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Improved Torque Measurement Technologies for Vehicle CO₂ Studies

Integral Powertrain has delivered significant improvements in the accuracy of the engine output and driveshaft torque measurement elements of its in-vehicle “Mobile Test-Bed”* system. As part of its vehicle CO₂ benchmarking methodology/toolset, IP can now offer a robust driveline torque measurement system capable of measuring drive shaft and propeller shaft torques on the Euro drive cycle with a signal-to-noise ratio of up to twenty times greater than traditional directly applied strain-gauge solutions. This technique has recently been used with great success on a four-wheel drive vehicle CO₂ benchmarking project where each driveshaft sensor was able to reliably measure down to 0.3% of peak drive cycle torque.

The key to achieving this level of accuracy with high torque robustness is IP’s latest shaft Strain Limiter device which protects the sensitive strain element. This device incorporates two torque transmission paths; one path is through the strain-gauged measurement section that is active up to an adjustable pre-set torque limit i.e. peak driveshaft torque to follow the vehicle drive-cycle trace. Once this torque threshold is surpassed, during full-load testing for example, the torque path by-passes the measurement section which robustly prevents over-straining of the shaft measurement section whilst still allowing the increased levels of torque to be transmitted. The manufactured strain limiters successfully protect the sensitive torque sensors during gear shift shock load events on the drive cycle and also during extended full engine load testing in 4th, 5th & 6th gears.



In conjunction with the drive shaft torque measurement system, Integral Powertrain can now offer improved engine output torque measurement with accuracy greater than 0.15% of full engine output. This robust level of accuracy is achieved by using an integrated transmission input shaft torque measurement solution on the secondary side of the dual-mass flywheel or torque converter. Being mounted on the secondary side of the flywheel again improves the signal-to-noise ratio compared with a flywheel-mounted strain gauge system. This solution also eliminates any measurement error due to clutch thrust loads during gear changes whilst still enabling highly accurate torque measurement throughout the complete engine speed/load range.

* IP’s “Mobile Test Bed” delivers engine dynamometer levels of accuracy and stability in a normal functioning vehicle, enabling robust capture of control system and hardware characteristics in a real world environment for meaningful powertrain benchmarking. This system comprises high accuracy fast response data capture:

- Engine and driveline torque
- In cylinder pressure with resulting combustion data
- Fuel flow
- Charge air mass flow
- Air Fuel Ratio
- Electrical power flow
- Key temperatures & pressures

