

Hybrid Booster Drive Technology - *HBD*™



Equipped with Hybrid Booster Drive (*HBD*™)

HBD™ complements the existing propulsion system in the vehicle in which it is installed. That vehicle then becomes a hybrid vehicle, using a combination of two types of energy, fuel and electric.

The *HBD* system is intended for vehicles with missions (or routes) requiring numerous stops and speeds primarily below 35 mph. Tests show as much as 30% improvement in mileage in routes which are similar to the SAE White Book Central Business District simulated route. Actual savings depend on drive cycle.

The *HBD*™ does not affect the normal operation of the internal combustion (IC) powered system and an *HBD*™ equipped vehicle will operate under IC power alone if the *HBD*™ is disabled.

The Hybrid Booster Drive™ consists of four component modules: an AC electric traction module, a motor controller module, an ultracapacitor storage module and supervisory control module with integral operational software. The *HBD* supplements the existing IC drive system in the vehicle. At no time does the *HBD* do it all. The engine always remains running, although it is not used as hard. Even during braking, the *HBD* may provide all the stopping power needed, but blends seamlessly and unobtrusively with the existing service brakes when needed. *HBD* can thus lower brake maintenance by as much as 4 times acting like a brake retarder during stops.

HBD Environmental Benefits

The *HBD*™ reduces emissions while increasing fuel mileage. These benefits are achieved by allowing the engine to operate at a steadier and efficient load range and recovering energy from stopping events. In many applications the engine is downsized to further increase mileage, lower emissions and reduce weight. *HBD*™ can be used on vehicles with diesel, gasoline, CNG, LPG, or 'Clean Diesel' fueled engines.

Components of the Hybrid Booster Drive™ (HBD)

Electric Motor

- Three phase induction motor
- Liquid cooled (ATF)
- 460 Volts AC
- 0 to 12,000 RPM
- Rated at 100 HP, continuous, 8000 RPM
- 215 NEMA frame

Motor Controller

- Variable frequency, variable voltage drive
- 0 to 400 Hertz output
- 0 to 460 Volts output
- 600 Volts DC input (nominal)
- Forced air cooled
- Rated at 175 KW peak

Electric Energy Storage

- Ultracapacitor
- 18 modules, 45 volts, 90 Farads each
- Central ventilation/cooling, forced air
- 1.2 MegaJoules of energy stored between 400 and 800 volts
- Fuse protected and relay isolated

Mechanical Driveline

- All gear drive
- Parallel shaft transfer case coupled between vehicle transmission and rear differential via split drive shaft
- 3.5 to 1 speed reduction, secondary
- Electric actuated sprag clutch to disengage electric motor
- Close-coupled planetary reducer between electric motor and transfer case
- 2 to 1 speed reduction, primary

System Controller

- CAN multiplexed controller
- Fully automatic hybrid drive integration
- Ultracapacitor optimization algorithm
- Proportional regenerative electric braking
- Seamless to operator
- Optimized for speeds under 40 MPH

Packaging

- All components mounted to chassis
- Environmentally protected
- Stainless steel enclosures
- Water tight conduits

What the HBD Does

- Adds torque to the driveline, assisting the diesel engine during acceleration up to 35 mph
- Reduces the power demand from the diesel engine during the acceleration up to 35 mph by approximately 50%
- Reduces the power through the transmission during acceleration up to 35 mph by approximately 50%
- Reduces maintenance on the engine and transmission
- Extends the life of the engine and transmission
- Reduces fuel consumption
- Reduces emissions
- Provides braking from 35 mph down to about 3 mph
- Eliminates most service brake use below 35 mph
- Extends the life of the service brakes
- Disengages the electric drive above 35 mph

What the HBD Does Not Do

- Does not alter the engine or transmission
- Does not require difference in operation or driver training
- Does not add boost at steady speed driving
- Does not add boost above 35 mph
- Does not assist braking above 35 mph
- Does not assist braking or retard speed down long grades
- Does not run with the engine off
- Does not start the engine

