LOW-SPEED PRE-IGNITION IN DI SI TURBOCHARGED ENGINES





DOWNSIZING – WHY T-GDI?





2

TURBO PERFORMANCE LEVELS





TURBO PERFORMANCE LEVELS AND IRREGULAR COMBUSTION





DEFINITION OF (LOW SPEED) PRE-IGNITION





CAUSES OF LSPI - OVERVIEW





6





Rik Alewijnse, AVL Powertrain UK ltd, 12 June 2012

VISIOLUTION SYSTEM SETUP





AVL VISIOLUTION SENSORS





VisioTomo Head Gasket Sensor









In this case showing autoignition.













Rik Alewijnse, AVL Powertrain UK ltd, 12 June 2012

engineexpo2012





Rik Alewijnse, AVL Powertrain UK ltd, 12 June 2012





crown due to overcooling at part load



LSPI – WORKING HYPOTHESIS







DESIGN ACTIONS - PREVENTATIVE





Source: Behr engineexpo2012

Dehnstoff Arbeitskol Führung



POWER CYLINDER SAFETY FACTORS



	Design target	Over Pressure Margin	
Head Bolt	Gap lift	+++	Ĩ
Gasket	Bead fatigue	++++	
Liner	Hoop stress fatigue	+++	
Main Bolt	Bearing shell retention	+++	
Crank	Torsional and bending fatigue	++++	
Rod	Buckling	\bigcirc)/ 9
Pin	Schlaefke ovalisation and bending	++++	A A A A A A A A A A A A A A A A A A A
Piston	Crown TMF	++++	
	2 nd Land fatigue	++	
Cyl Head	Chamber TMF	++++	



DESIGN ACTIONS - ADAPTIVE



Second ring land







CONCLUSIONS



- Turbo Gasoline Direct Injection engines are an excellent enabler for engine downsizing to address the CO₂ reduction challenge.
- Specific performance levels in t-GDI engines are not new, but high loads below 2000 rpm mean that Low Speed Pre-Ignition needs careful consideration
- LSPI has a range of causal factors, which are an area of active research
- Design actions are available to reduce (but not eliminate) the occurrence of LSPI events.
 - Other design actions to accommodate the effects of occasional LSPI are also necessary.
 - Con rod design for t-GDI engines must consider compressive loading, with buckling failure as the limiting load case



Thank You



