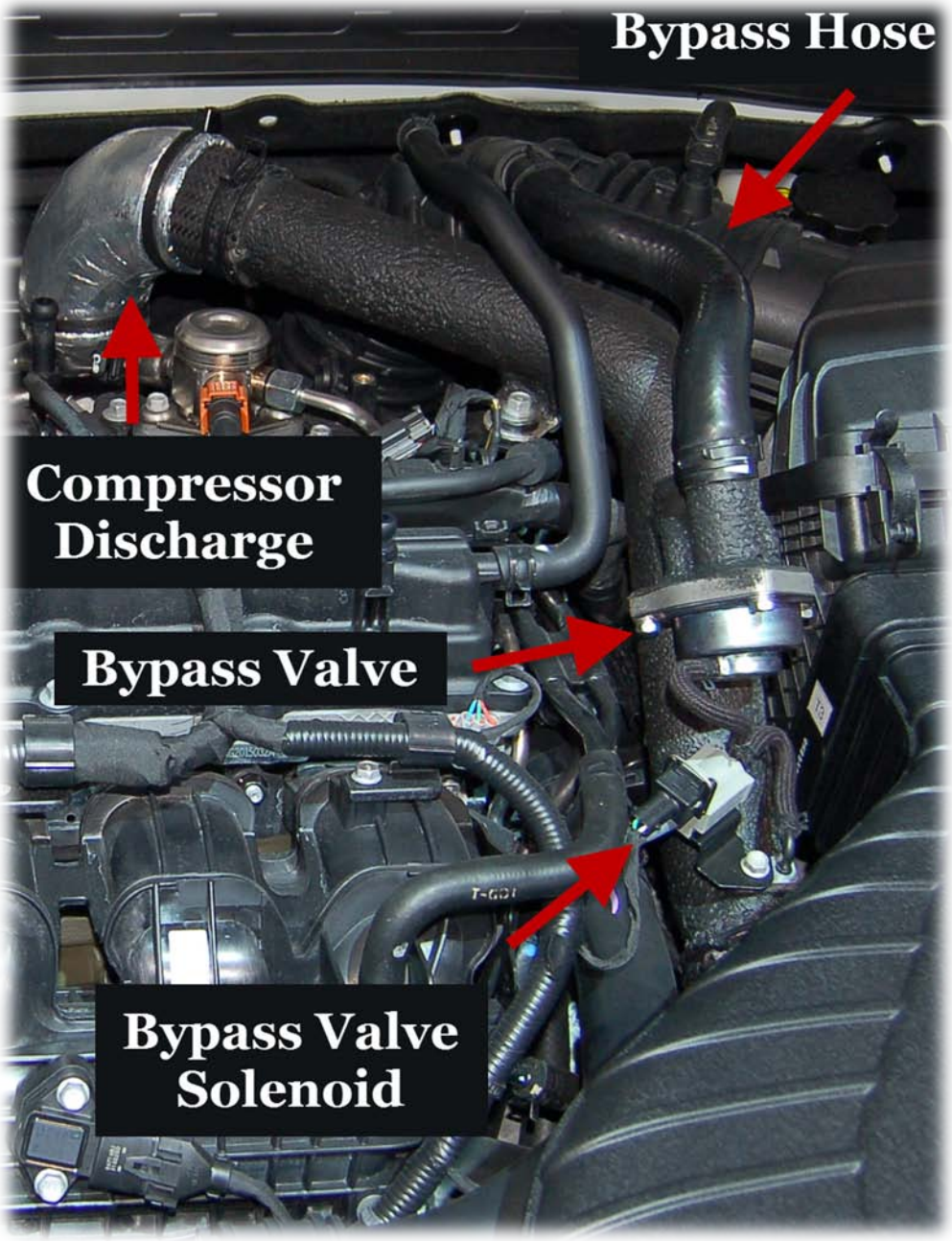



Actuator Rod
Wastegate Actuator (Electric Motor)
Actuator Rod

ELECTRONICALLY CONTROLLED BYPASS VALVE

- Solenoid controls the boost pressure reaching the bypass valve



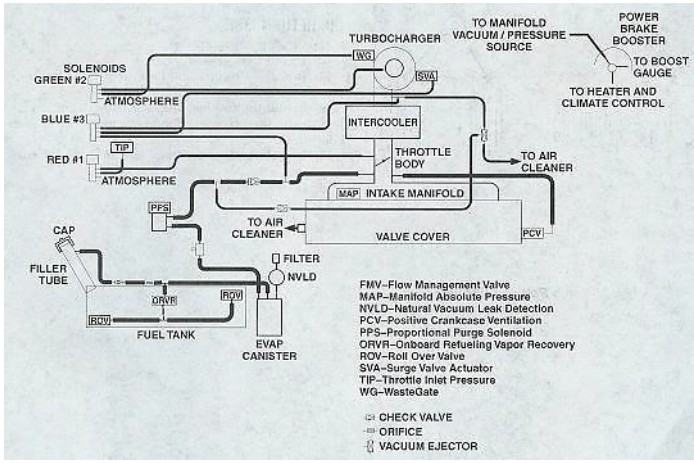

Bypass Hose
Compressor Discharge
Bypass Valve
Bypass Valve Solenoid

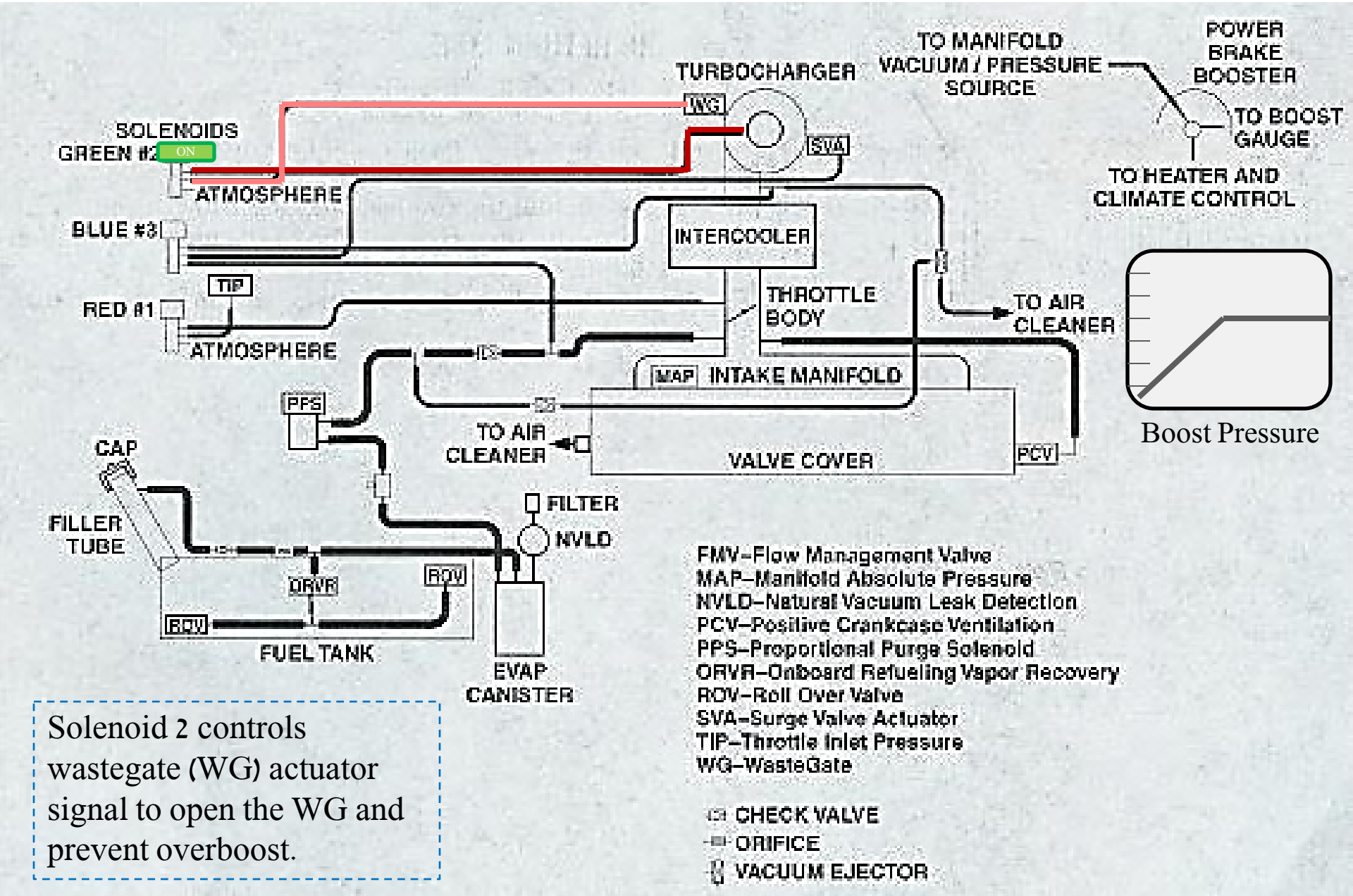
SERVICE AND DIAGNOSTICS

- Oil quality
- Coolant quality
- Aftermarket Parts
- Oscilloscope for Diagnostics
  - Underboost
  - Overboost
  - Surge

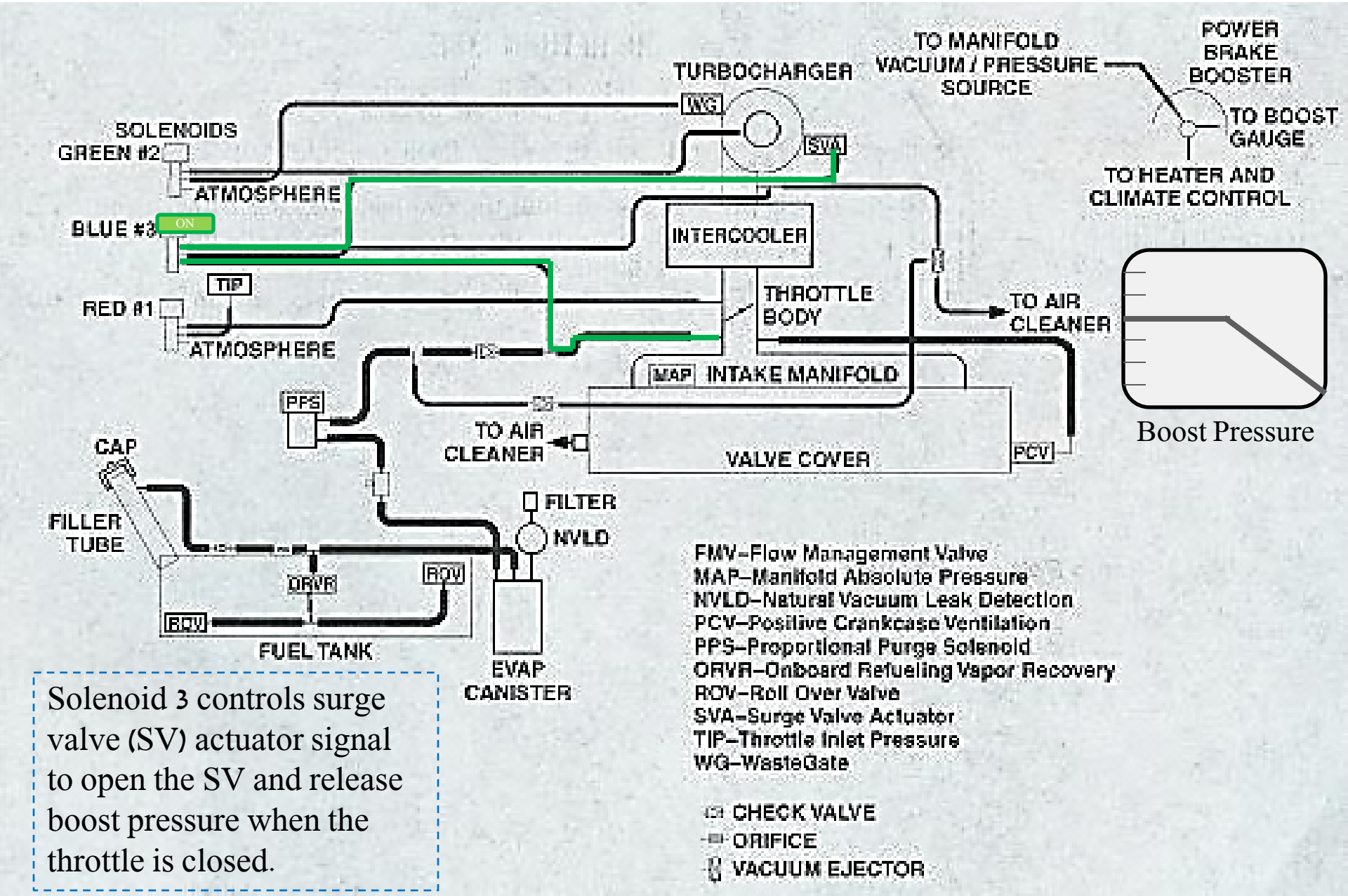
EXAMPLE: 2004 DODGE SRT4

- 3 Solenoids
  1. Throttle Inlet Pressure
  2. Wastegate Actuator
  3. Surge Valve Actuator
- Throttle Inlet Pressure Sensor
- Manifold Absolute Pressure Sensor

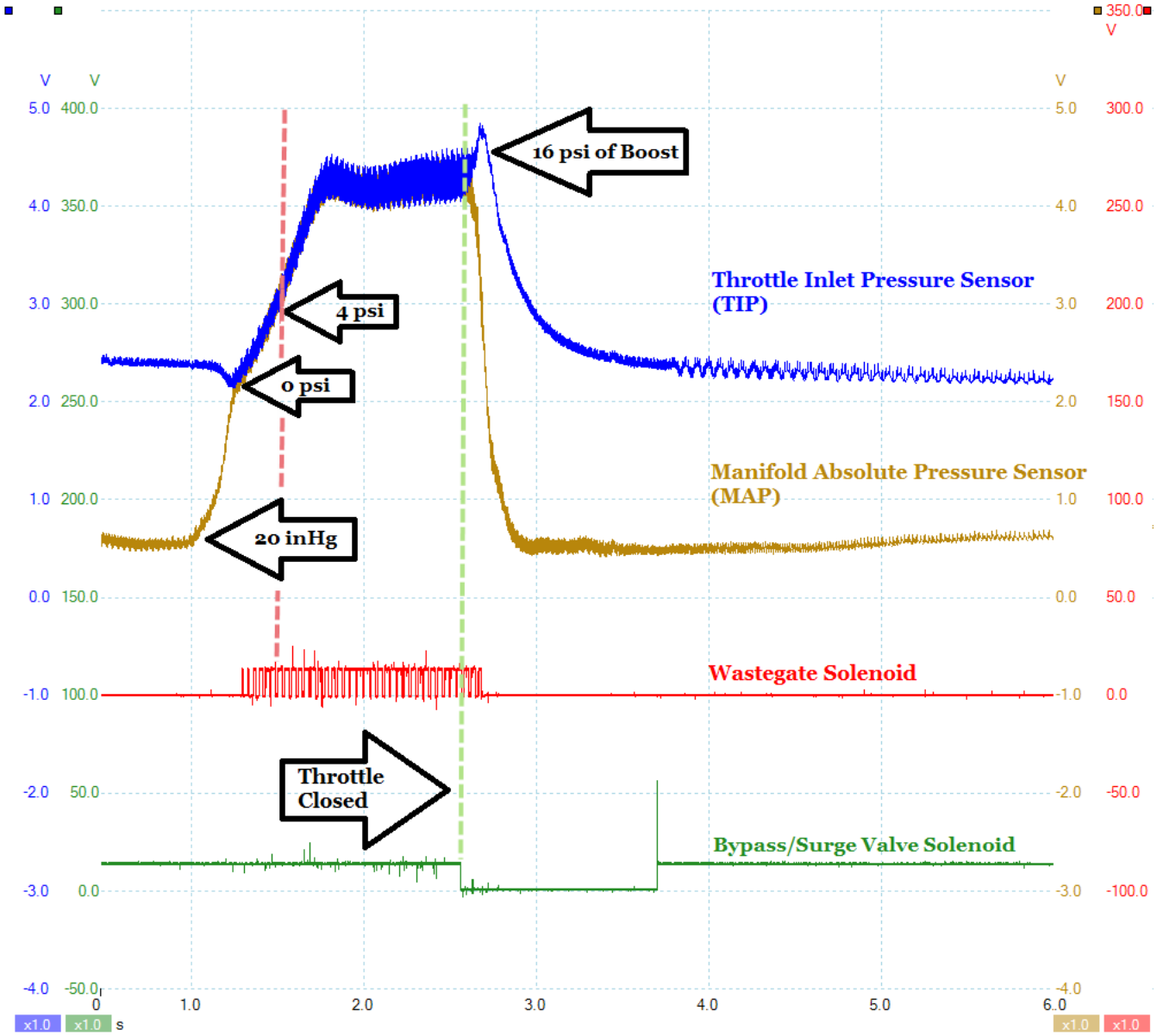


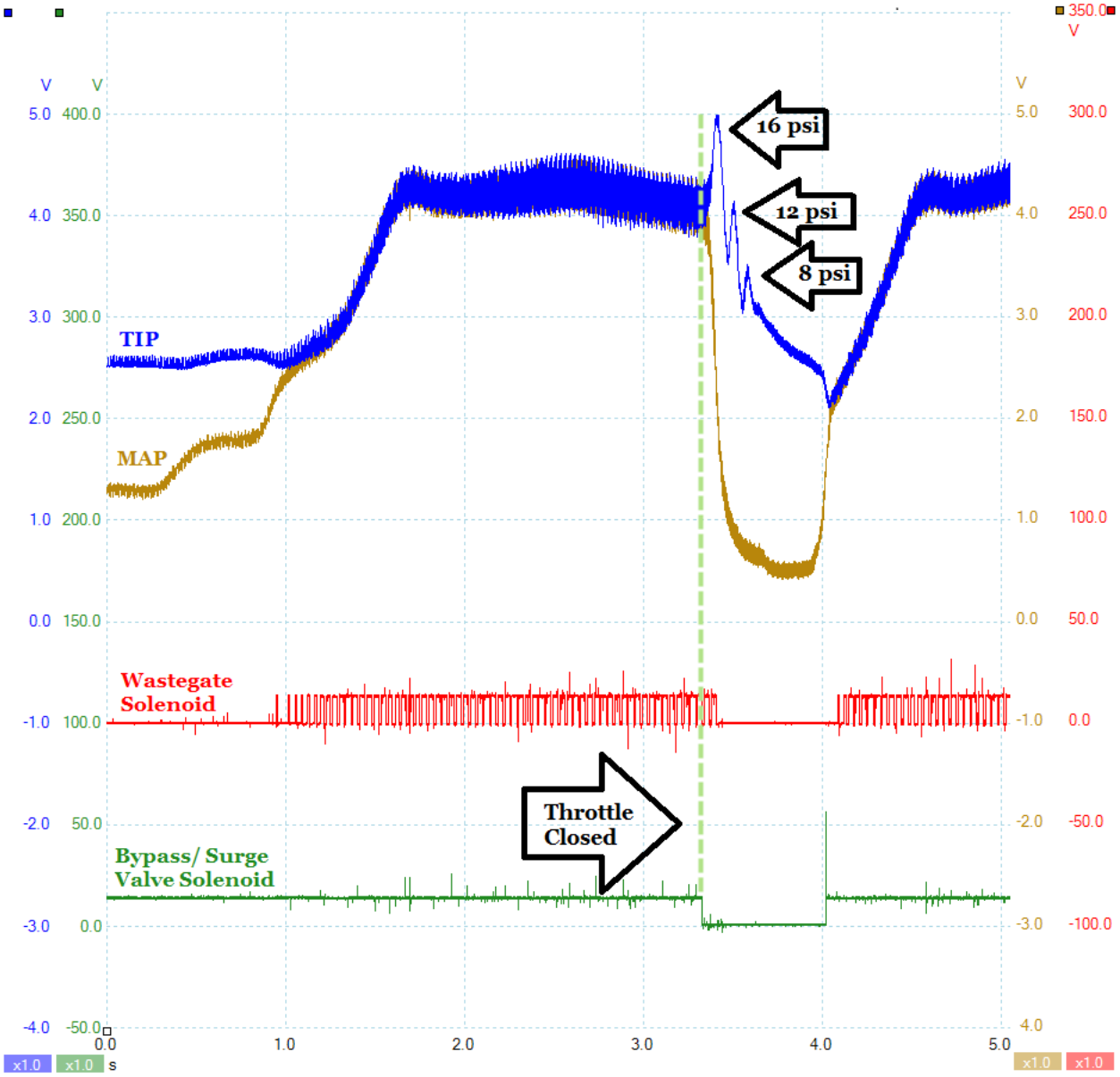


Solenoid 2 controls wastegate (WG) actuator signal to open the WG and prevent overboost.



Solenoid 3 controls surge valve (SV) actuator signal to open the SV and release boost pressure when the throttle is closed.


16 psi of Boost
4 psi
0 psi
20 inHg
Throttle Inlet Pressure Sensor (TIP)
Manifold Absolute Pressure Sensor (MAP)
Wastegate Solenoid
Throttle Closed
Bypass/Surge Valve Solenoid
V
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
0
1.0
2.0
3.0
4.0
5.0
6.0
s
x1.0


16 psi
12 psi
8 psi
TIP
MAP
Wastegate Solenoid
Throttle Closed
Bypass/ Surge Valve Solenoid
V
V
5.0
400.0
4.0
350.0
3.0
300.0
2.0
250.0
1.0
200.0
0.0
150.0
-1.0
100.0
-2.0
50.0
-3.0
0.0
-4.0
-50.0
350.0
V
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
4.0
0.0
1.0
2.0
3.0
4.0
5.0
x1.0
x1.0
s
x1.0
x1.0

QUESTIONS?

THANK YOU!

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