Appendix B

Handbook 130 – Uniform Regulation for Method of Sale of Commodities and Uniform Engine Fuels and Automotive Lubricants Regulation

Items:

232-1: Uniform Method of Sale:
   2.27. Retail Sales of Natural Gas Sold as a Vehicle Fuel

237-1: Uniform Engine Fuels and Automotive Lubricants Regulation:
   Section 1. Definitions – Diesel Liter Equivalent (DLE) and Diesel Gallon Equivalent (DGE)

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Clean Vehicle Education Foundation

Proposal for CNG & LNG - DGE

NCWM Interim Meeting
January 28, 2013

Douglas Horne – President

Why DGE is Now Needed by the NGV Market
- In the 1994 NCWM set GGE at 5.66 lbs but deferred the development of DGE because:
  - The consumer market was LD gasoline conversions
  - And diesel class NGVs were fleets such as transit that use private stations.
- In the last twenty years the market growth has been in HD vehicles and now a national network of public CNG and LNG fueling is emerging.
CNG and LNG Delivery Systems

- Natural Gas Pipeline Supply
  - National Average: LHV 20,161 BTU/ft³
  - ~ 250°F at 2 psig

- LNG Plant
  - CO₂ removal

- Delivery by tanker
  - Delivery

- On site storage
  - Mass flow meter

- 4500 psig to 4000 psig

- 3600 psig

- DGE 6.312

- -20°F at 100 psig

- DGE 6.22

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DGE Based on CNG Composition Used in 1994 GGE Calculation

- The 1994 acceptance NCWM of Gasoline Gallon Equivalent (GGE) for natural gas to be equal to 5.660 lbs was based on a national weighted average composition of natural gas:
  - energy content (lower heating value – LHV) of 923.7 BTU/scf
  - density of 0.0458172 lbs/scf
  - or 20,160.531 BTU/lb

- Using the same natural gas composition and the ratio of the LHV of diesel to the LHV of gasoline as noted in Table B.4 of the DOE Transportation Energy Data Book:
  - 128,790/155,400 X 5.660 gives the Diesel Gallon Equivalent (DGE) of 6.312 lbs

- For those NGVs that use CNG as a replacement for diesel then the average energy equivalent per gallon would be 6.312 lbs

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Appendix B – Item 232-1: Uniform Regulation for Method of Sale of Commodities and Item 237-1: Uniform Engine Fuels and Automotive Lubricants Regulation

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**DGE Based on LNG Composition**

| National Average Natural Gas Composition Used for GGE Standard - Applied to LNG DGE Calculation |
|-------------------------------------------------|----------------------------------|-----------------|-----------------|--------------------|------------------|-----------------|-----------------|
| Components | C1 | C2 | C3 | n-C4 | n-C5 | C8 | N2 | CO2 |
| LHV (BTU/LB) | 21537 | 20364 | 19667 | 19529 | 20485 | 19043 | 0 | 0 |
| LBS/HC | 0.0425 | 0.0603 | 0.1195 | 0.1582 | 0.1907 | 0.0228 | 0.0744 | 0.117 |
| %V | 92.87 | 3.34 | 0.63 | 0.07 | 0.04 | 0.06 | 2.07 | 0.78 |
| %V* | 92.59 | 3.57 | 0.63 | 0.07 | 0.04 | 0.06 | 2.09 | 0.78 |
| LBS/HC | 0.028777914 | 0.00292984 | 0.000758557 | 0.00311594 | 0.00323459 | 0.0042890287 | 0.001919321 | 0.001052093 |
| %MASS | 87.9259175 | 1216.445032 | 1674.475956 | 48.17560525 | 34.0679129 | 49.27383785 | 34.0679129 | 34.0679129 |
| LHV | 18936.17413 | 1216.445032 | 1674.475956 | 48.17560525 | 34.0679129 | 49.27383785 | 34.0679129 | 34.0679129 |

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**Proposal**

- CNG dispensers may dispense natural gas in two units:
  - GGE = 5.66 lbs
  - DGE = 6.312 lbs
- LNG dispensers will dispense LNG in one unit:
  - DGE = 6.22 Lbs

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