# Density Correction: LMD-26.1[1] & MOS-26.3[2]
Facts, Figures and Questions and Answers

Agenda item LMD-26.1 modifies Handbook 44 to codify that density correction may be used to account for the traceable volume growth that occurs when gasoline is blended with ethanol to make a finished motor fuel. MOS-26.3 modifies HB 130, adding a requirement to the method of sale for liquid measuring devices that perform temperature compensation and/or density correction. We respectfully ask for your support for LMD-26.1 and MOS-26.3 as Voting items.

Why is this necessary? The volume of gasoline and ethanol when blended is more than the volume of the two liquids measured separately. This is due to a change in density.

Who benefits if Chapter 11.3.4[3] is applied? In many states, motor fuels can be sold by volume at standard conditions (net volume) at the wholesale level. The determination of an accurate volume is beneficial to all parties and guarantees equity in the marketplace. Companies that blend gasoline and ethanol at the terminal loading rack using traditional sequential or ratio blending methods would be able to more accurately invoice on the known volume gain.
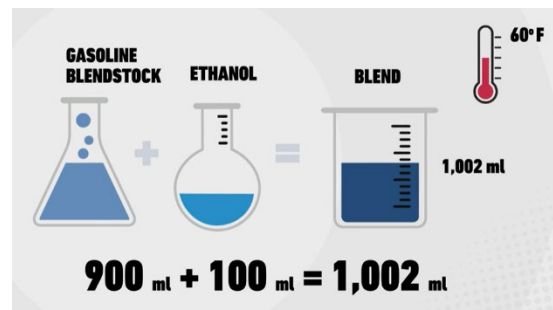
Are the measurements traceable to a direct a physical standard? The determination of the additional volume is traceable to API MPMS Ch. 11.1 which includes Chapter 11.3.4. Ch. 11.1 includes data collected and analyzed over a period of decades (over 75 years?) to understand the how pressure, temperature and volume affect different liquid fuels. Chapter 11.3.4 is already used to calculate the net volume using Automatic Temperature Compensating Systems. Density correction uses the same process inputs as ATC and does not have any additional process variables. The only additional variable is the ideal fraction of ethanol (% ethanol), which is an intermediate calculated value based on the simple ratio of the net volumes of the components - which have already been calculated with ATC.

Didn't some terminals change their configuration to add a custody meter after the products are blended? Some who built terminal loading bays later and were aware of this growth phenomenon might have chosen to build their terminal using the side-stream blending configuration to capture the volume growth that occurs.

Can the inequity for ratio blending facilities be resolved without investing in physical infrastructure? Yes, for terminals that don't directly measure the volume growth in the final blended product, one can apply the industry standard (API Chapter 11.3.4) that calculates the expansion.

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[1] **LMD-26.1** *S.2. Measuring Elements, S.4. Marking Requirements, N.4. Testing Procedures, U.R.6. Temperature Volume Compensation and Correction Wholesale, and T.5. Density Correction Systems.*

[2] **MOS-26.3** Section 2.20 Gasoline and Gasoline Oxygenate Blends

[3] MPMS Ch. 11 Physical Properties Data (ASTM D1250-e19, Adjunct), Chapter 11.1 - Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils, Ch. 11.3.4 Miscellaneous Hydrocarbon Properties - Denatured Ethanol and Gasoline Component Blend Densities and Volume Correction Factors

Is it equitable to use Ch. 11.3.4? Yes. We know that there is between 0.08% and 0.3% growth that occurs when gasoline is blended with ethanol. That range is due to the density / API gravity of the gasoline blendstock and the percent ethanol in the blend. A fuel owner should not be asked to give away a known volume**.** The video at the following link explains the issue and a demonstration of the growth that occurs when blending gasoline and ethanol. https://cdn.api.org/videos/API-Ethanol-Blending-Long-Full-Video.mp4

Does this apply to me if my state only allows transactions on a gross measure? No. Gross volume is, by definition, uncompensated, consequently the calculations described in the Ch. 11.3.4 are not applicable to gross volume measurement. Even when custody transactions are done in gross volumes, inventory reconciliation using the net volumes of blends of gasoline and ethanol calculated using Ch. 11.3.4 will be more accurate.

What information is needed to calculate the excess volume? The same information used to calculate the net temperature compensation is needed plus the percent ethanol blend.

Can an inspector confirm this correction? Yes, the inputs that are used are the same inputs an inspector uses to check temperature compensation with the addition of the percent of ethanol being blended. As with temperature compensation, a verified reference calculation tool could be made available to run the calculations that are found in Ch. 11.3.4.

Is the API standard approved or used internationally?   Yes. API is accredited via a voluntary consensus process by ANSI and is aligned with the World Trade Organization, Technical Barriers to Trade principles. API Chapter 11.1, which includes Chapter 11.3.4, was developed with international participants and is used internationally. It is an adjunct to ASTM D1250-e19 which specifically references API Ch. 11.3.4.

Can Chapter 11.3.4 be used for custody transfer? Yes. Three of the four scenarios in Ch. 11.3.4 can be applied to custody transfer, in fact the standard recommends it be "utilized on all applications." Only Scenario-4 is not suitable for generating properties for custody transfer quantities. The values derived from Scenario-4 are expected to be sufficiently accurate to form the basis for a commercial discussion of the delivered volume.

Why is the density correction applied at net gallons and not gross gallons? The title of Ch. 11.3.4 is *Miscellaneous Hydrocarbon Product Properties –Denatured Ethanol and Gasoline Component Blend Densities and Volume Correction Factors (VCF)*. The calculation of temperature corrected net volumes require the application of the VCFs in the standard. Gross volume is, by definition, uncompensated, consequently the calculations described in the Ch. 11.3.4 are not applicable to gross volume measurement.

Can 11.3.4 be applied at retail? Some dispensers determine the volume of E15 by separately measuring the E10 and the E85 and adding those two volumes together. As such, a retail station would theoretically be able to apply Ch. 11.3.4 but they would need to have four pieces of information, the temperature of the two fuels, a calculated net volume of each fuel, the density/API gravity of the E10, the density/API gravity of the E85, and the percent volume of ethanol in the E85.