



GTI ENERGY

solutions that transform

Advances in CNG Fuel Gauge and Dispenser Performance

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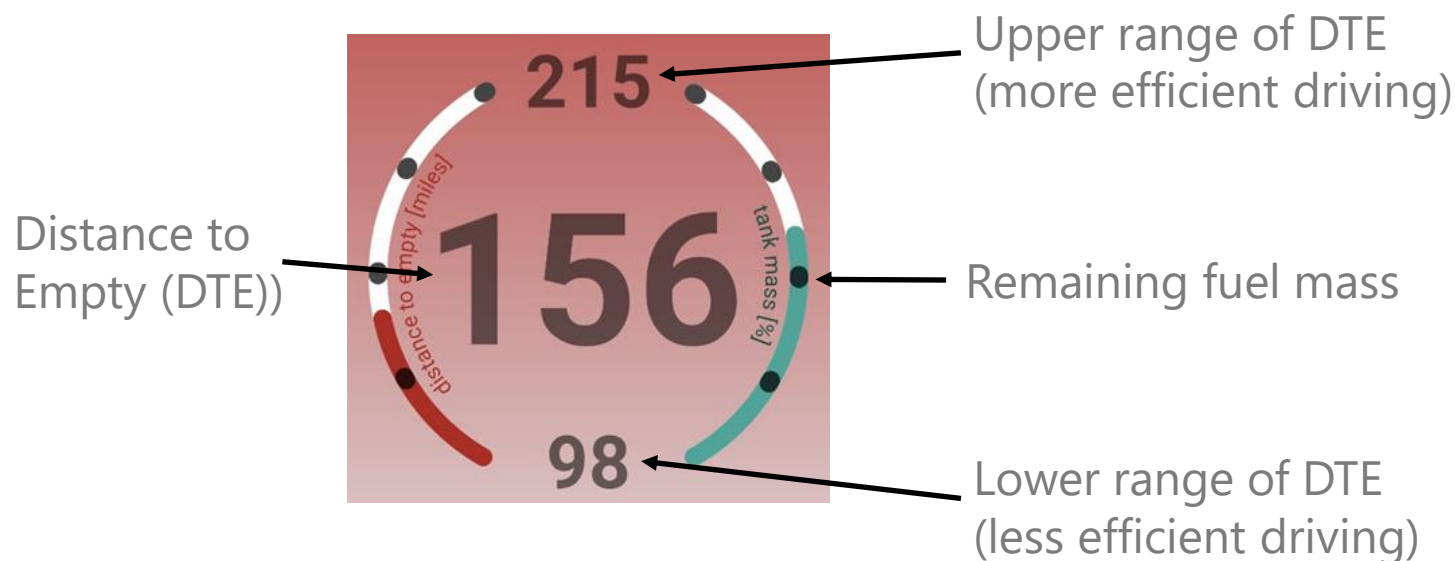
GTI Working on 2 CNG Problems

- Low confidence in fuel gauge reading
 - Gas pressure in tanks depends on temperature
 - Simple fuel gauges don't capture differences with temperature
 - Leads to more frequent stops for refueling or over-sizing storage
- Incomplete filling of CNG vehicles
 - Filling algorithms have to make conservative assumptions about gas temperature in tanks
 - Leads to underfilling by 10-15%
 - Vehicle storage system size increased (\$\$) to compensate



Next Generation Fuel Gauge

- GTI and Argonne National Lab (ANL) partnered to improve fuel gauges
 - Measure in-tank temperature as well as pressure
 - Calculate total fuel mass remaining
 - Calculate distance until empty

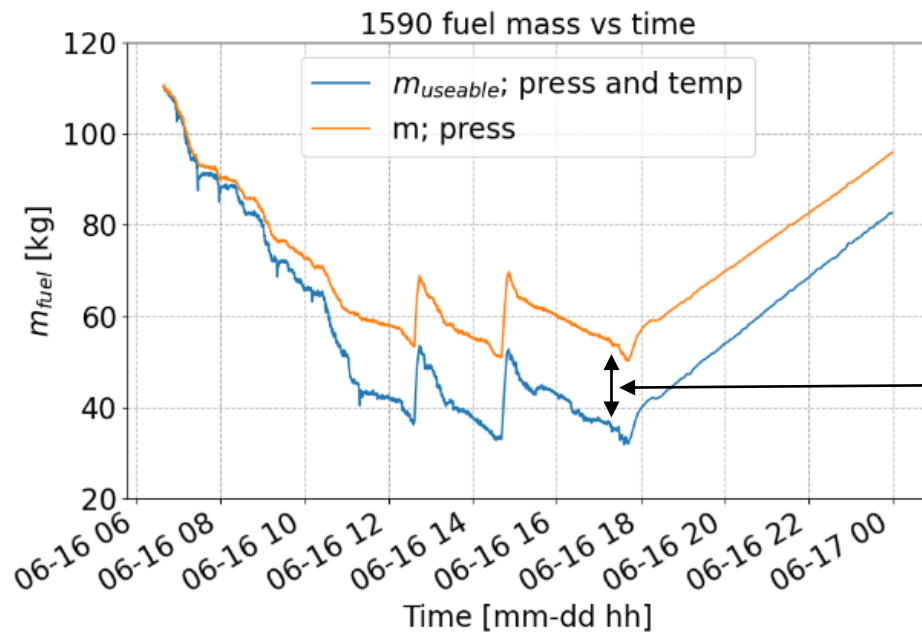


Prototype installed on test vehicles

Project funded by the US Department of Energy

Fuel Guage Demonstration

- Deployed on 10 Ozinga concrete trucks
 - Challenging application with large % idling time
- Showed improved accuracy over pressure-only gauge

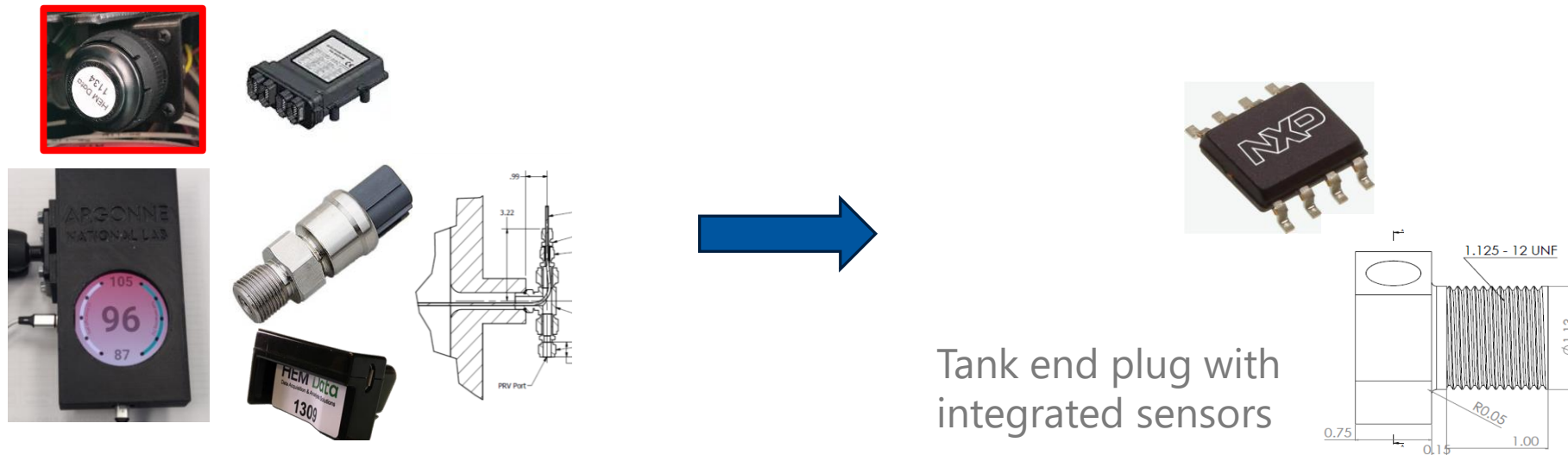


As much as 20kg (~15%) error without temperature reading



Fuel Gauge Commercialization

- Pursuing commercialization with fuel system packagers or integrators
 - Requires simplification of components
 - Research-level components to be replaced with cost-effective components
 - Software components can be transferrable to in-dash display, or dispatch software



Tank end plug with integrated sensors

Smart Dispenser

- GTI is working to improve CNG dispenser performance
 - Measure vehicle tank temperature as well as pressure
 - Transmit real-time data to CNG station via wireless communication
 - Supply dispenser with adjusted filling target using vehicle data



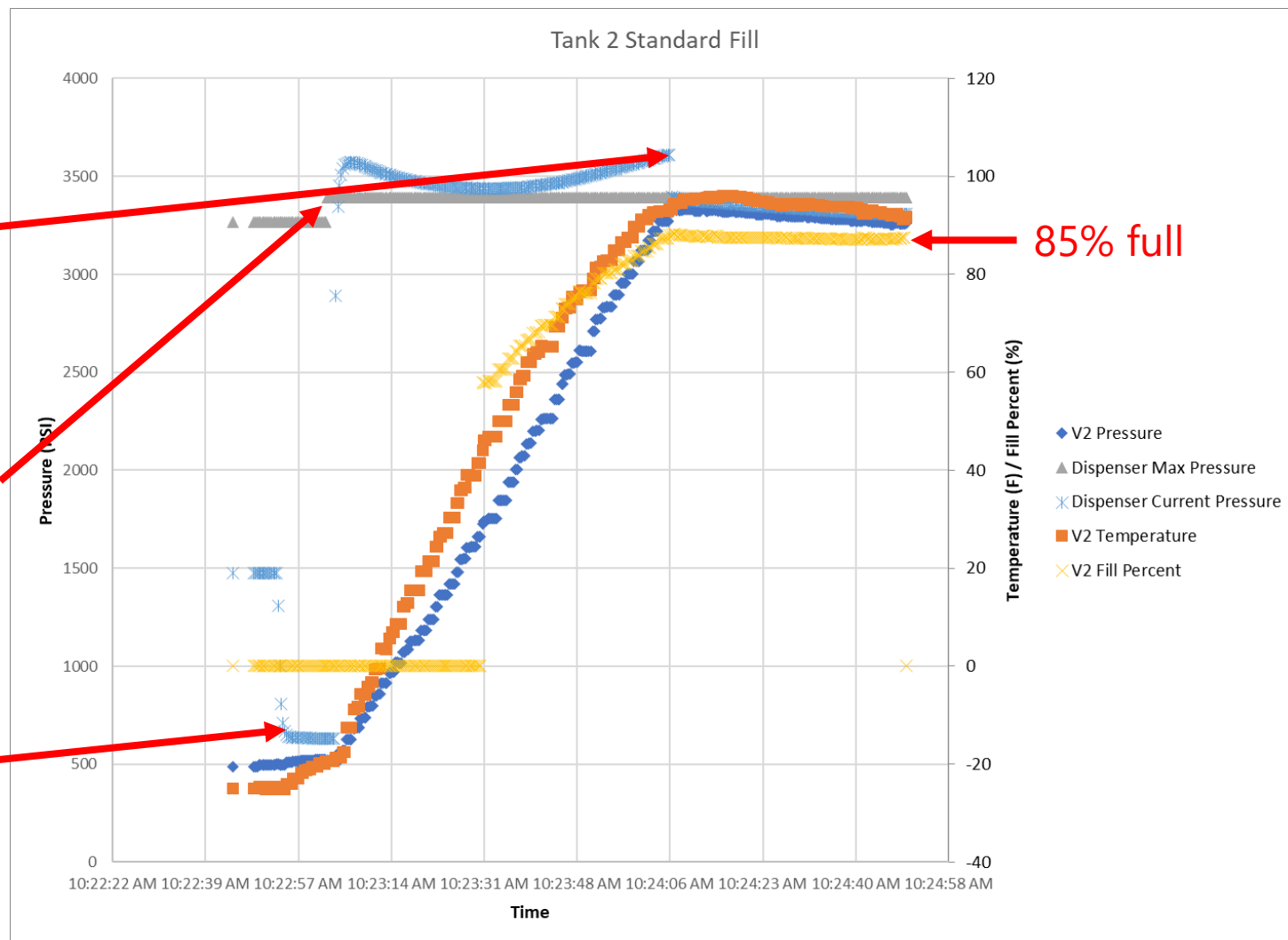
Smart Dispenser Testing

Standard / Smart CNG Fill

3) Hose pressure is used to estimate vehicle pressure. Fill stops when dispenser target is reached.

2) Hose pressure and ambient temperature are used to set filling target.

1) Dispenser hose pressure drops when connected to vehicle.



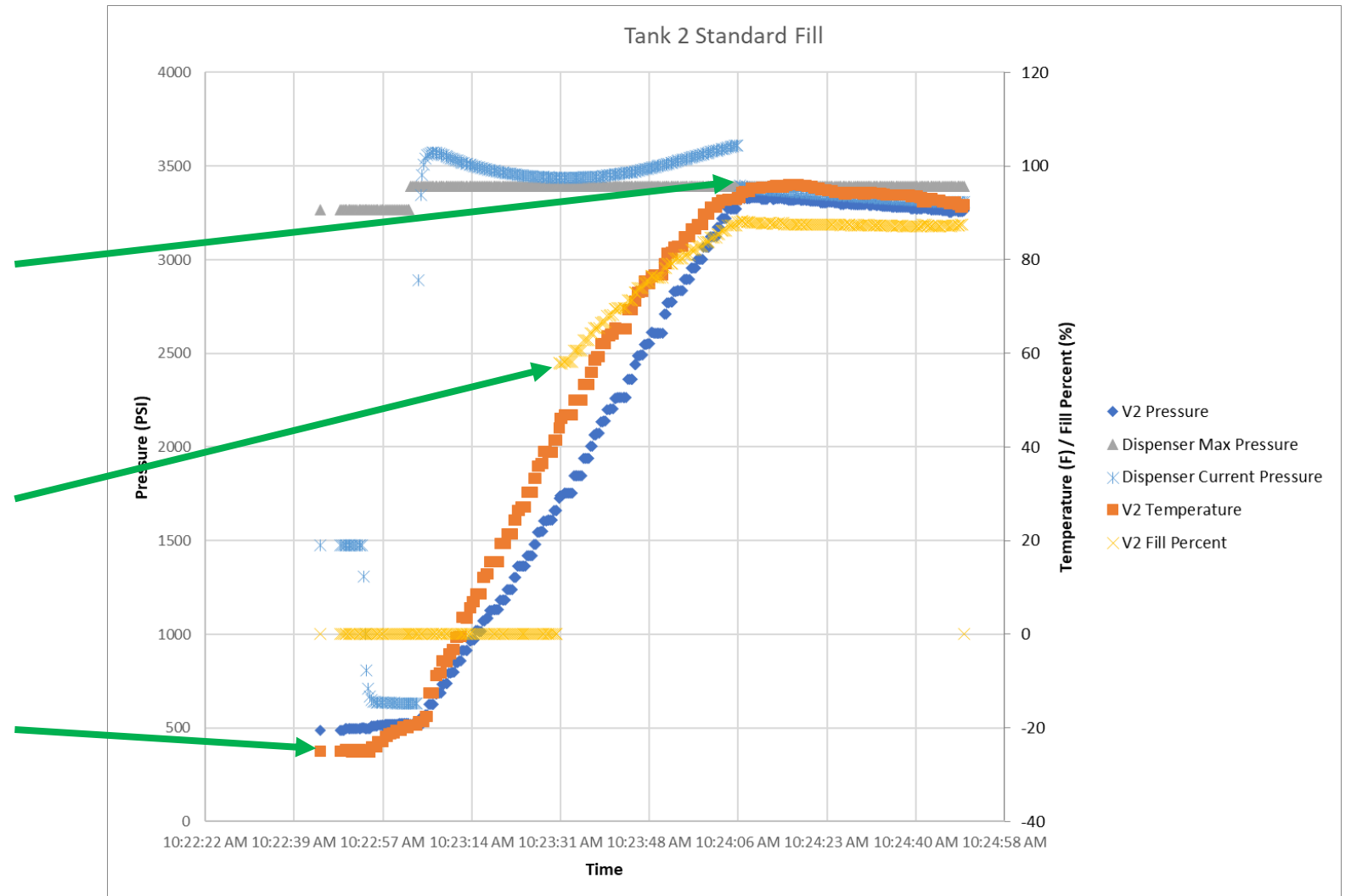
Smart Dispenser Testing

Standard / Smart CNG Fill

3) Smart Controller will override dispenser and fill to 100% or max pressure.

2) Smart Controller identifies which vehicle and dispenser are connected

1) Smart Controller monitors vehicle pressure and temperature in real time as soon as it enters the CNG station



Smart Dispenser Commercialization

- Pursuing commercialization with fuel system packagers and dispenser manufacturers
 - On vehicle components are nearly identical to fuel gauge requirements
 - In-tank temperature sensor
 - Wireless transmitted
 - Most existing CNG stations have wireless networks and station controllers that just need updated software to connect to vehicles and improve fills

