

# APTA Expo 2014 Houston, TX FUEL ECONOMY AND THE MODERN TRANSMISSION

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## **General Fuel Economy Tips**



**Get Involved with OEM in Vehicle Design During Pre-Production Meetings** 

- Pick your drivetrain (axle ratio, tire size, etc.) to best match the vehicles characteristics, expected duty cycles, terrain, etc.
- □ Have OEM make various performance scans
- Reduce Parasitic Losses
  - □ Monitor tire pressure / wheel alignment / brake functionality
  - □ Consider utilizing electric accessories (i.e radiator fans / A/C system)
  - □ Control your A/C settings (is lowest temp. always necessary?)
  - □ Use synthetic oils / lower viscosity oils
  - □ Monitor idle time, consider a shutdown timer
  - □ Monitor maintenance practices / intervals and adjust to maximize fuel economy
  - □ Choose a transmission shift schedule that properly performs yet maximizes fuel economy for the vehicles duty cycle
- □ When discussing fleet fuel economy, be aware of differences in fleet configurations to ensure "apples to apples" comparison (i.e. axle ratio, tires, fan type, route, etc.)

## **Fuel Economy Features of Modern Transmissions**



- AIS (Automatic Idle Shift) / RELS (Reduced Engine Load at Stop) / ANS (Automatic Neutral at Standstill)
  - □ Pseudo-neural state during stop
  - □ Eliminates converter losses 20 to 30% reduction in engine load = less fuel used
  - **□** Reduced heat load on transmission.
  - **□** Reduced wear on engine components.
- AIS (Automatic Idle Shift) While Driving
  - □ Activate AIS before full vehicle stop
- □ Vehicle Mass and Topography Calculations (Topodyn / LBSS / Sensotop)
  - Use of various measurements and calculations to determine best shift points based on load / grade
  - □ Automatically select different shift strategies based on vehicle load / grade
- □ Shift to Neutral With Parking Brake Apply (Auto Neutral)

#### **Fuel Economy Features of Modern Transmissions**



- □ Active Acceleration Limitation (VAC Management)
  - Consider allowing less than APTA acceleration requirements
- **Oil Pump Pressure Management** 
  - □ Bypass main pressure to reduce parasitic loss
- □ Lock Up Torque Converter in 1<sup>st</sup> Gear
- **Use Torsional Damper Converters**
- □ Use Low Viscosity Transmission Oils

#### **Questions?**





#### Thank you for your attention!



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#### **Detailed Appendix**



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1) What is AIS / RELS / ANS?		8 - 9	
<ol> <li>What is AIS While Driving?</li> <li>Vehicle Mass / Topography Calculations (Topodyn / L</li> </ol>	BSS / Sensotop	10 - 11 b). 12 - 13	
4) Active Acceleration Limitation (VAC management).		14 - 15	and the second
5) Torque Converter Lockup in 1 <sup>st</sup> Gear		16 – 17	

# What Is AIS / RELS / ANS?



#### <u>Automatic Idle Shift (AIS) / Reduced Engine Load at Stop (RELS) / Automatic Neutral at</u> <u>Standstill (ANS):</u>

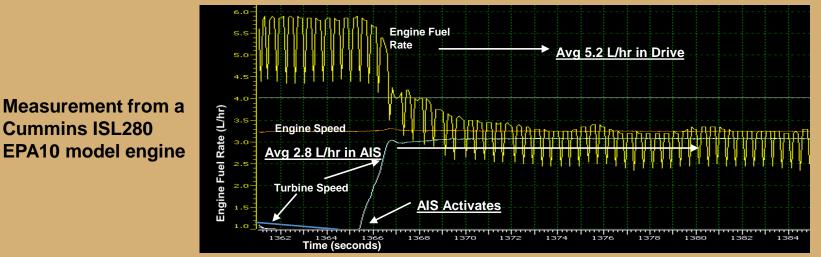
AIS / RELS / ANS is a function that puts the transmission into a pseudo-neutral state once at a stop:

- The process begins when the driver presses the brake to come to a complete stop
- Once the vehicle is at rest and all conditions are met, AIS / RELS / ANS is engaged
- **Once engaged, the transmission is in a pseudo-neutral state**
- □ When in AIS / RELS / ANS, some OEM's set the vehicle brake interlocks or lock the transmission brake clutches to prevent any possible rollback
- □ To release AIS / RELS / ANS, OEM's generally perform this in one of two ways:
  - □ Throttle tip in
  - Footbrake release

# AIS / RELS / ANS



- □ The AIS / RELS / ANS function puts the transmission into a pseudo-neutral state when the vehicle comes to a stop
- □ Transparent to driver
- □ ~50% fuel saving compared to idling vehicle in drive
- □ Save approximately 1 gallon of fuel per 100 minutes



#### What Is Automatic Idle Shift While Driving?



#### Automatic Idle Shift (AIS) While Driving:

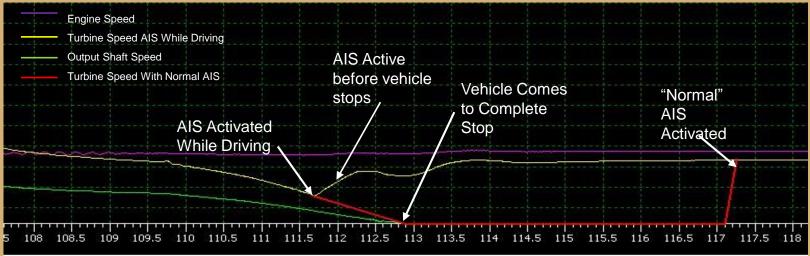
AIS while driving is a function that puts the transmission into a pseudo-neutral state once the vehicle is close to stopping:

- □ The process begins when the driver presses the brake and is ready to come to a complete stop
- Once the vehicle is close to a stop and all conditions are met, then AIS while driving is engaged
- This engagement happens just after the retarder is no longer effective but the vehicle is still rolling
- □ Once engaged, the transmission is in a pseudo-neutral state
- Once in AIS, some OEM's set the vehicle brake interlocks or lock the transmission brake clutches to prevent any possible rollback
- □ To release AIS while driving, OEM's generally perform this in one of two ways:
  - Throttle tip in
  - Footbrake release

# **AIS While Driving**

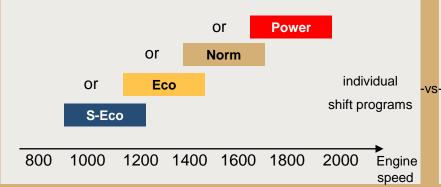


- □ Automatic Idle Shift (AIS) while driving function puts the transmission into a pseudoneutral state when the vehicle comes close to a stop.
- **Transparent to driver.**
- □ With this feature, ZF EcoLife transmission is able to gain ~5.5 seconds of additional AIS per stop. That is an approximate fuel savings of 1 gallon/850 stops.



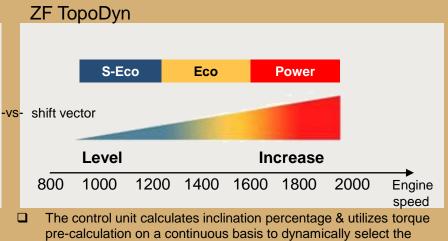
#### Vehicle Mass / Topography Calculations (Topodyn / LBSS / Sensotop)

Automatic shift program selection depends upon the topography 



State-of-the-art technology

- Different shift programs stored at the control unit; however, only one program is active at a time.
- Optional: Hidden eco / power switch for workshop personnel for switching back and forth between two programs.
- Electronics select the shift point within the respective program in a gradient- and load-related manner.
- Used for current competition fuel savings technology, as they switch between the various programs.



optimum shift program for the current topography.

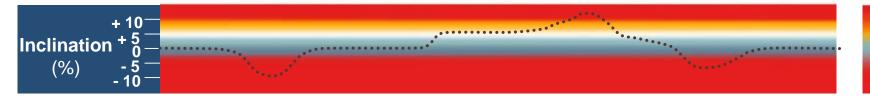
#### Advantages:

- Reduction of fuel consumption on flat grounds (starting with the + Eco - program).
- Increase of drivability on gradients (uphill/downhill). +
- Higher level of stability of the individual drive programs in order to + prevent gear hunting.

#### **ZF Ecolife With Topodyn Technology**

ZF TopoDyn adjusts the shift points in a continuously variable manner without the need for discrete program changes





Life

opoDyn

## What Is Acceleration Limitation (VAC Technology)?



- □ One of the most effective features inside Topodyn / LBSS technology is the fact that it utilizes a vehicle acceleration limitation at launch.
- Most vehicle drivers depress the accelerator pedal to 100% at takeoff, even though it may not always be necessary.
- □ Using acceleration limitation technology, the transmission controller watches the acceleration rate (  $\partial$  m/s<sup>2</sup>) rise.
- Once the acceleration <u>rate</u> rise hits the pre-defined limit in the transmission software, the controller begins to send a torque limit to the engine to slow the vehicle's acceleration down.
- □ When the vehicle slows down to below the pre-defined acceleration rate limit, then the torque limit from the transmission to the engine is released.
- □ The end result is eliminating driver influence to vehicle behavior, which provides a consistent, smooth ride from vehicle to vehicle / driver to driver.
- □ Most important, IT SAVES FUEL!

# What Is Acceleration Limitation (VAC Technology)?



Actual Engine % Torque

Engine Torque

From Transmission Control Here

Note: Smooth vehicle speed even under trans. limitation

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Engine Control

**Engine Released** 

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Trans Control

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## Torque Converter Lockup In 1<sup>st</sup> Gear

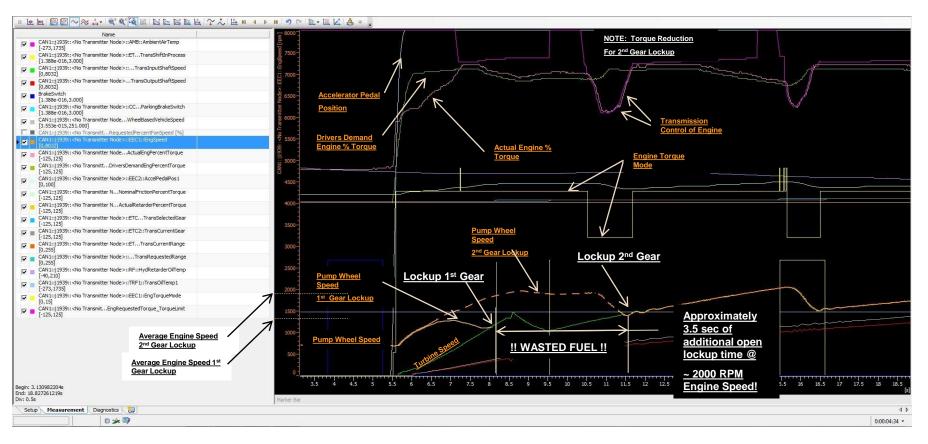
- □ Traditionally, torque converter lockup is performed in 2<sup>nd</sup> gear for transit bus applications
- □ In the past, 2<sup>nd</sup> gear was chosen as it provided the most comfortable shift given the hardware and controls available
- This was considered "state of the art" in its time as it provided the most driver / passenger comfort. However, the price for this comfort is increased fuel consumption
- ❑ As the demand from the end user for improved fuel consumption rises, it becomes critical to implement 1<sup>st</sup> gear lockup for gaining further efficiency.

#### New Technology:

- With the addition of torsional dampers in torque converters, variable control valves and rapid TCU processors, 1<sup>st</sup> gear lockup has become a possible reality for the North American Market.
- □ Hence, additional fuel economy could be realized as a result.

#### **Torque Converter Lockup in 1st Gear**





#### Thank you for your attention!



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