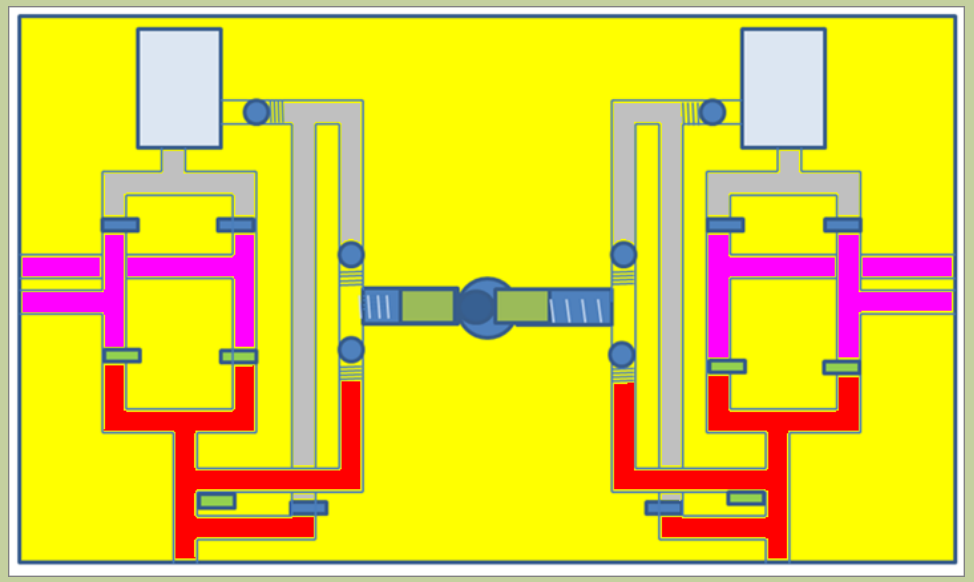
Fall 2010

Basic Stability Systems

Matt Dixon
Southern Illinois University Carbondale, dixonm@siu.edu

Presented at the Fall 2010 ICAIA Conference.

Basic Stability Systems



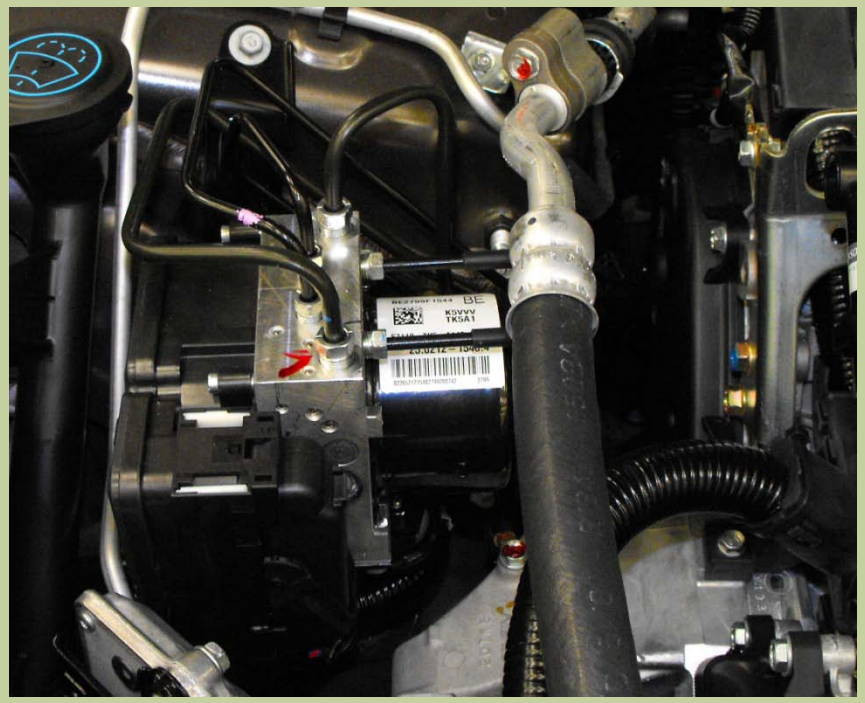
Presented by Matthew Dixon
Assistant Professor, SIU Carbondale
Fall 2010 ICAIA Conference

Basic Stability Systems:

A progression beyond ABS/TRAC with additional components that monitor for and react to situations such as oversteer and understeer.

Basic Stability Systems:

Required for all new models under 10,000 lbs. GVW for 2012 M.Y. by **FMVSS 126**



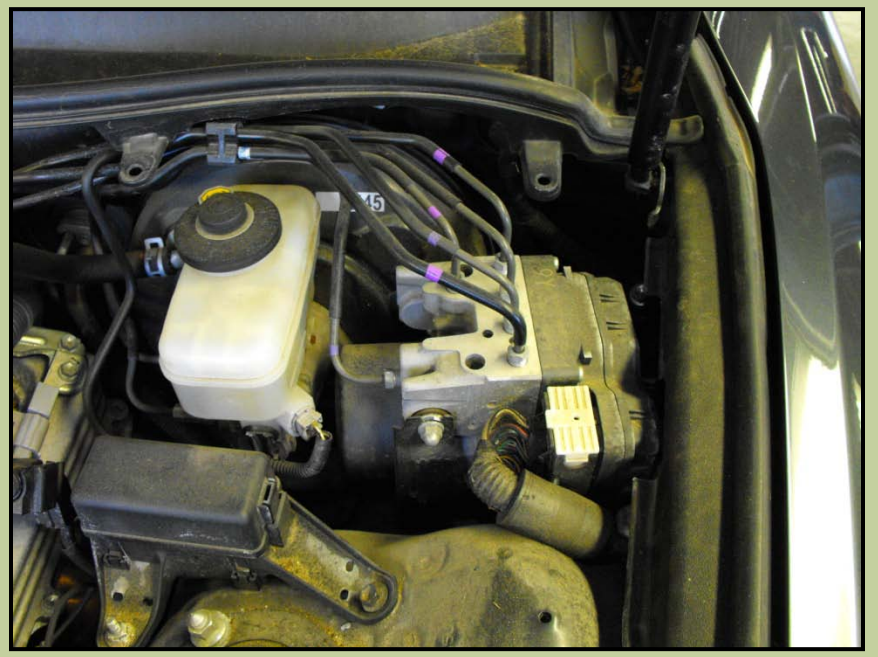
2010 Acura TL
ABS/TCS/VSA unit

Stability: Components

Master Cylinder:

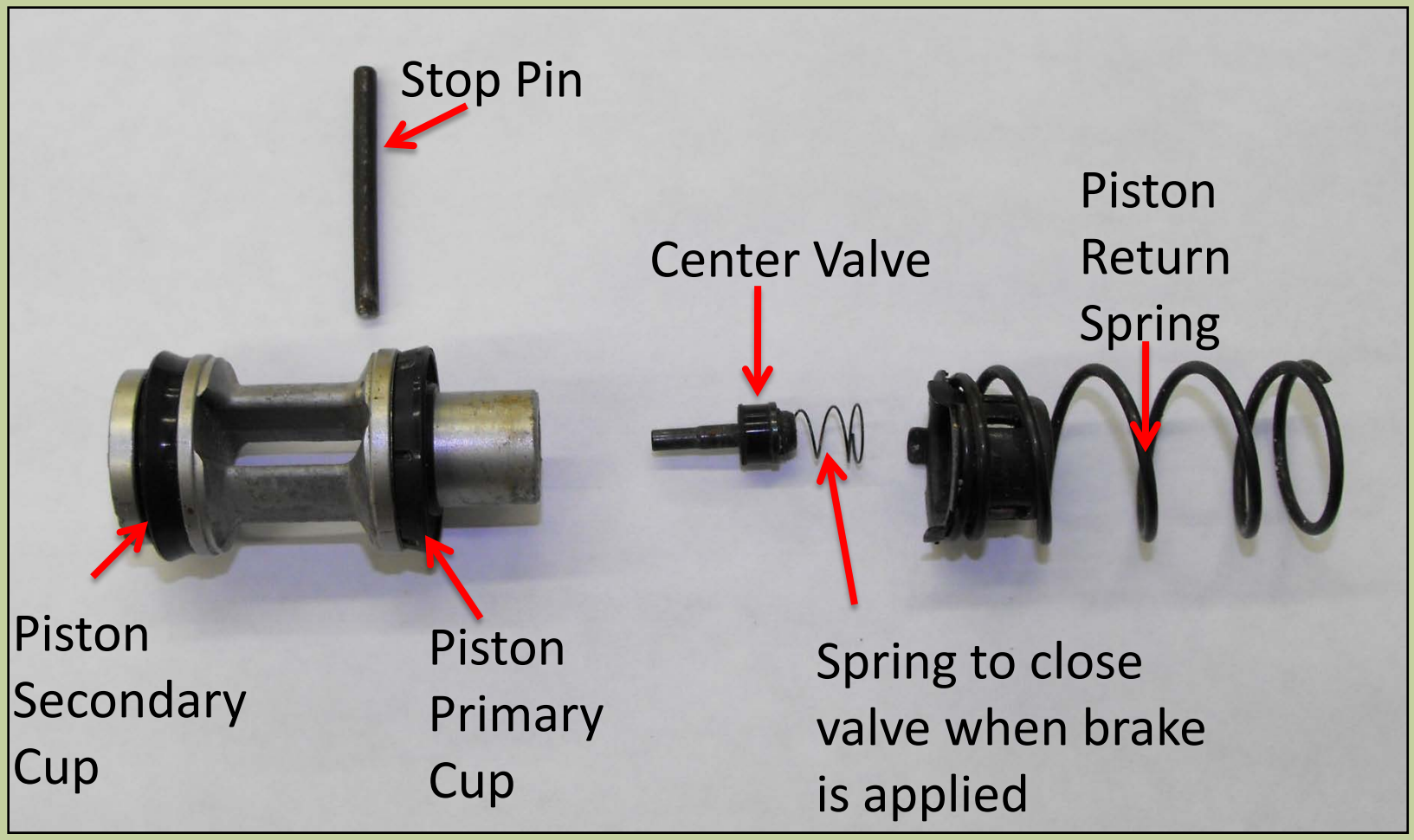
Center valve type

allows for rapid fluid transfer from reservoir to pump inlet



Replaces compensating port style

Stability: Components

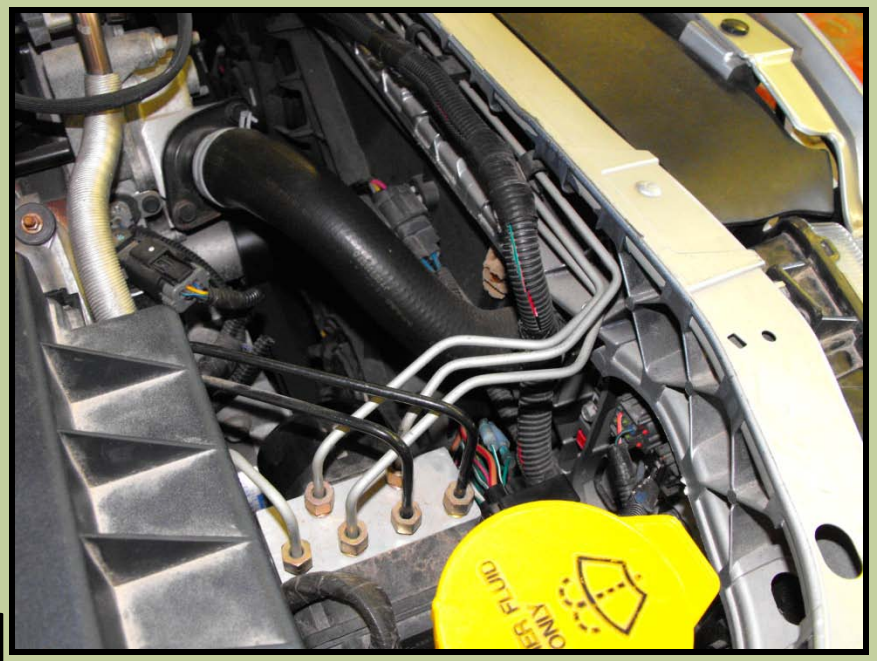


Stability: Components

Integral ***ECU*** and
hydraulic control unit

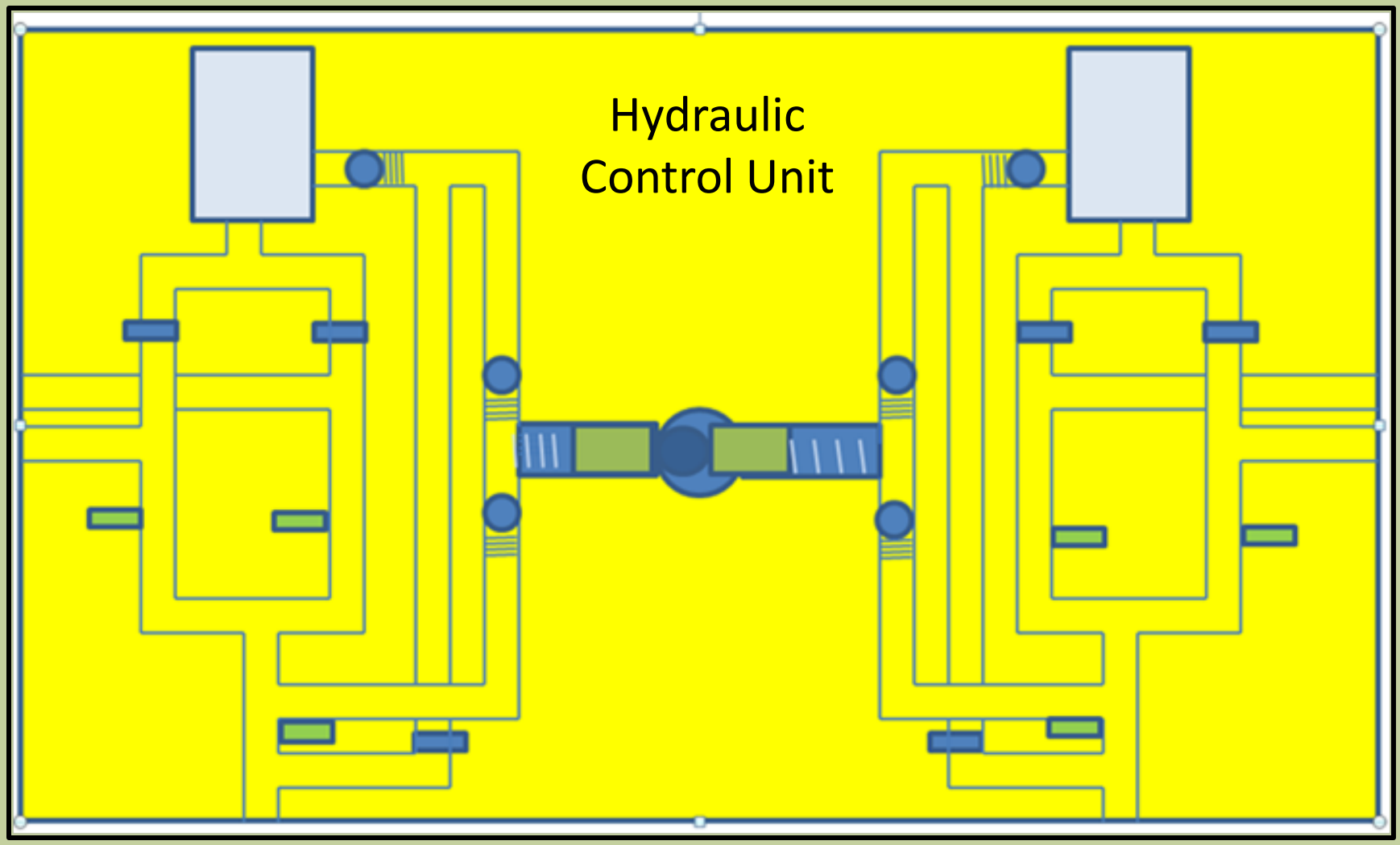
ESC requires 4 channels

Typical system utilizes
12 valves/ solenoids and
integral motor/pump

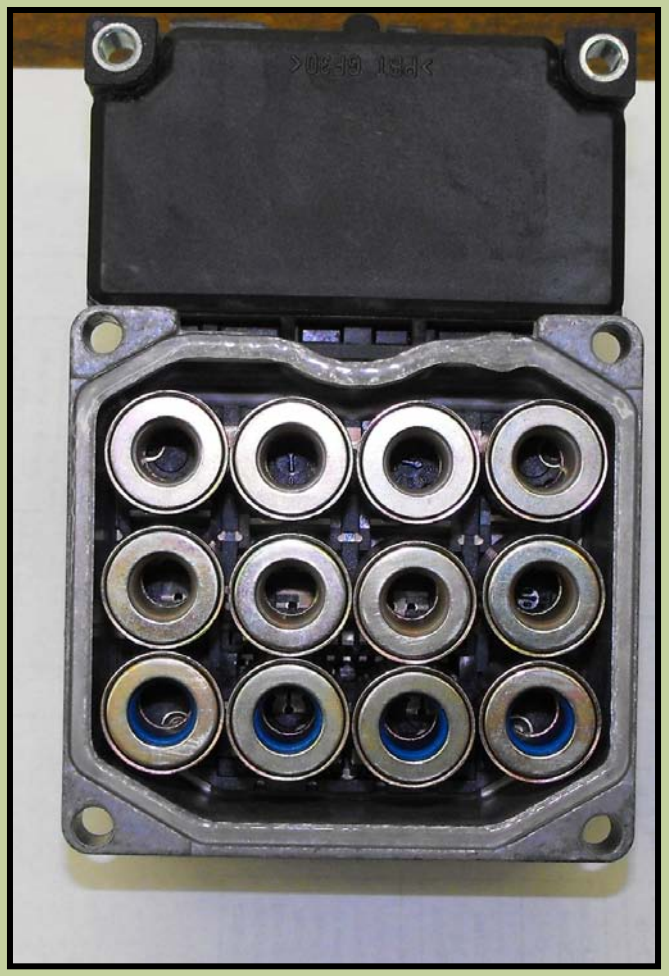


‘05 Chrysler 300C,
notice line routing

Stability: Components



Stability: Components



ECU

Contains the electronics and the solenoids that react on the valves

Stability: Components

ESC Off switch

Not required, if used
default is “on” for
every ignition cycle

“Off icon” required

Input may be to another
ECU

Stability: Components

Indicator on instrument cluster

Standardized symbol

Option to flash icon during a stability event

Stability: Components

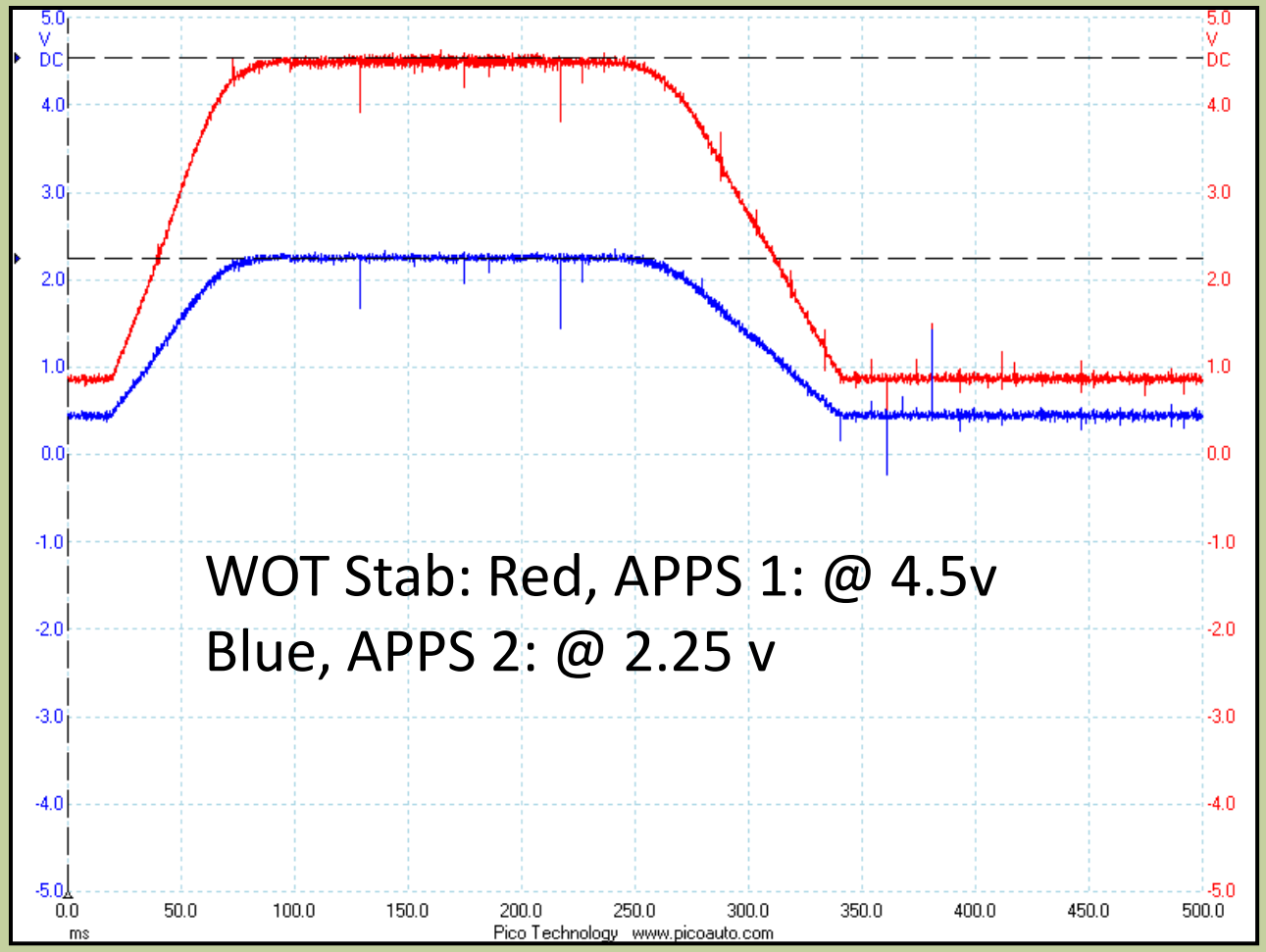
Accelerator Pedal Position Sensor (APPS 1 and 2)

Position % calculated by PCM and broadcast over network

Driver intention necessary for torque reduction requests

Stability: Components

APPS 1 and 2 on '08 Dodge



Stability: Components

Electronic Throttle Control

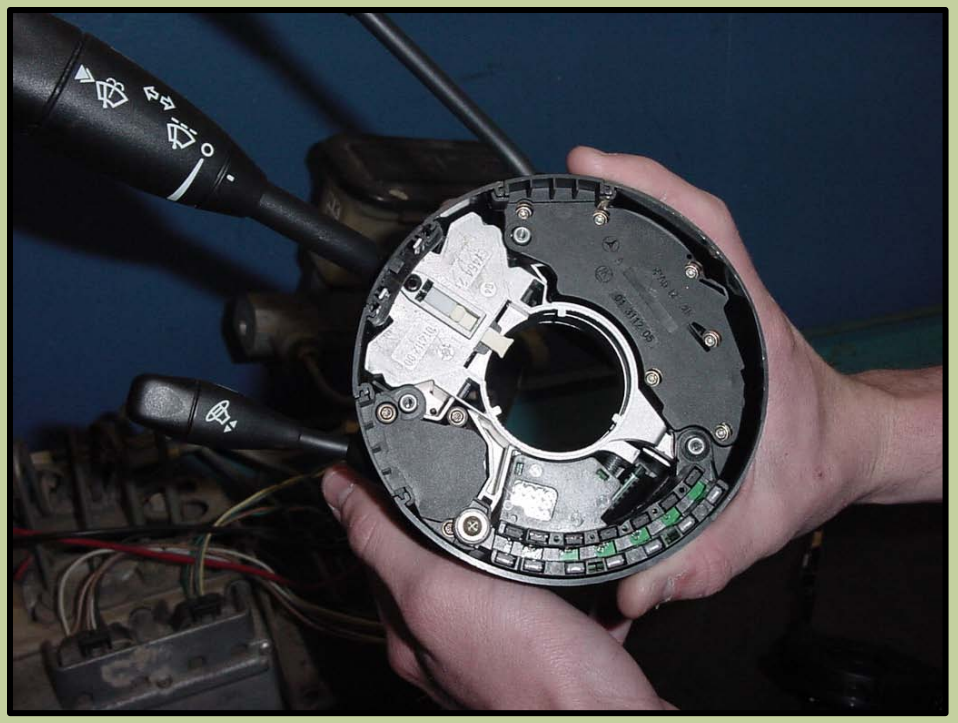
Primary output of PCM to reduce engine torque

PCM can also reduce spark advance, cut injector pulsewidth

Stability: Components

Steering Angle Sensor (SAS)

Most late model units provide serial data over dedicated or non dedicated CAN



‘05 Chrysler 300 SAS photo diode/LED; part of SCM

Stability: Components

Steering Angle Sensor (SAS)

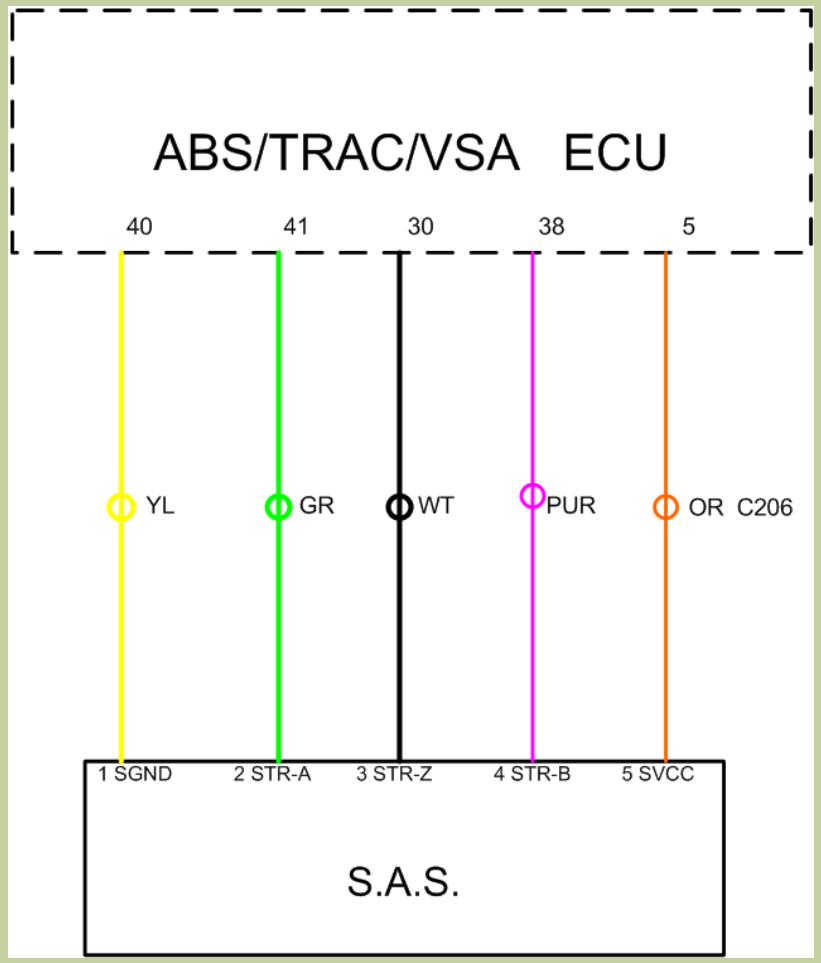
May be several sensors within one

Measures driver intent usually in degrees

STEERING ANGLE SENSOR STATUS	Normal	
STEERING ANGLE	18.00	°
Z-PHASE	3.56	V

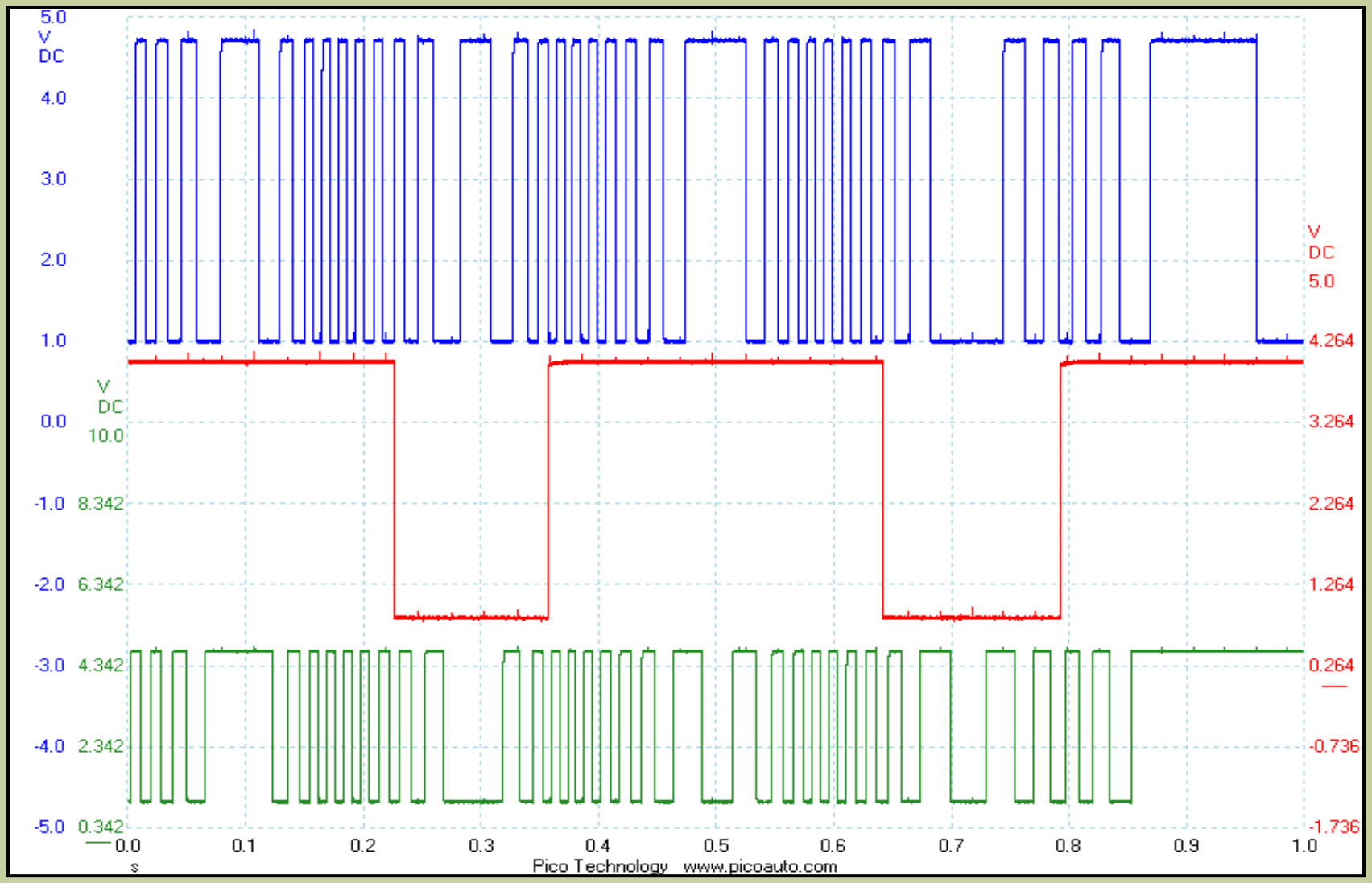
Stability: Components

Typical wires: Power, Ground, Communication lines



S.A.S. on 2010 Acura TL

SAS: ‘04 Acura TL non serial type



Stability: Components

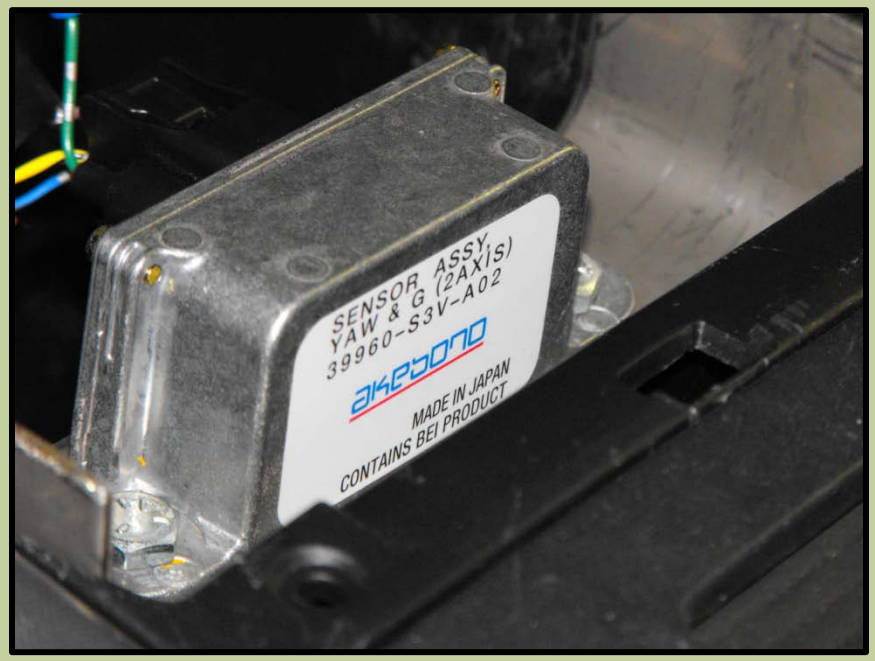
Lateral Accelerometer:

Units: g force

Yaw Accelerometer:

Units: degrees per second

Compare to steering input, and wheel speed sensors to determine understeer, oversteer



2004 Acura TL analog unit

Stability: Components

Common units for lateral and longitudinal movement is ***g's***

Common unit for yaw is ***degrees per second***

LATERAL ACCELERATION SENSOR STATUS	Normal	
LATERAL ACCELERATION SENSOR	0.00	G
LONGITUDINAL ACCELERATION SENSOR STATUS	Not Installed	
LONGITUDINAL ACCELERATION SENSOR	0.00	G
YAW RATE SENSOR STATUS	Normal	
YAW RATE SENSOR	0	°/s

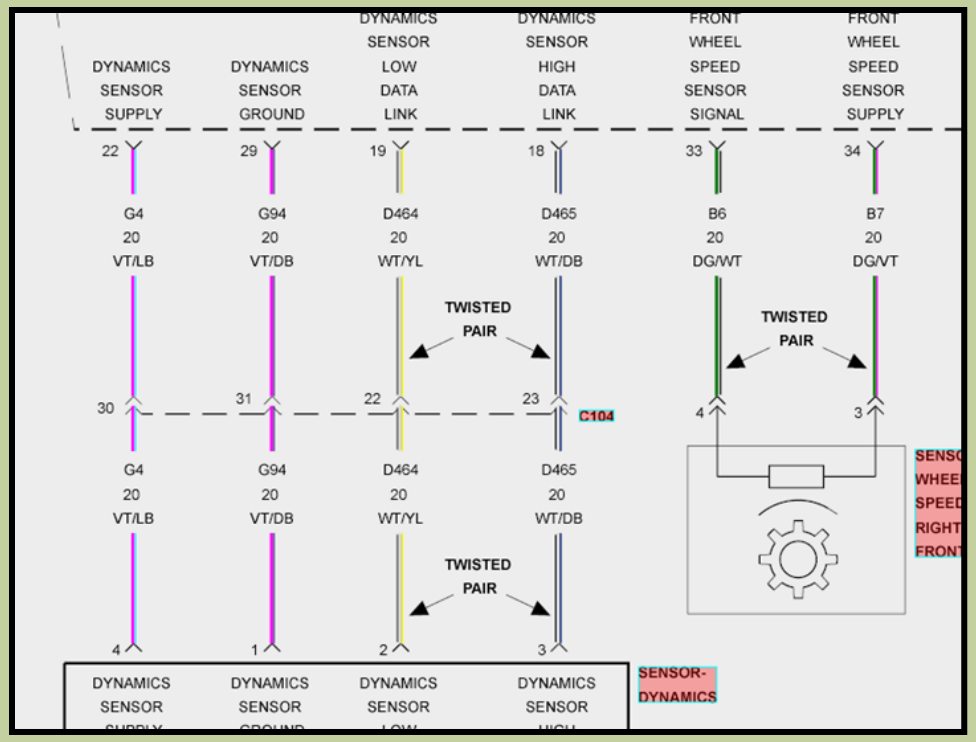
‘04 Acura TL non serial data type

Moving sensor by hand

Stability: Components

Lateral, Yaw sensors may be combined into a ***sensor cluster***, may also include a longitudinal sensor and or a roll sensor

Typically provide serial data on a dedicated C.A.N.



Chrysler 300C sensor cluster

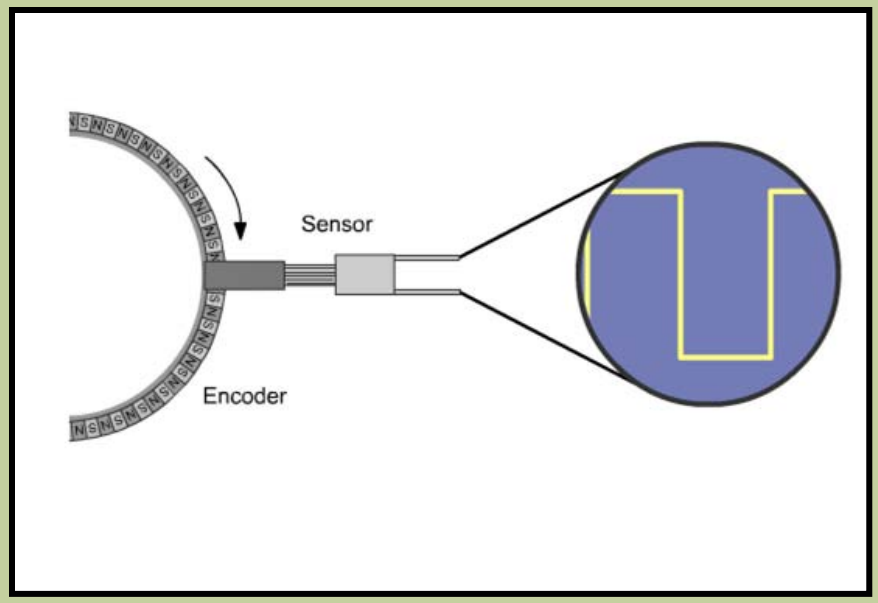
4 wires: Power, Ground, Network+, Network -

Stability: Components

Wheel Speed Sensors

Current vehicles provide DC signals

Digital type sensors can read under 1 MPH

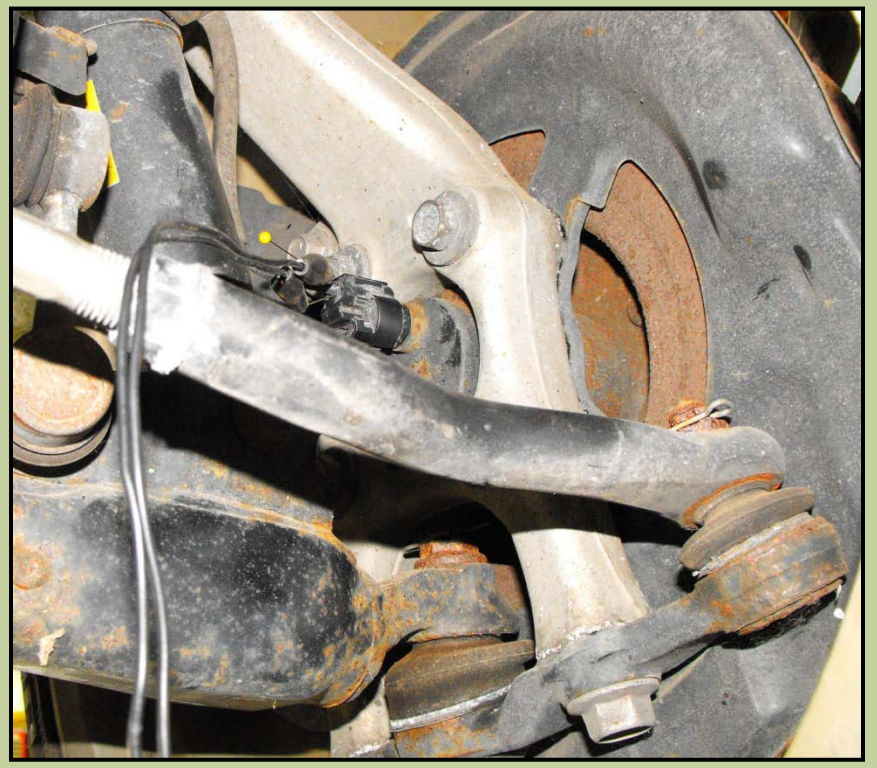


Magnetic Encoder type sensors do not use a conventional tone ring

Stability: Components

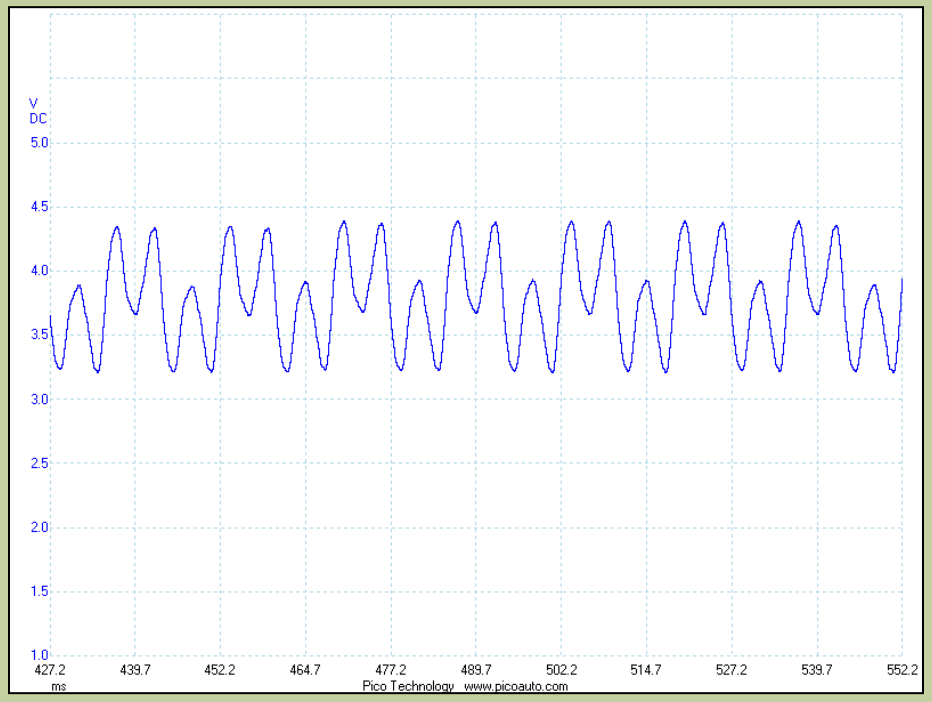
Wheel Speed Sensors

Toyota/Lexus magnetic encoder sensor provides different amplitudes forward vs. reverse rotation?

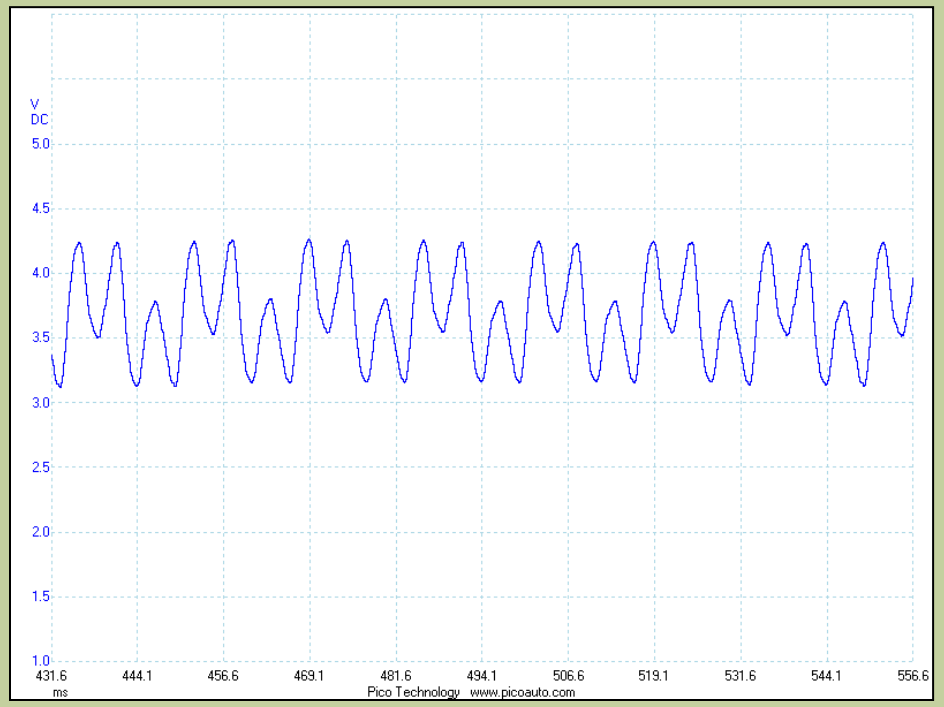


Stability: Components

'06 Lexus IS 350: no rotational difference noted



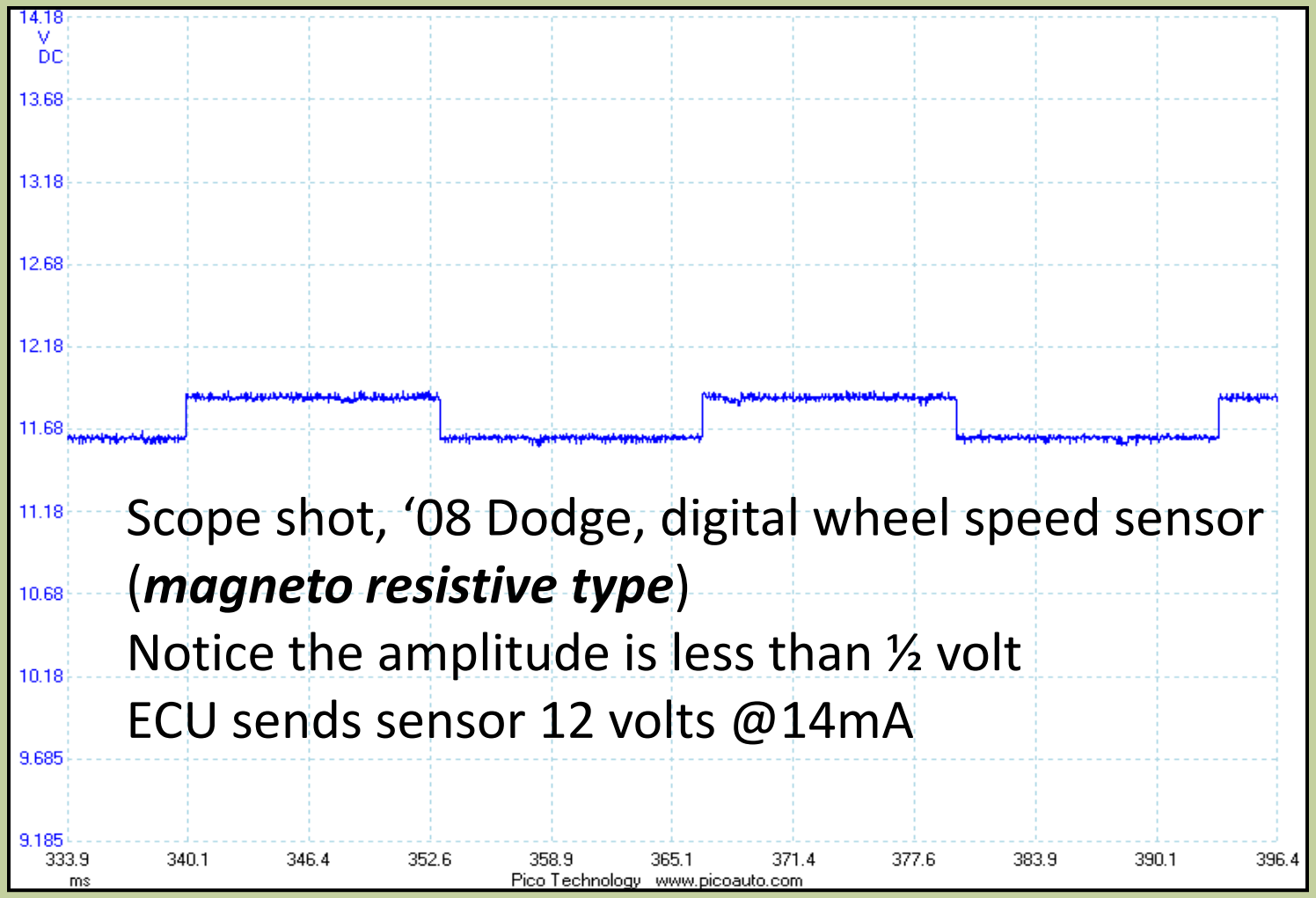
Forward



Reverse

Stability: Components

Wheel Speed Sensors



Scope shot, ‘08 Dodge, digital wheel speed sensor (***magneto resistive type***)

Notice the amplitude is less than ½ volt

ECU sends sensor 12 volts @14mA

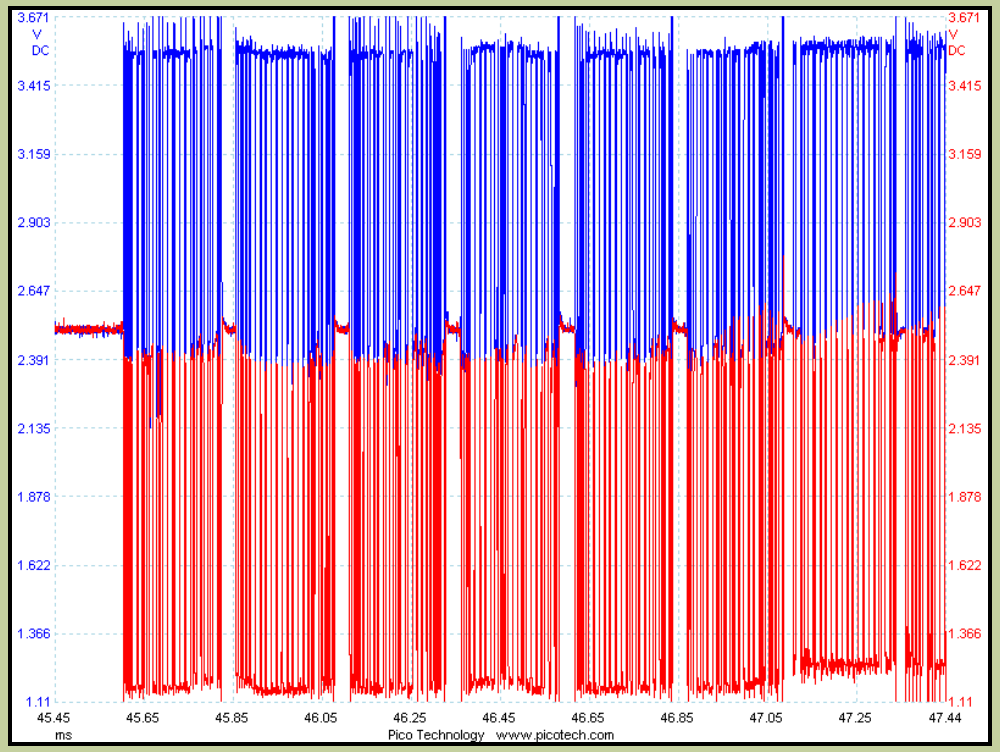
Stability: Components

Networks:

CAN high speed (F CAN, CAN C, GM LAN)

Many use “private” networks for SAS or sensor cluster

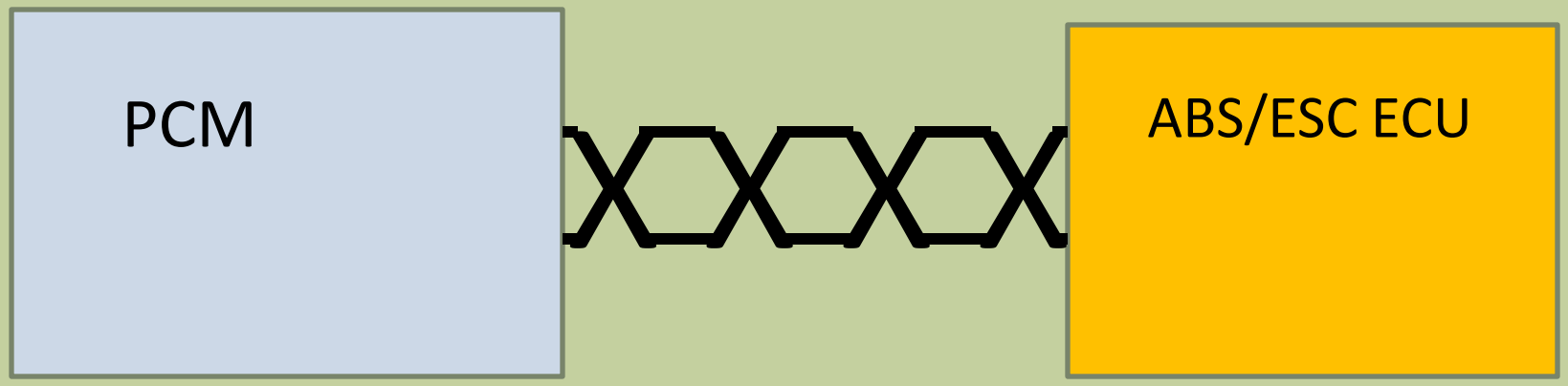
Other CAN’s or an ISO K-Line may also be used



Blue: CAN + Red: CAN – at DLC on ‘07 Nissan Maxima

Stability: Components

Networks:



Torque reduction request and confirmation rely on high speed C.A.N. two wire twisted pair

Stability: Components

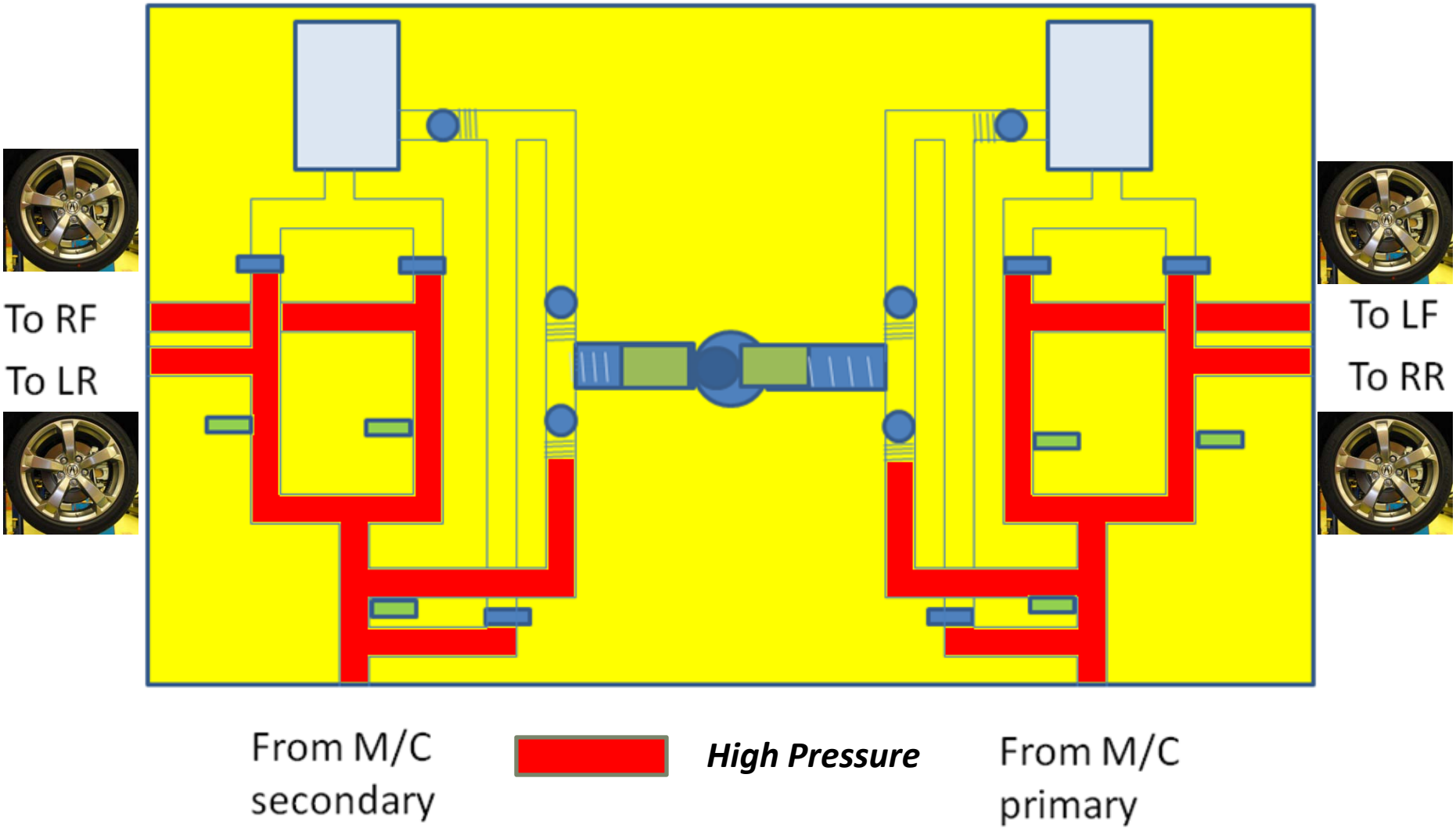
Brake Switch

Some systems may use a pressure sensor or travel rate sensor

Alerts ECU of driver intention and used for traction control

This example: 3 momentary contact switches:
2 normally closed,
1 normally open

Default pressure build mode



Situation1: Vehicle Understeer

Wheels turn, vehicle “pushes” in straight line, front wheels typically slow compared to rears

Vehicle Understeer: ECU view point

INPUTS	
SAS:	**+ 47°**
Yaw:	**1° per second**
Lateral:	**.002 G**
APPS:	0%
Brake:	not applied
VSS:	39 MPH
LF:	34 MPH
RF:	33 MPH
LR:	42 MPH
RR:	42 MPH

OUTPUTS

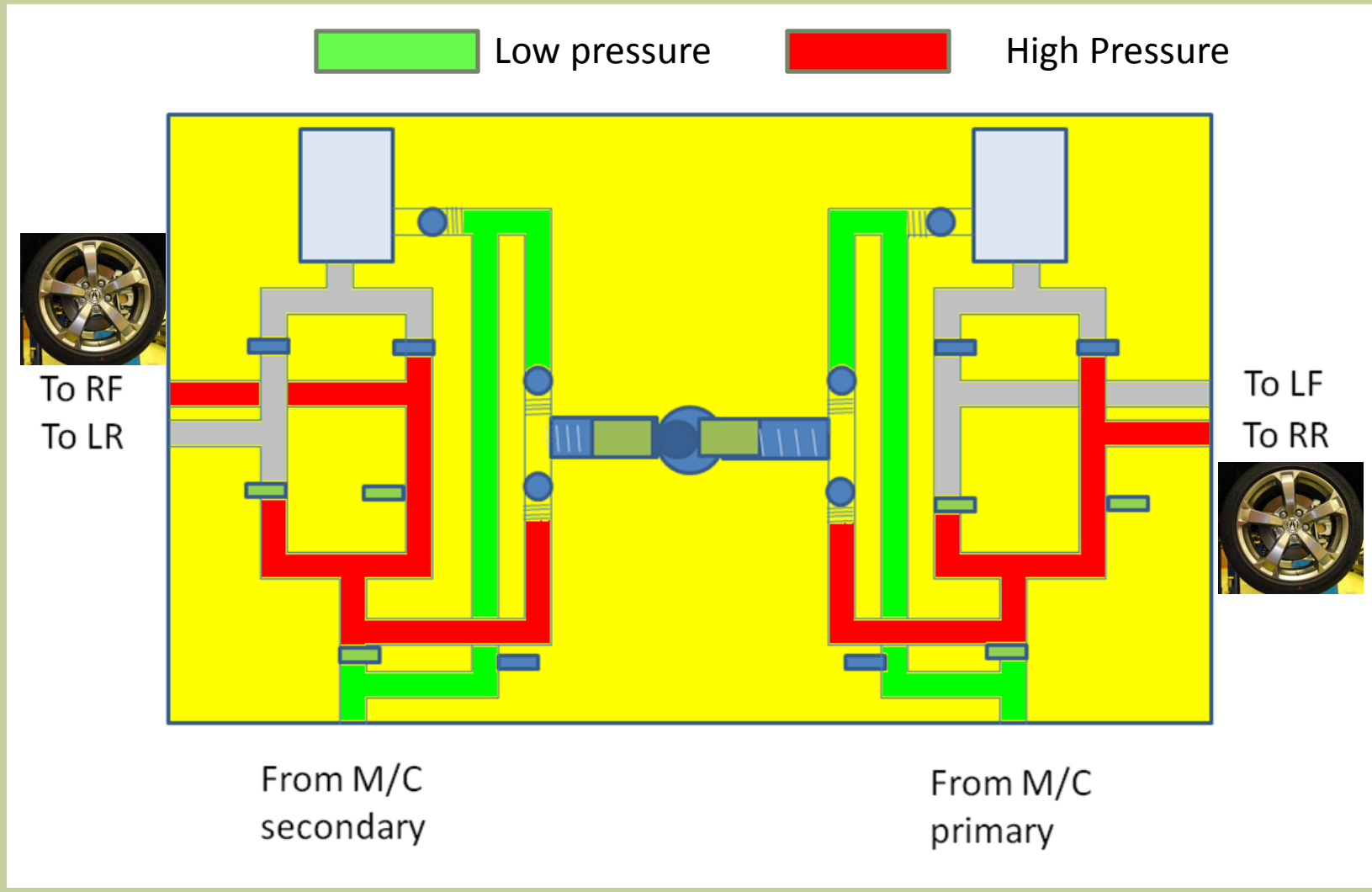
Energize pump

Energize HCU isolation valves 1+2 to close (to block)

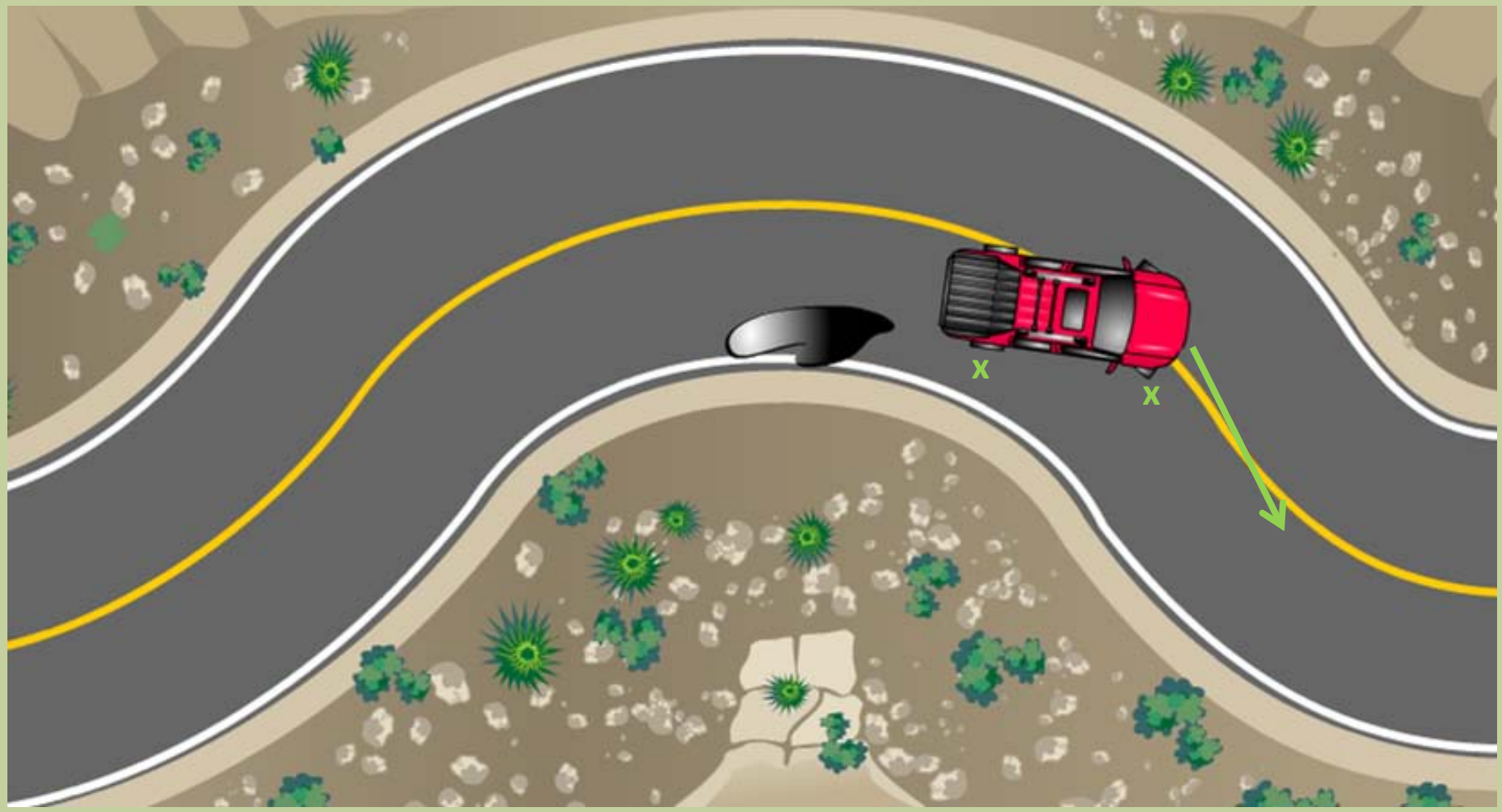
Energize pump inlet valves 1+2 to open (to flow)

Energize LR and LF inlet valves to close (to block)

Response: apply inside brakes (right)



Response: apply inside brake(s)



Situation 2: Vehicle Oversteer

Vehicle over responds to steering input and becomes “loose”; Rear wheels slow if not torque induced

Vehicle Oversteer: ECU view point

INPUTS	
SAS:	**+ 17°**
Yaw:	**14° per second**
Lateral:	**.87 G**
APPS:	0%
Brake:	not applied
VSS:	32 MPH
LF:	34 MPH
RF:	33 MPH
LR:	28 MPH
RR:	26 MPH

OUTPUTS

Energize pump

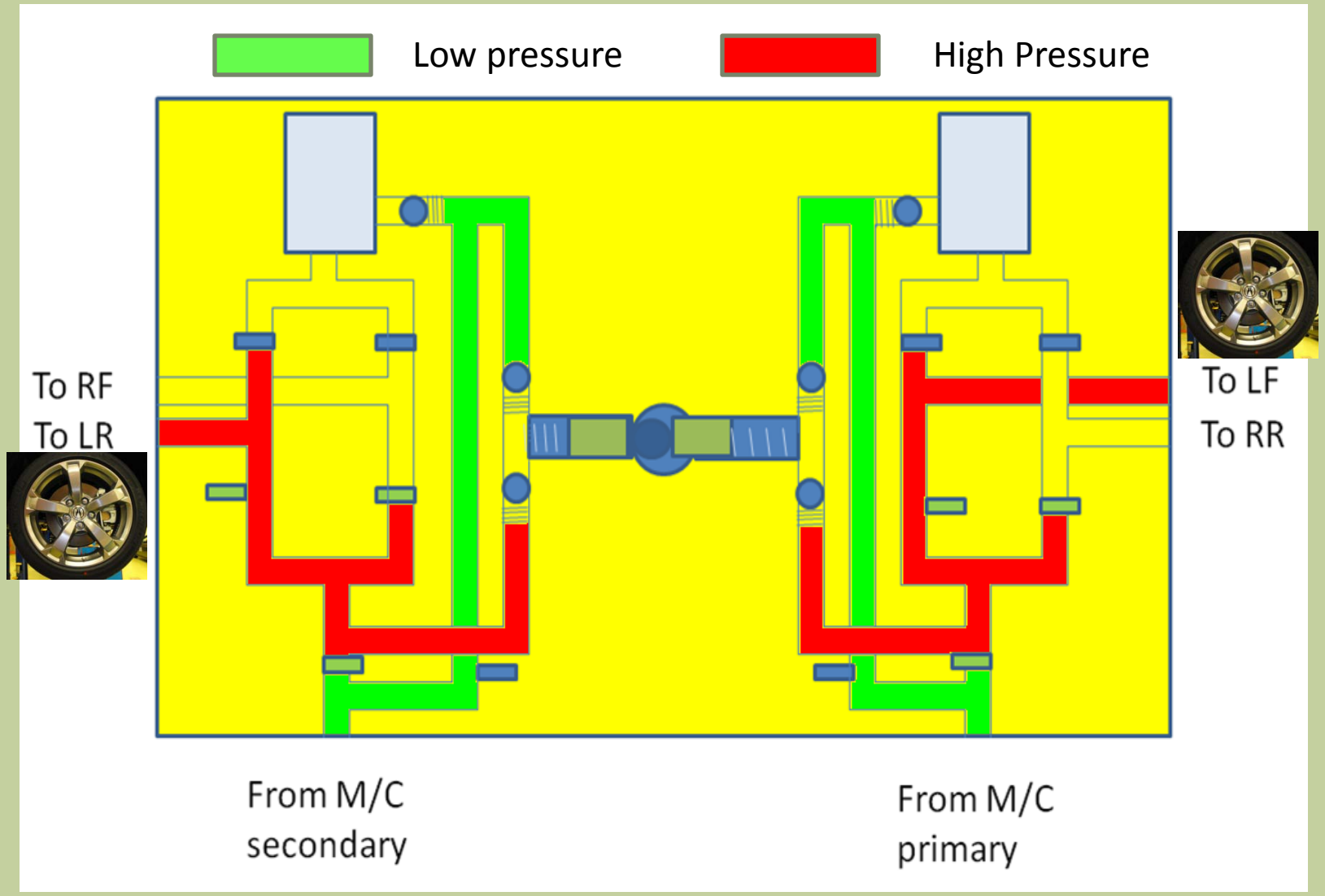
Energize HCU isolation valves 1+2 to close (to block)

Energize pump inlet valves 1+2 to open (to flow)

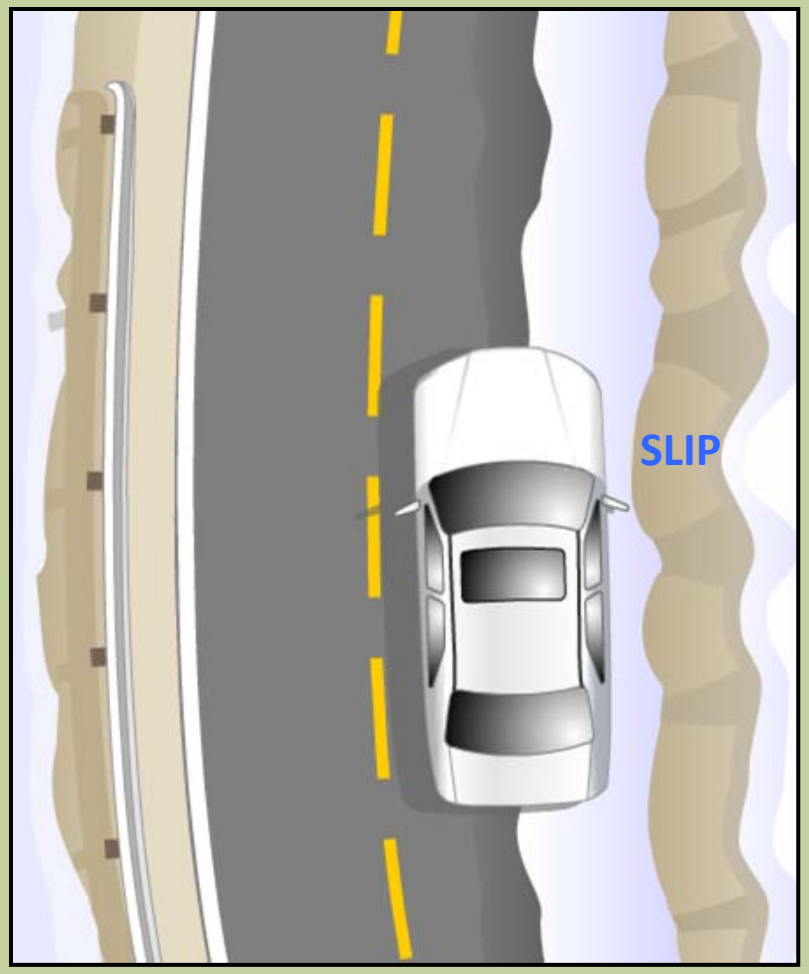
Energize RR and RF inlet valves to close (to block)

Response: Apply outer brake(s)

Response: Apply outer brakes (left)



Situation 3: Positive wheel slip



Front drive vehicle

Traction control:

Drive wheel encounters positive slip

Can happen to both wheels, this example right side only

Situation 3: Positive wheel slip

INPUTS	
SAS:	0°
Yaw:	0° per second
Lateral:	.00 G
APPS:	**27%**
Brake:	not applied
VSS:	32 MPH
LF:	29 MPH
RF:	**68 MPH**
LR:	29 MPH
RR:	29 MPH

OUTPUTS

Send torque reduction request

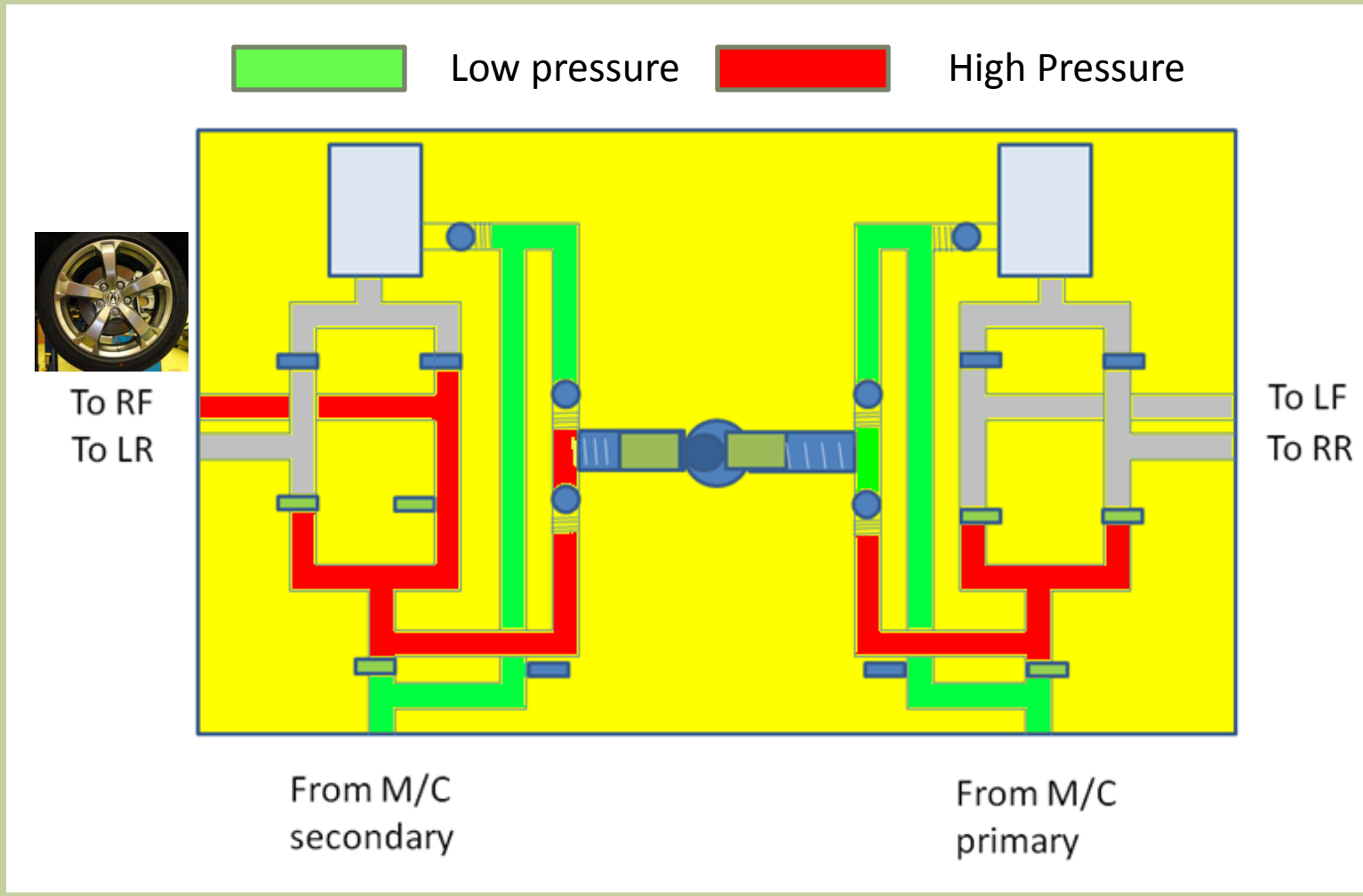
Activate pump + thermal limiter program

Energize HCU isolation valves 1+2 to close (to block)

Energize pump inlet valves 1+2 to open (to flow)

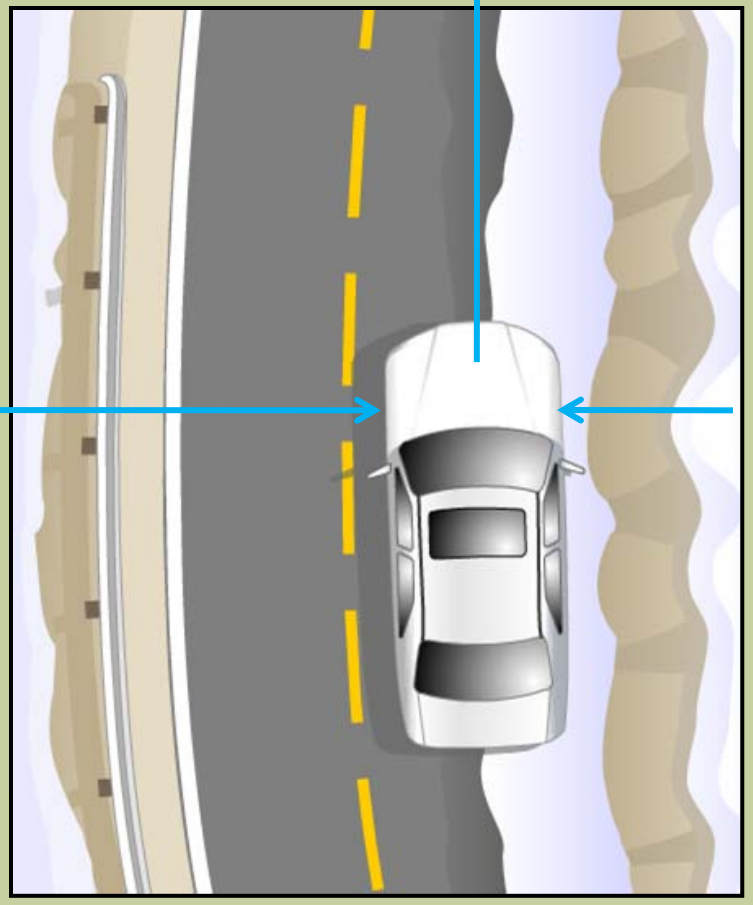
Energize inlet valves LF, RR, LR, (to close)

Response: Pressure to RF wheel brake



Response: Pressure to RF wheel brake

4. Vehicle moves ahead

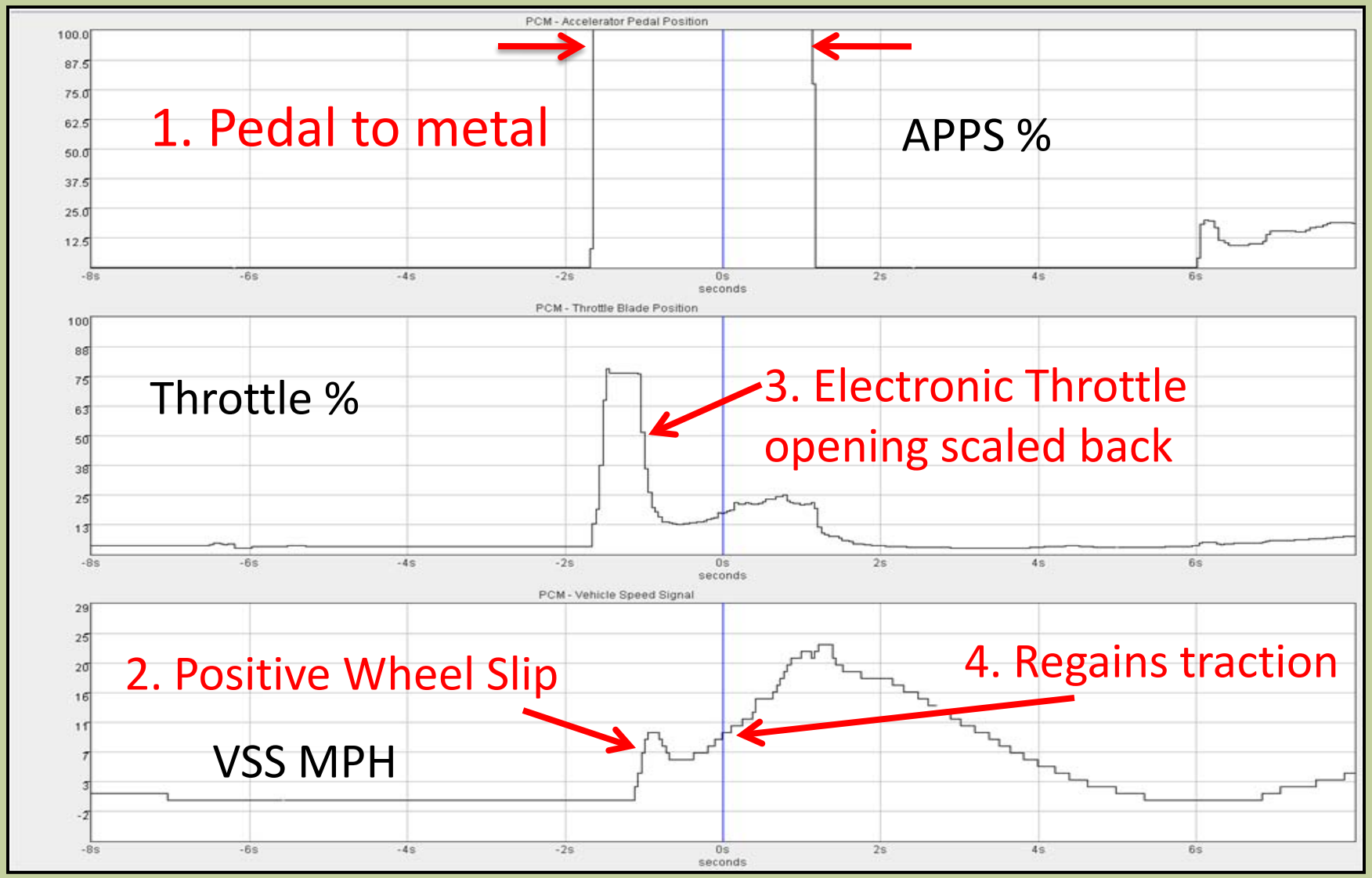


3. Torque applied to wheel with greater traction

2. Brake Pulsed

1. Engine torque reduced

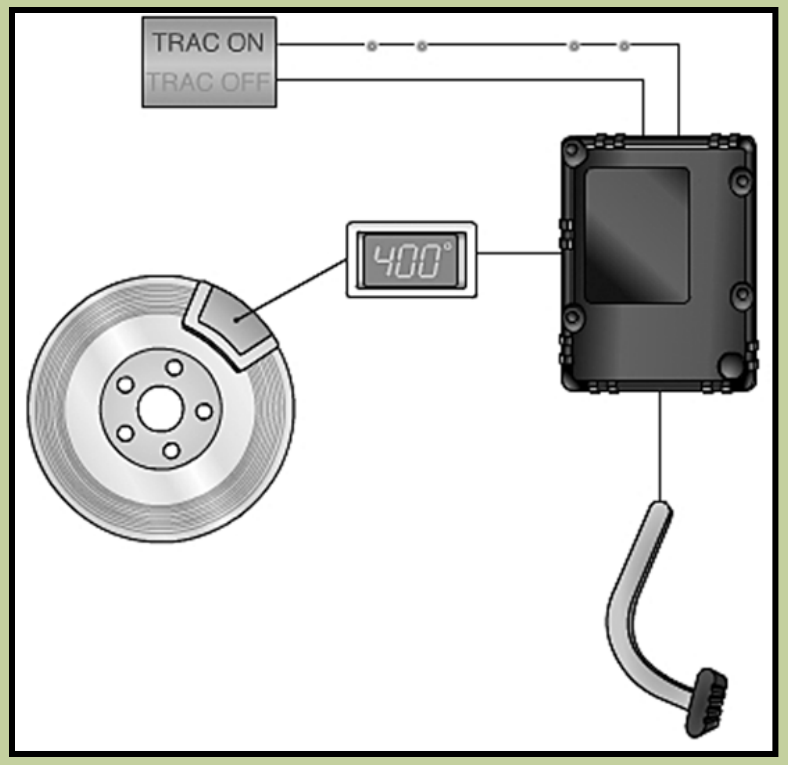
Response: Engine Torque Reduction



Response: Pressure to RF wheel brake

Thermal Limiter:

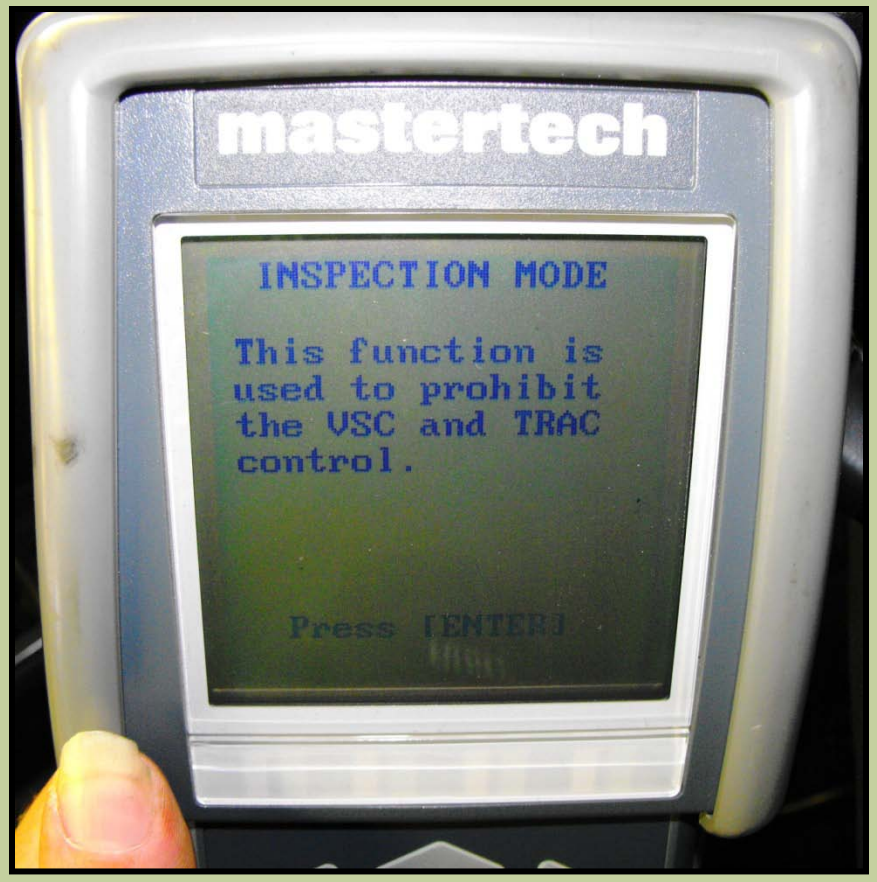
ECU calculates temperature based on application time and wheel speeds



If linings exceed programmed value traction control is halted temporarily

Service Procedures: Inspection Mode

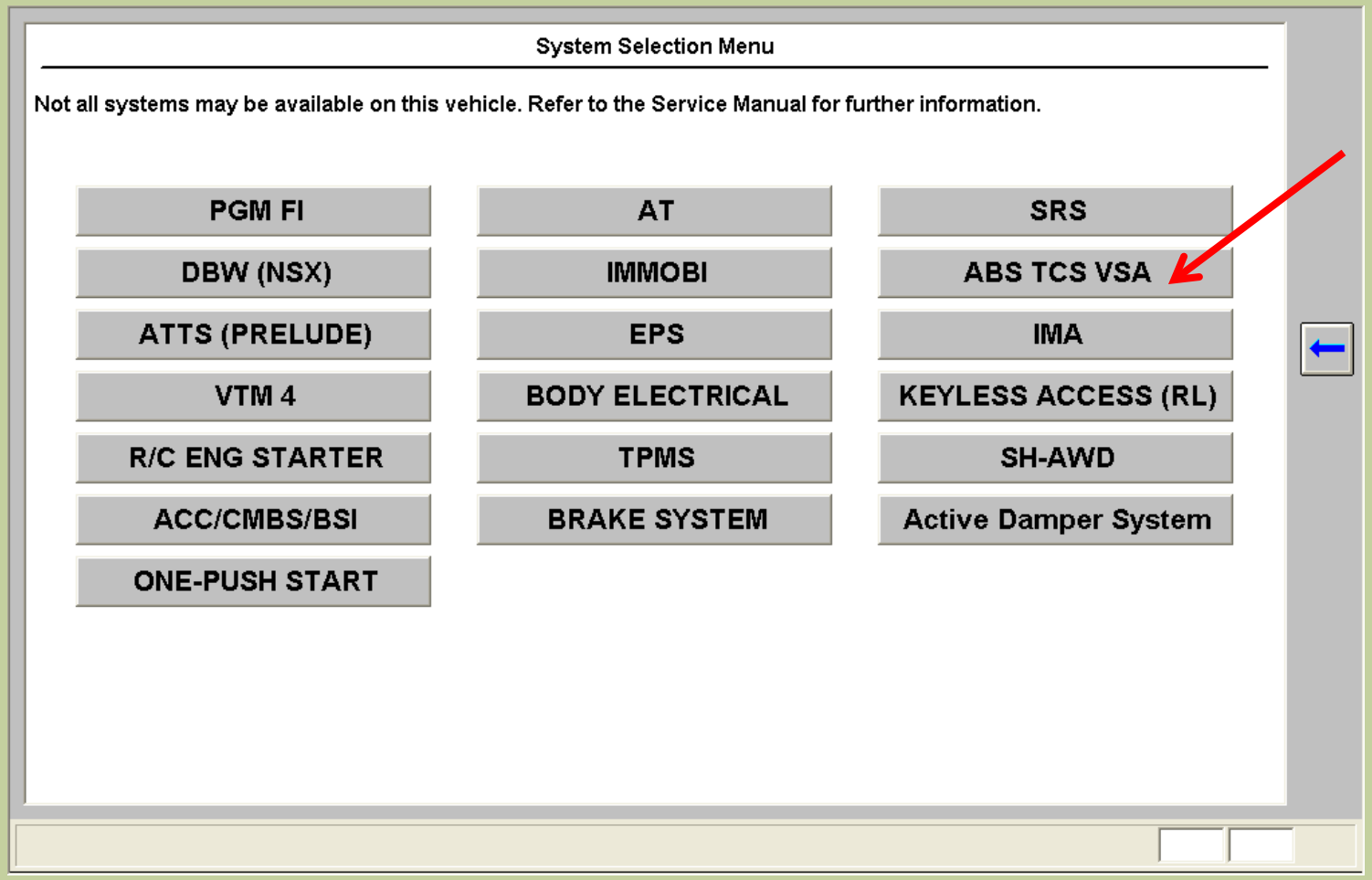
May be necessary for
- run on dynamometer, transmission testing etc.



Service Procedures: SAS, or Accelerometer replacement

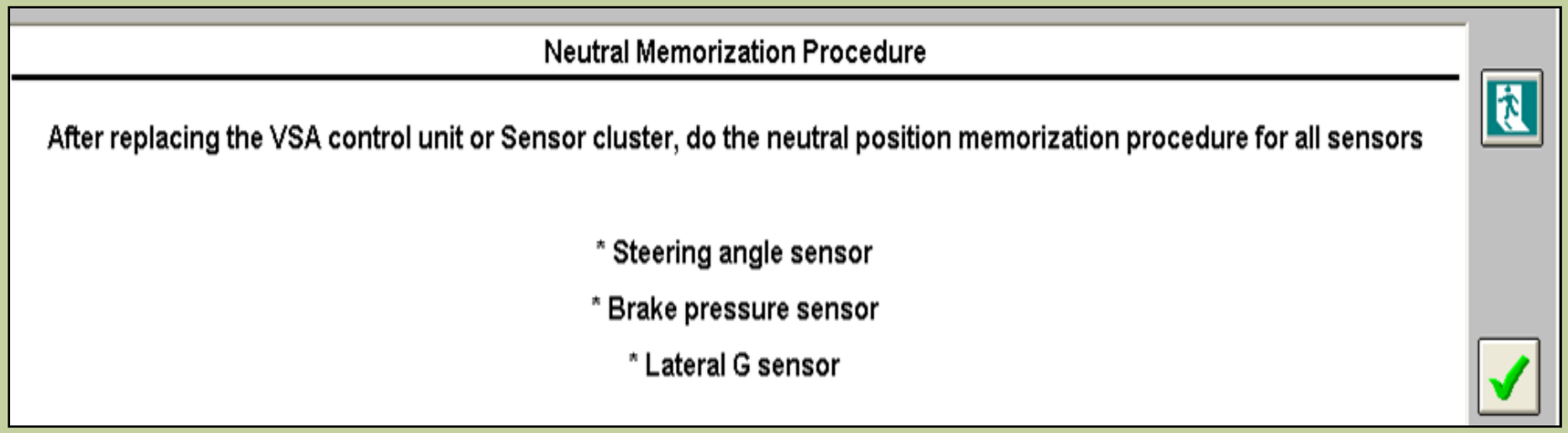
Components such as a sensor cluster must be correctly **positioned** and **torqued** to specification and **initialized** using a scan tool.

Service Procedures: SAS, or Accelerometer replacement



2010 Acura TL screen shots, Honda MVCI scan tool

Service Procedures: SAS, or Accelerometer replacement



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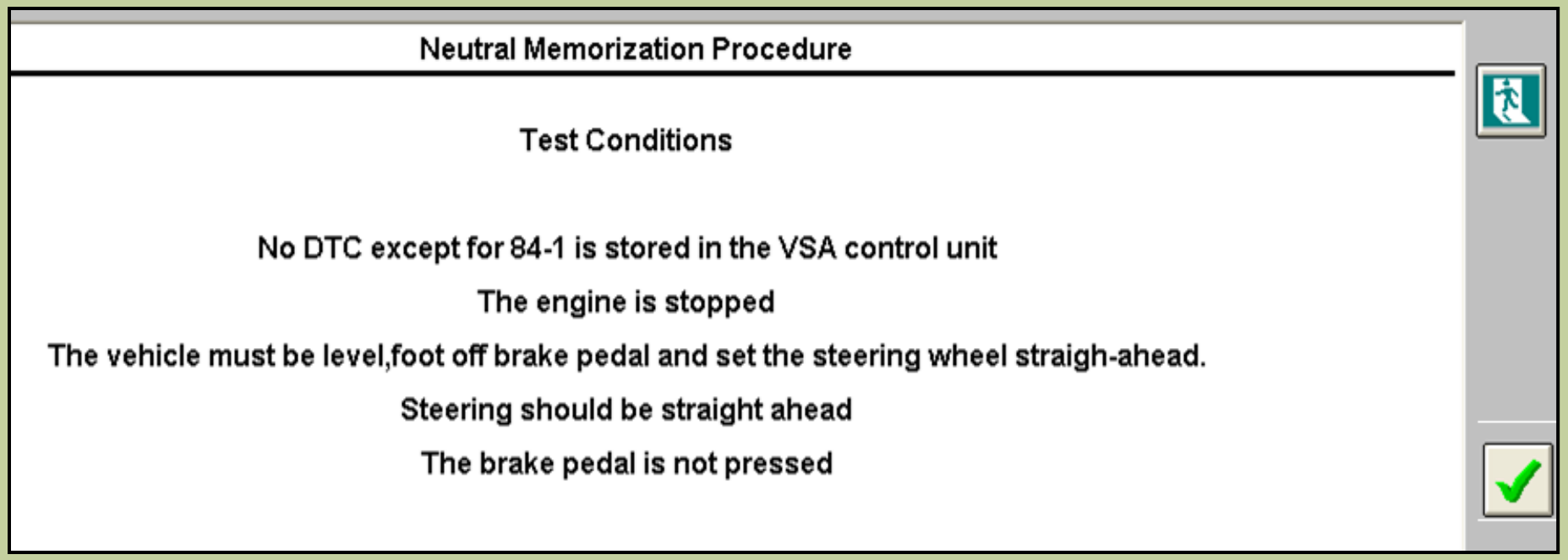

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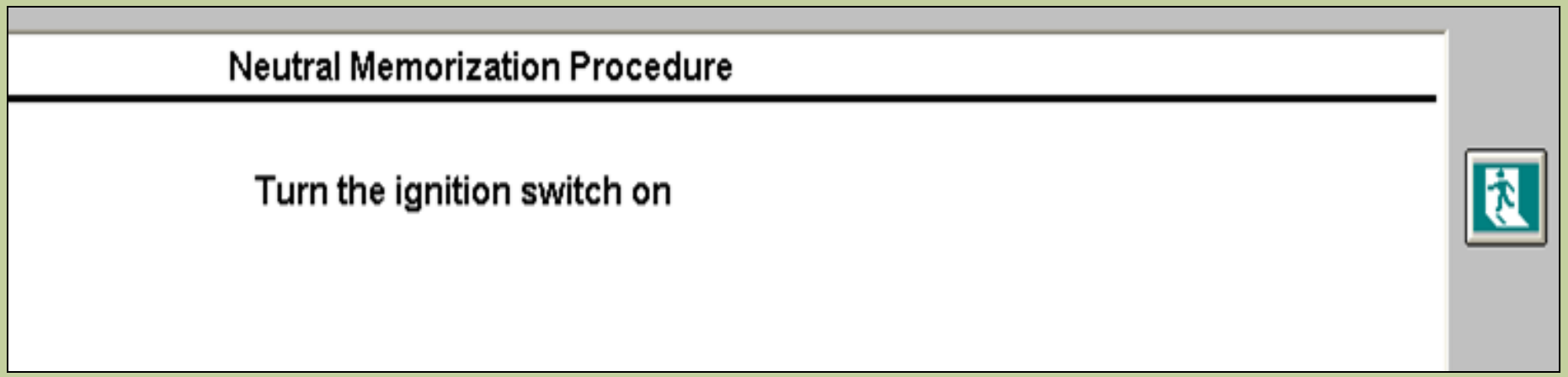

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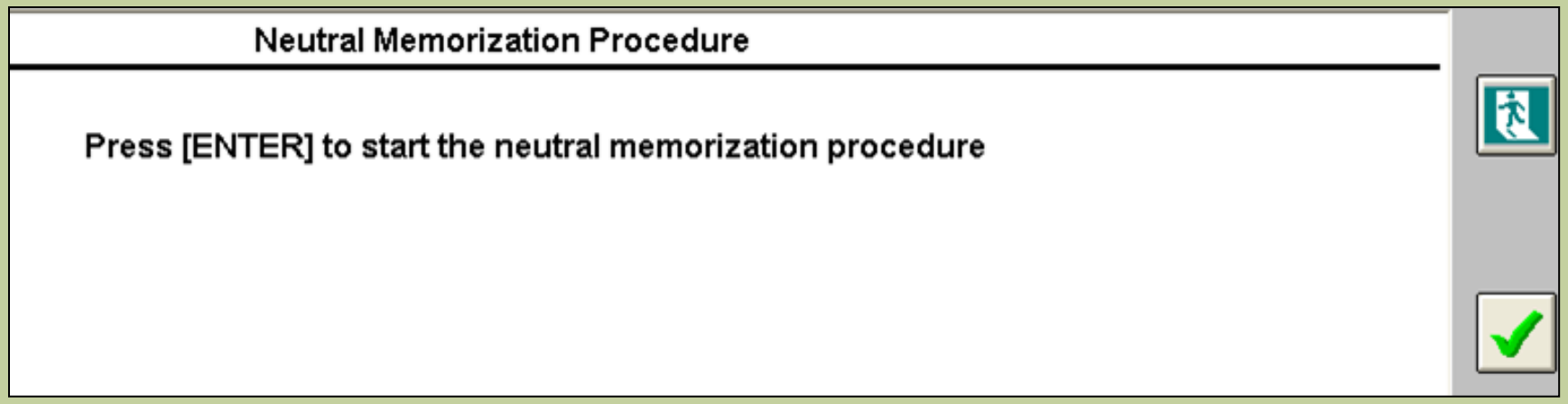

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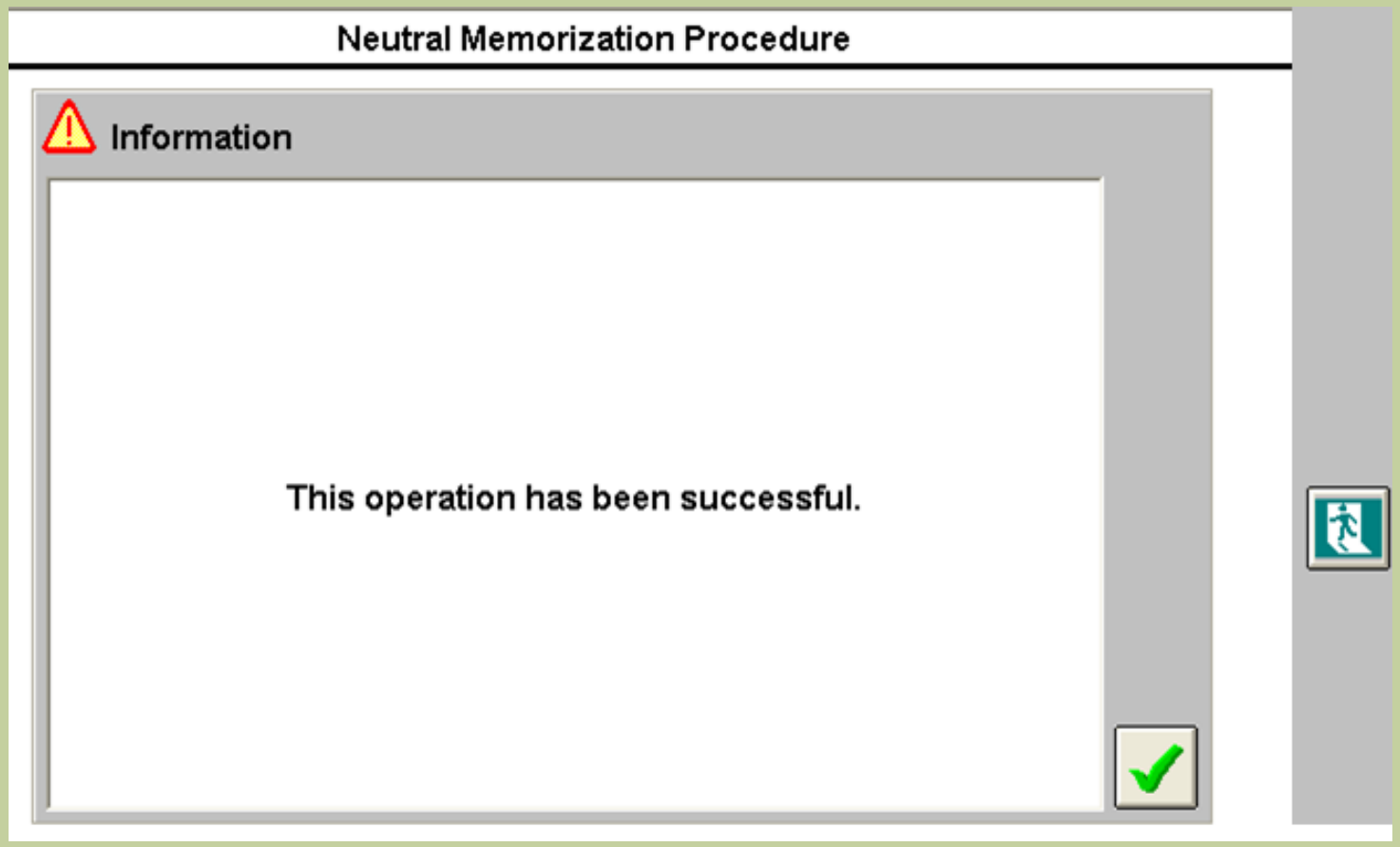


2010 Acura TL screen shots, Honda MVCI scan tool

Service Procedures: SAS, or Accelerometer replacement

ADJUSTMENT STATUS OF YAW RATE SENS-OR	COMPLETED	
ADJUSTMENT STATUS OF LATERAL ACCEL-ERATION SENSOR	COMPLETED	
ADJUSTMENT STATUS OF LONGITUDINAL A-CCELERATION SENSOR	COMPLETED	
ADJUSTMENT STATUS OF SAS	COMPLETED	
ADJUSTMENT STATUS OF BRAKE PRESSUR-E SENSOR	COMPLETED	

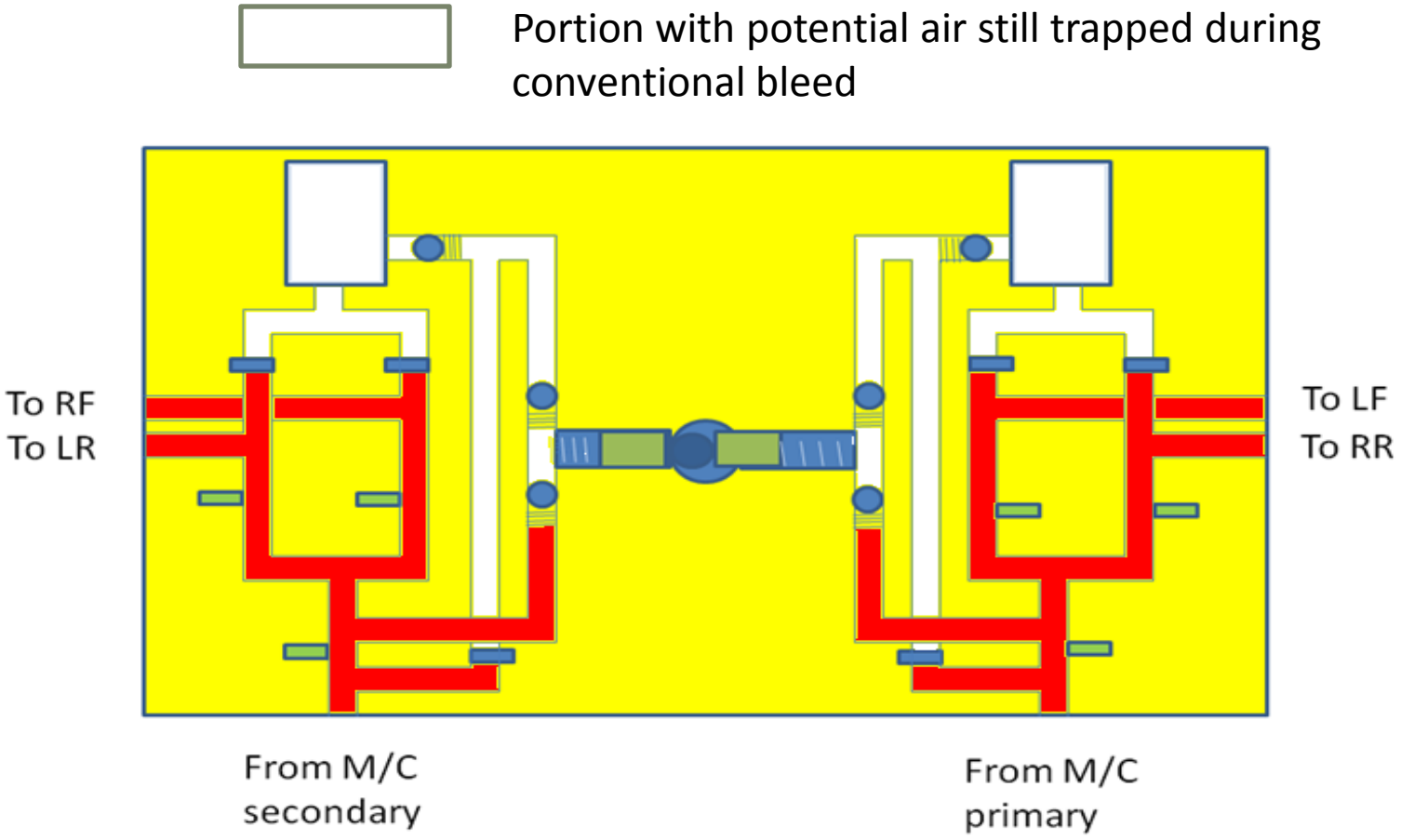
2010 Acura TL screen shots, Honda MVCI scan tool

Service Procedures: Bleeding

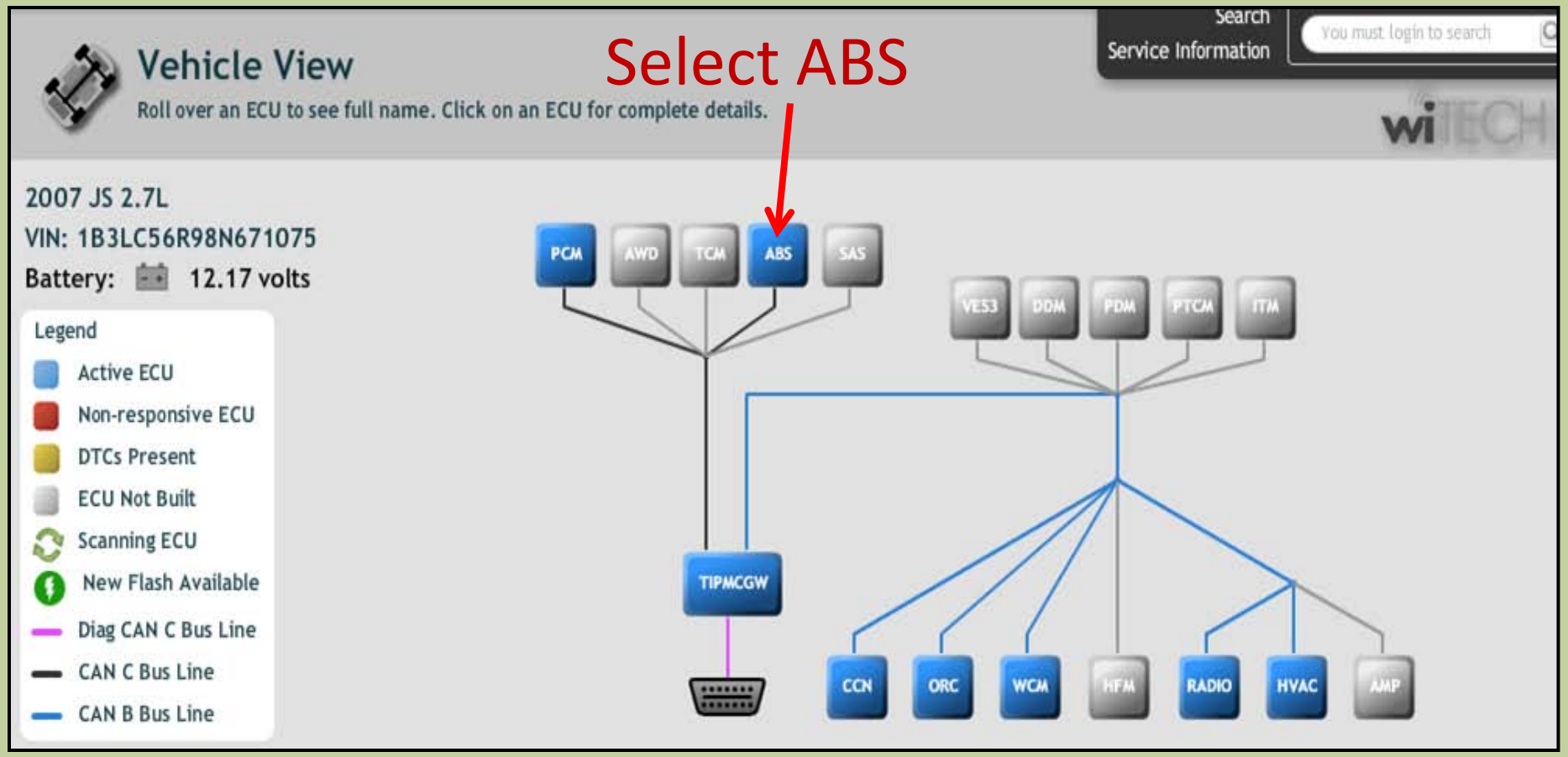
Hydraulic Control Unit replacement *typical* bleed procedure:

1. Manual Bleed
2. Scan tool bleed
3. Followed by a manual bleed

Service Procedures: Bleeding

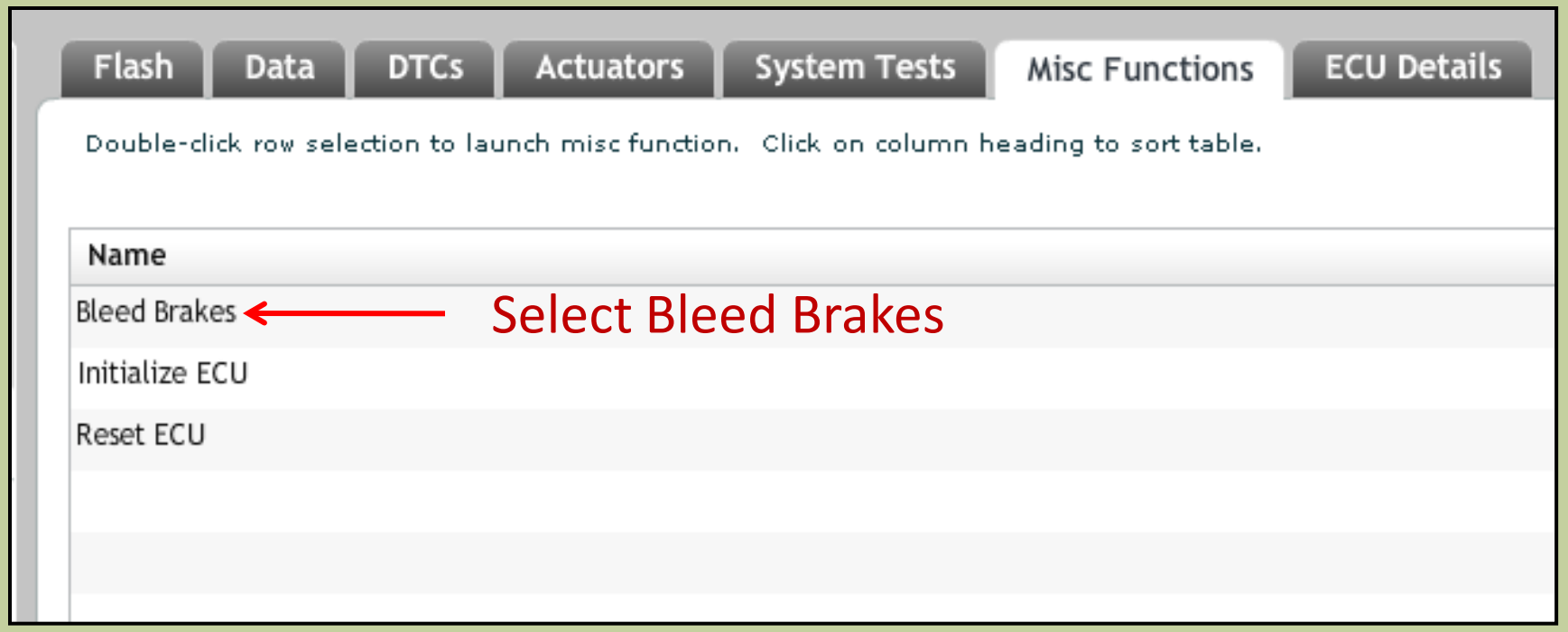


Service Procedures: Bleeding



2008 Dodge screen shots, Wi-Tech scan tool

Service Procedures: Bleeding



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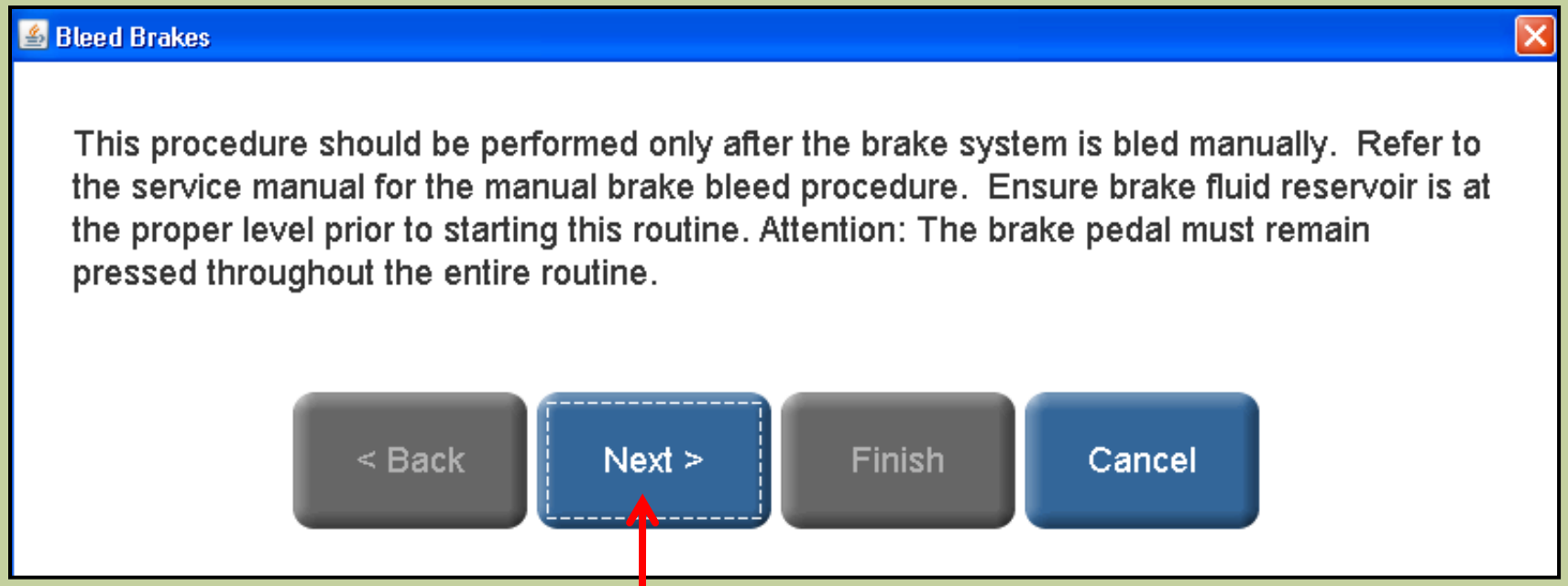

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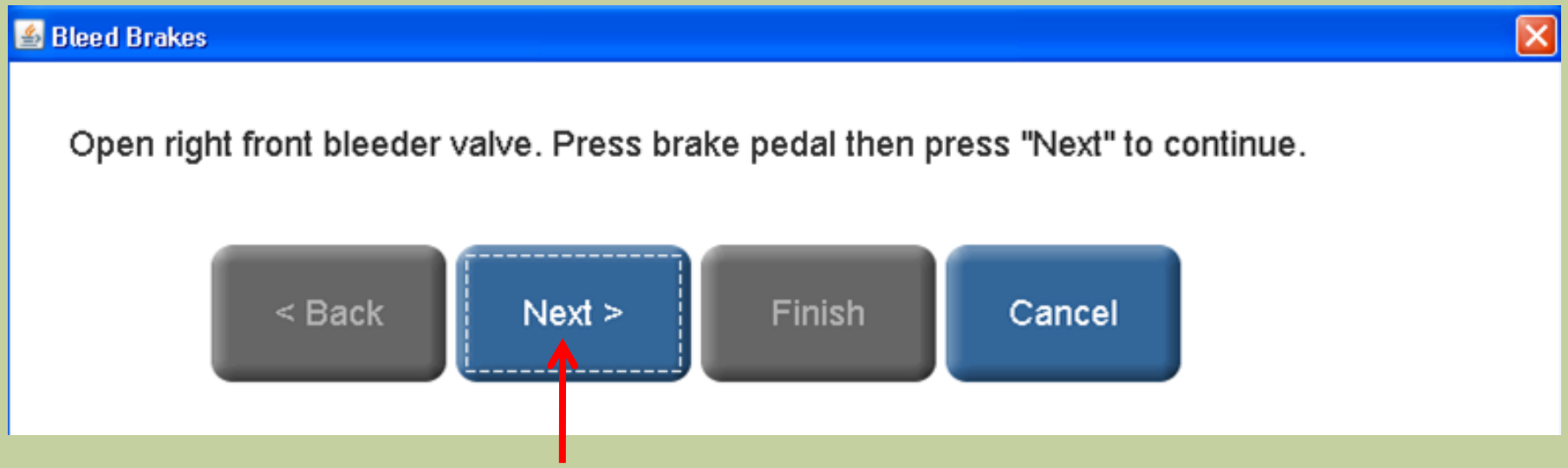
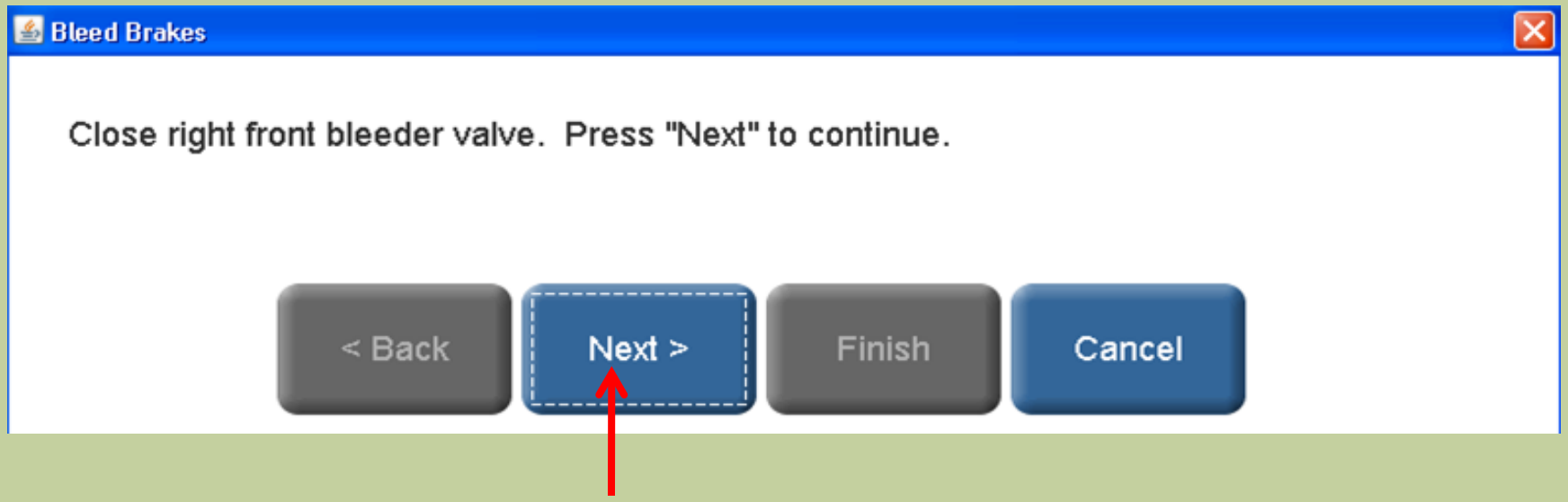


(at this point the pump runs and HCU valves cycled)

2008 Dodge screen shots, Wi-Tech scan tool

Service Procedures: Bleeding



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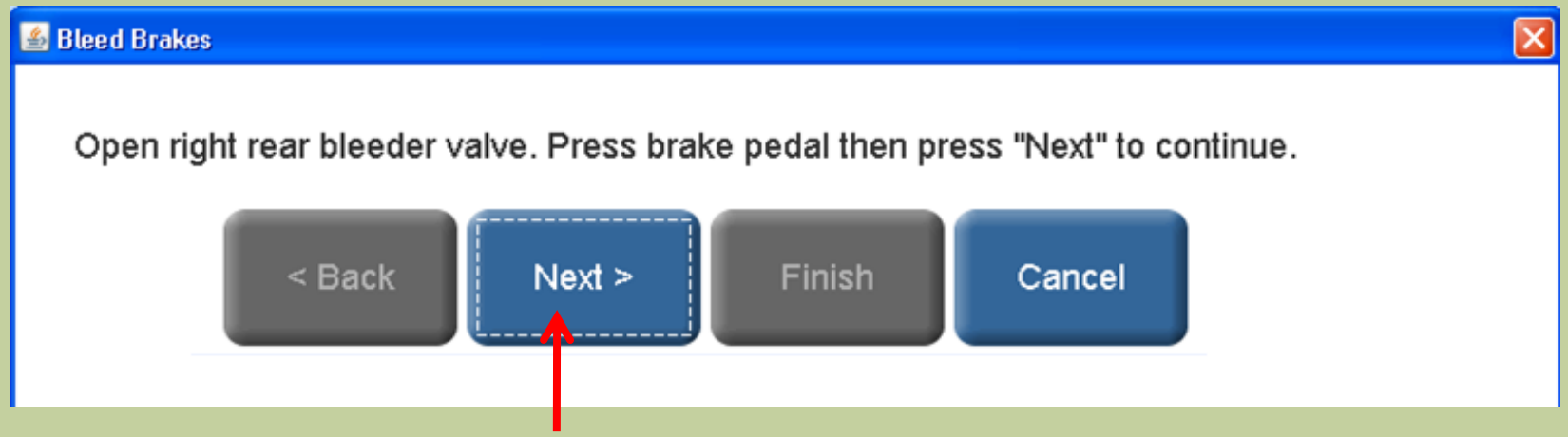

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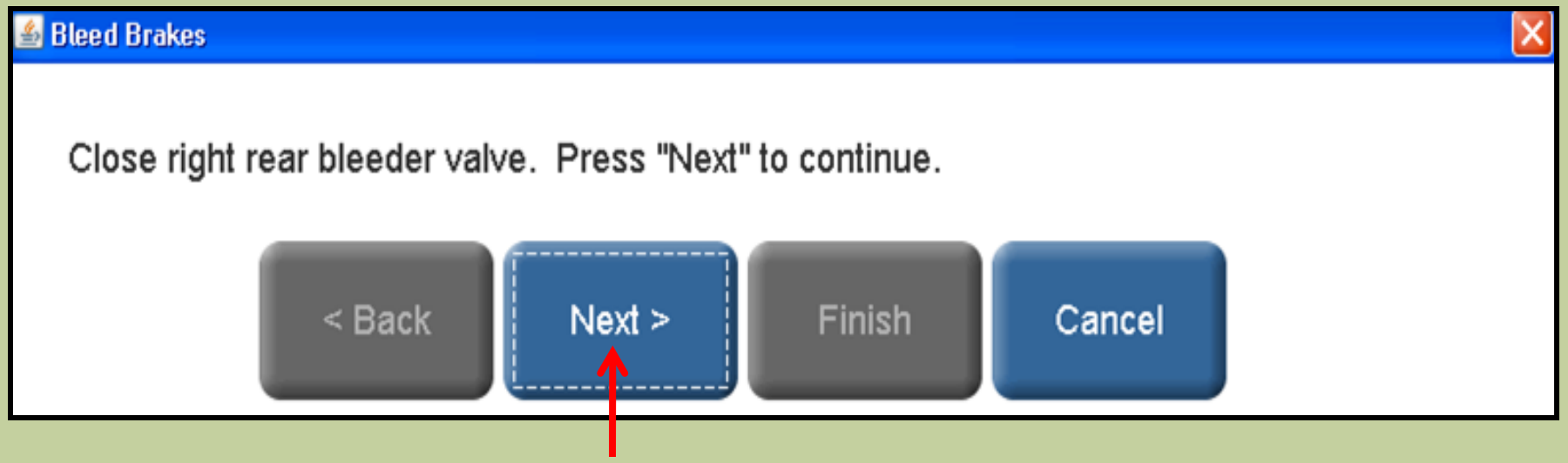
2008 Dodge screen shots, Wi-Tech scan tool

Service Procedures: Bleeding



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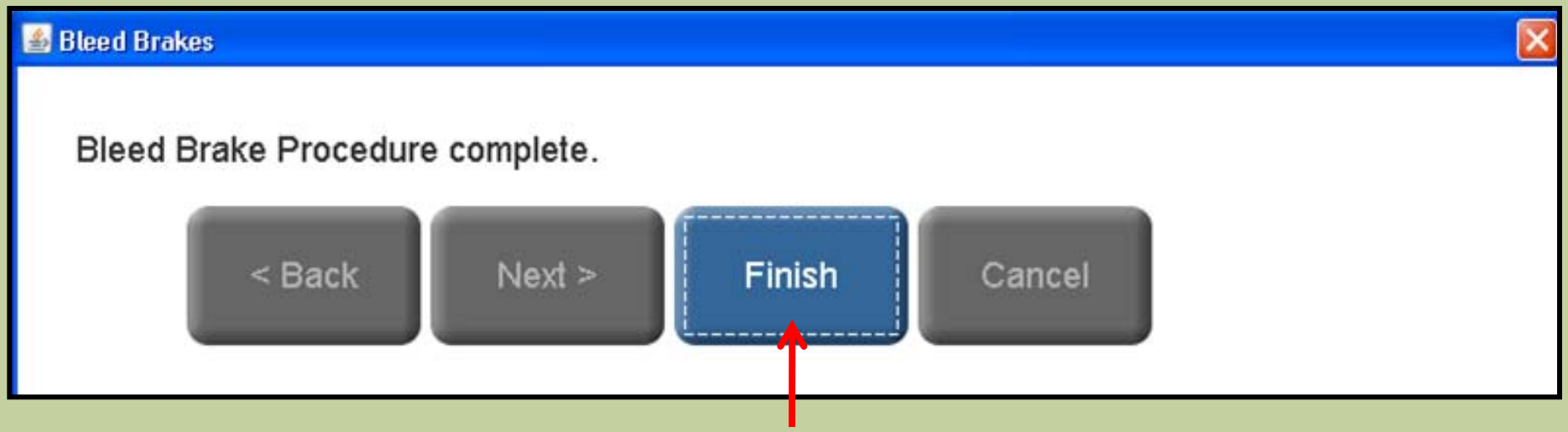

2008 Dodge screen shots, Wi-Tech scan tool

Basic No Code Diagnostics:

1. Load test **battery** and test terminal connections
2. Verify matching and correct **tire size** along with proper inflation **pressure**
3. Inspect **tone rings** both visually and with scope
4. Measure for wheel **bearing play**
5. May need to perform **system bleed** and or **neutral memorization** procedures

Presentation Conclusion

This presentation is posted at:

http://opensiuc.lib.siu.edu/ Google “open SIU”

Questions, comments: dixonm@siu.edu

Thank You