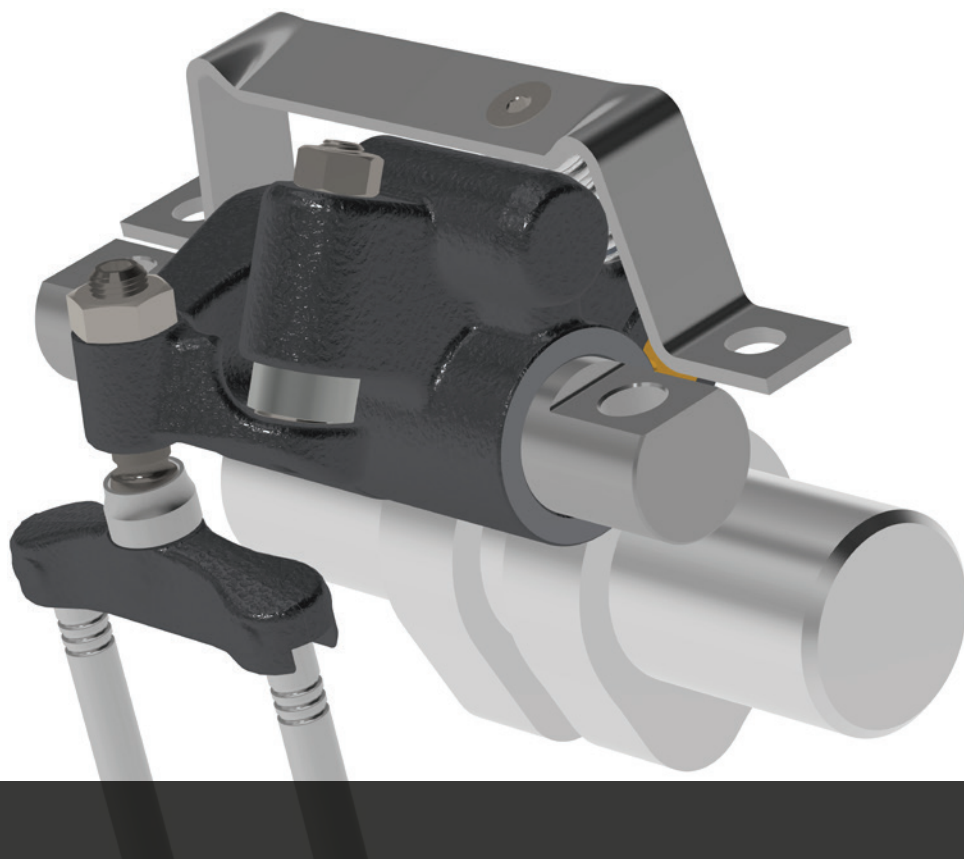




# VVA

## 2-STEP VARIABLE VALVE ACTUATION



## FOR EXHAUST THERMAL MANAGEMENT, ENGINE PERFORMANCE & EMISSIONS

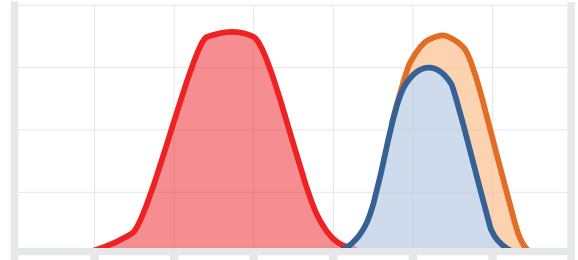
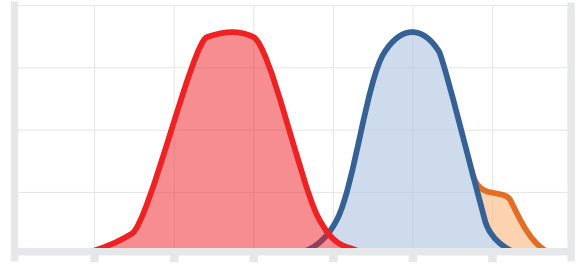
Jacobs Vehicle Systems' Two-Step Variable Valve Actuation (VVA) is for OEM's challenged with meeting future transient emissions and fuel economy targets. A variable lift valvetrain opens up possibilities to meet these needs with minimal changes to the base engine and aftertreatment system while using proven mechanisms to achieve these benefits.

- ▶ Reduces fuel consumption
- ▶ Optimizes compression ratio vs load
- ▶ Improves transient response
- ▶ Improves emissions by keeping the aftertreatment system hot during low load operation
- ▶ Reduces engine out NOx emissions
- ▶ Developed with nearly 60 years of engine brake and integrated valvetrain experience
- ▶ Available for multiple valvetrain types
- ▶ Provides the benefits of a fully-flexible VVA system with a less complex, lower cost system

# BENEFITS

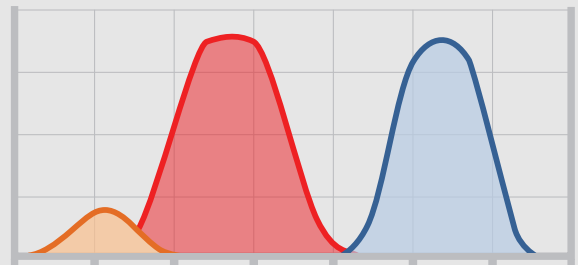
## Early or Late Intake Valve Closing

- Reduces fuel consumption 1-2% at low loads
- Optimizes compression ratio with up to 20% reduced PCP
- Improves transient response/start up
- Improves emissions by keeping the aftertreatment system hot during low load operation up to 125°C without BSFC penalty
- Reduces engine out NOx up to 3 g/kWh at equivalent BSFC



## Early Exhaust Valve Opening

- Faster warm up of engine and aftertreatment system up to +150°C TOT
- Improves transient turbocharger response
- Lowers peak torque engine speed
- In-cylinder solution for DPF regeneration replacing expensive exhaust heaters and dosers
- Improves emissions by keeping the aftertreatment system hot during low load operation



## Internal Exhaust Gas Recirculation

- Improves emissions
- Stabilizes cold start-up combustion
- Improves engine warm-up time
- Eliminates or downsizes problematic external EGR systems and intake throttles
- Provides up to 40% EGR at low loads
- Improves aftertreatment performance
- Faster response than external EGR systems
- Improves transient emissions
- Improves emissions by keeping the aftertreatment system hot during low load operation
- Intake or exhaust opening systems available

