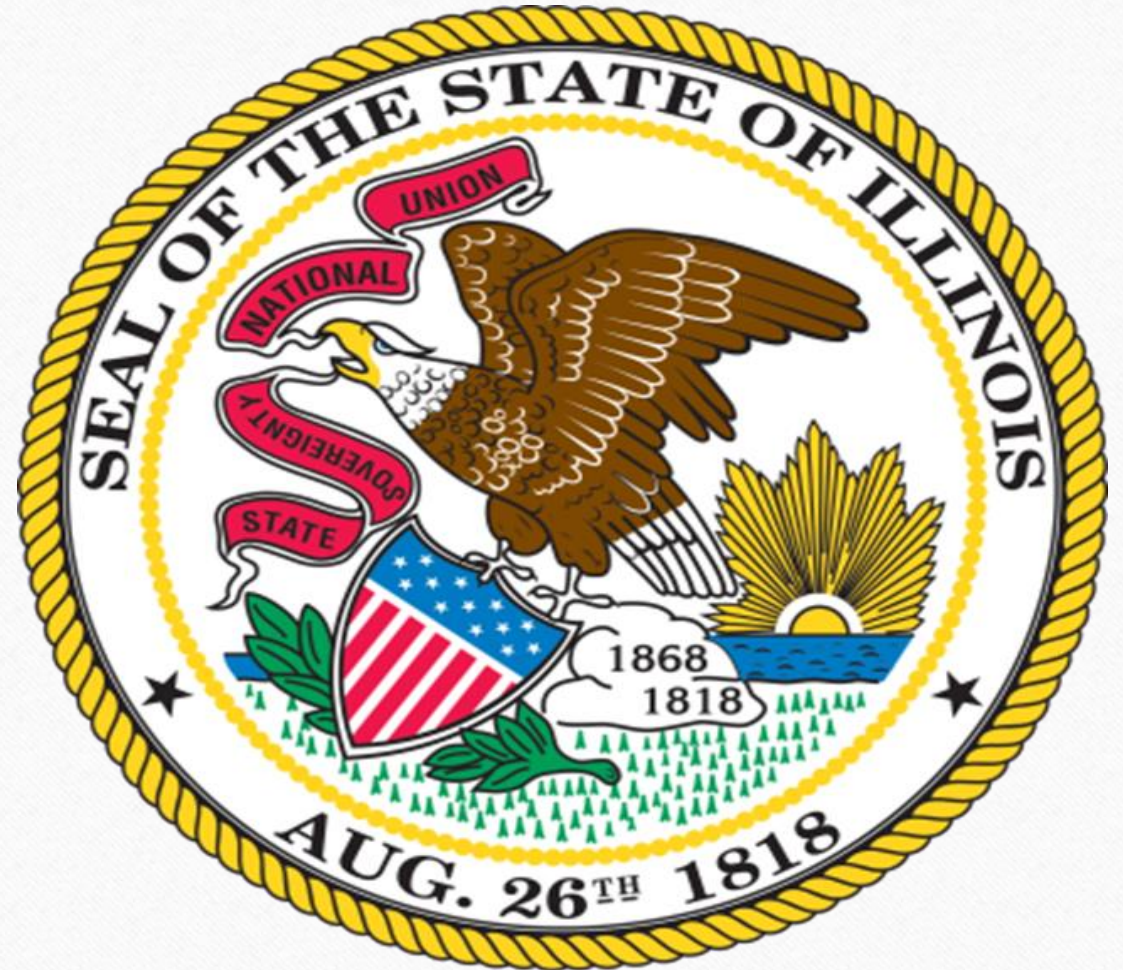


Bureau of Weights & Measures

Illinois Department of
Agriculture



Bureau of Weights & Measures: Protecting Equity in Trade

The Illinois Department of Agriculture's Bureau of Weights and Measures safeguards consumer and commercial interests by ensuring fair, accurate, and traceable measurement in all commodity transactions. Our statutory responsibilities include:

- Verifying meter accuracy and transaction integrity at loading racks.
- Overseeing wholesale and retail commodity measurement and delivery.
- Monitoring the quality of motor fuel sold in the state.
- Maintaining certified laboratories for metrology standards and grain moisture measurement.

API's Proposal: Density Correction via “Excess Volume”

- API proposes adopting its MPMS Standard 11.3.4, which introduces a calculation for “excess volume” to replace a traceable custody meter in systems without side stream or hybrid side stream blending.
- This approach would substitute **a calculated estimate** for a **direct, traceable measurement**, a fundamental shift away from accepted metrological practice.

What is “Excess Volume”?

- “Excess volume” refers to the slight volume increase that occurs when gasoline and ethanol are blended, due to molecular interactions that reduce mixture density.
- API MPMS 11.3.4 provides regression-based equations to estimate this effect.
- These calculations are based on laboratory models and are **not directly measured**.
- Results are applied only to **net gallons**, raising questions about consistency and intent.
- This standard is designed for engineering and inventory purposes, not for commercial billing or regulatory use.

Regulatory Concerns with API 11.3.4

- **No verification method exists:** Results cannot be independently proven or traced to national or international standards.
- **Estimates, not measurements:** Weights & Measures regulates physical measurements, not modeled projections.
- **Not endorsed for custody transfer:** API itself does not recommend 11.3.4 for transactional use.
- **Not jointly developed:** Unlike API 11.1 / ASTM D1250-08, 11.3.4 is not harmonized with ASTM or the Energy Institute, reducing its legitimacy.

Regulatory concerns continued

API 11.3.4 Implementation on the Accuload Register (2019) without regulatory approval or notification

- **API Guidance:** Publications address general issues; local, state, and federal laws must be consulted.
- **No Warranty:** API does not guarantee accuracy, completeness, or applicability to specific circumstances.
- **User Responsibility:** Operators and manufacturers must comply with all applicable laws and standards.

Source: API MPMS 11.3.4, Foreward & Special Notes

Why 11.3.4 Lacks Metrological Standing

- API MPMS 11.3.4 is an **industry practice**, not a recognized metrology standard. It lacks international adoption, harmonization, and traceability.
- In contrast, standards like API MPMS 11.1 / ASTM D1250-08 are jointly developed and globally recognized, making them acceptable for custody transfer and regulatory compliance.

Comparison with Recognized Standards

- **API MPMS 11.1:** Traceable temperature/pressure corrections.
- **ASTM D1250:** Custody transfer-grade petroleum measurement tables.
- **OIML R120:** International trade measurement requirements.

API 11.3.4 differs fundamentally. It relies on regression estimates, is not traceable, and cannot be verified through established regulatory methods.

Temperature Compensation (11.1) vs API 11.3.4 (Excess Volume)

| Feature | Temperature Compensation (API 11.1 / ASTM D1250) | API 11.3.4 (“Excess Volume”) |
|-------------------|--|---|
| History | In use for 100+ years ; established early 1900s | Created in 2019 |
| Data Basis | Built on millions of observed data points over decades | Limited dataset (2008–2013), 5,878 reduced to 1,662 |
| Method | Corrects measured volumes to 60 °F based on verified density–temperature relationships | Uses regression models to estimate blending gain (not measured) |
| Traceability | Fully traceable to national/international standards | Not traceable ; no verification method exists |
| Recognition | Jointly developed (API, ASTM, Energy Institute); globally accepted | API-only standard; not harmonized internationally |
| Intended Use | Legal custody transfer; required by NIST HB 44 & OIML R117 | Designed for engineering/inventory , not billing |
| Commercial Impact | Ensures fairness and reproducibility in trade | Bills unmeasured, unverifiable gallons ; risks inequity and consumer overcharges |

Traditional Measurement (Traceable)

- **Gross Volume (measured at actual temp):** A (Gasoline) + B (Ethanol) = C (Gross Gallons)
- **Net / Compensated Volume (traceable):** C converted back to 60 °F reference using API 11.1 / ASTM D1250 (dates back 100+ years) ☒
- **Result:** $A+B=C$ converted 60 °F. Traceable, verifiable, and legally defensible measurement

API 11.3.4 (Excess Volume Calculation)

- **Gross Volume (measured at actual temp):** $A \text{ (Gasoline)} + B \text{ (Ethanol)} = C \text{ (Gross Gallons)}$
- **Net / Compensated Volume (traceable):** C converted back to 60 °F reference using API 11.1 / ASTM D1250 (dates back 100+ years)
- **Excess Volume Added (not measured):** “Estimated Gallons” from API 11.3.4 model
- **Result:** $A+B=C$ converted 60 °F + **Estimated gallons.** Bills **More than physically measured**, unverifiable.

Estimates Are Incompatible with Commercial Billing

- Regulations such as NIST Handbook 44 and OIML R117 require commercial transactions to be based on **traceable, verifiable measurements**.
An “estimated” quantity cannot meet these standards because:
- It is not a primary measurement.
- Inputs vary by feedstock, temperature, and composition.
- Model uncertainty is not reflected in invoices.
- Results cannot be independently reproduced for audit or enforcement.

Laboratory Derived Models \neq Field Measurements

- API 11.3.4 regressions are based on controlled laboratory testing (2008–2013) using limited feedstocks and temperature ranges.
- Outlier removal and dataset manipulation further reduce field applicability.
- Such results may be valid for engineering use but **do not meet the traceability or reproducibility requirements for trade measurement.**

Data Integrity Concerns

- Of 5,878 original data points, only 1,662 were used after exclusions and adjustments.
- This level of filtering raises concerns about representativeness, transparency, and methodological integrity.

Traceability and Legal Metrology

- Traceable measurement requires a direct link to a physical standard. “Excess volume” is a derived value and not directly observed, verified, or recorded at the point of custody transfer.
- Billing based on a model undermines the traceability chain.
- Disputes would hinge on unverifiable inputs rather than physical measurements.

Billing Implications if Adopted

Adoption would allow estimated volumes to be added to measured custody meter values.

- **Sequential, ratio, or hybrid systems:** Estimated gallons would be billed beyond what was physically measured.
- **Side-stream systems:** No additional gallons are billed because the actual volume is captured by a traceable meter, demonstrating that estimates are unnecessary where proper measurement occurs.

Excess Volume on a Sequential blend system

Additional **ESTIMATED** gallons billed to the customer based on API's 11.3.4 calculation

E.3.2 Automatic sequential—Sequential blending is accomplished by loading individual components in the proper proportion according to the finished product recipe. This is accomplished by opening product line block valves one at a time through one meter/load arm position in a set sequence to complete the finished product.

Gallons measured by a **verifiable and traceable** Custody meter

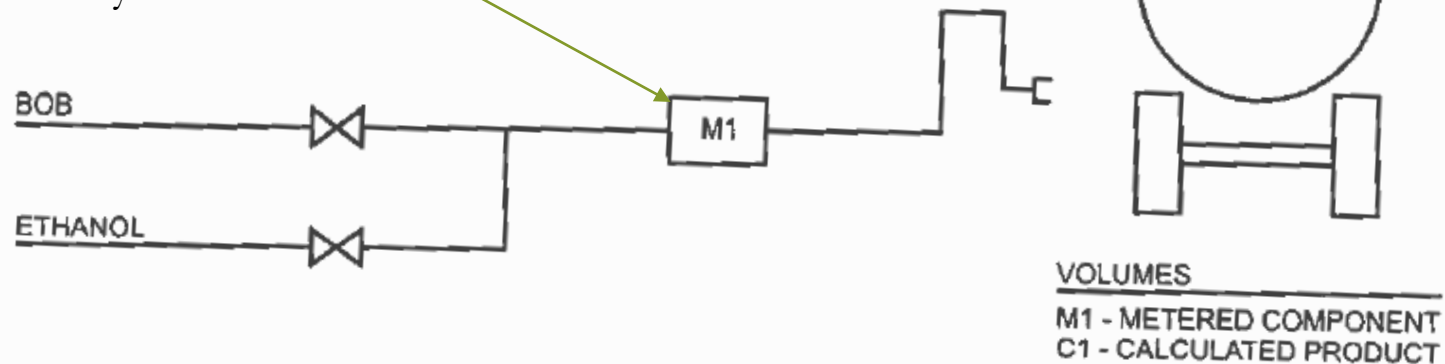


Figure E.1—Sequential Metering

Excess Volume on a Ratio-blend system

Additional **ESTIMATED** gallons billed to the customer based on API's 11.3.4 calculation

E.3.3 On rack ratio blending—On rack ratio blending is accomplished by simultaneously combining two or more products through dedicated unique meters in respective amounts and flow rates according to the finished product recipe. This is accomplished at the individual loading position while delivering into a truck or rail car. This process is typically automated.

Volumetric corrections are covered under Scenario 1. See Figure E.2.

Gallons measured by a **verifiable and traceable**
Custody meter

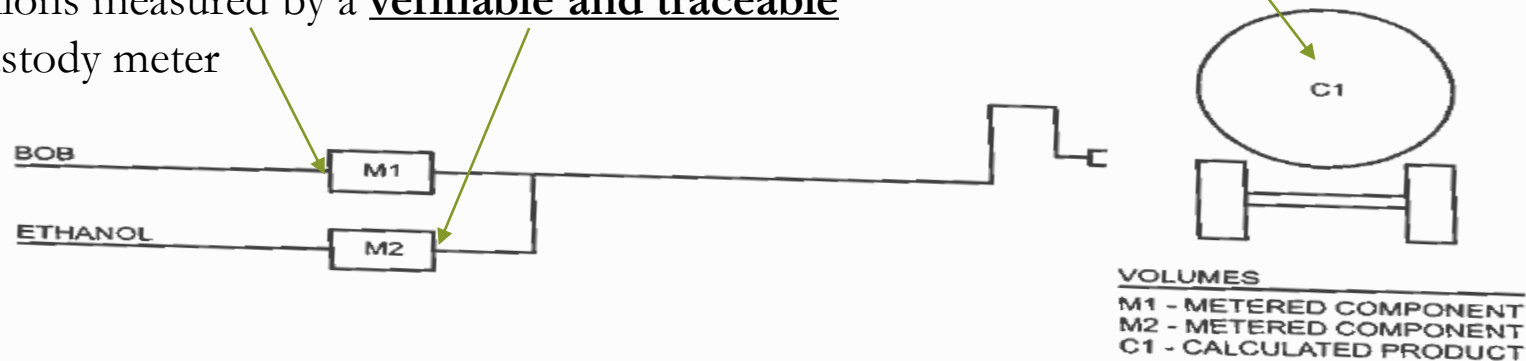


Figure E.2—Ratio Metering

Excess Volume on a Hybrid Ratio-blend system

Gallons measured by a **verifiable and traceable**

Custody meter

E.3.5 Hybrid ratio—The blending is accomplished by simultaneously combining a ratio product with a sequential product stream through unique meters and control valves in respective amounts and flow rates according to the finished product recipe. This is accomplished at the individual loading position while delivering into a truck or rail car. This process is typically automated.

Volumetric corrections are covered under the Scenario 1, since the normal practice is that the ratio product is the hydrocarbon blend component of BGE. See Figure E.4.

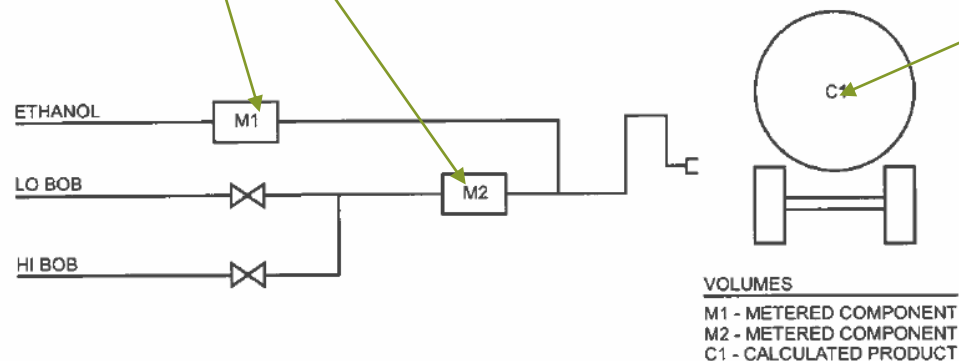


Figure E.4—Hybrid Ratio Metering

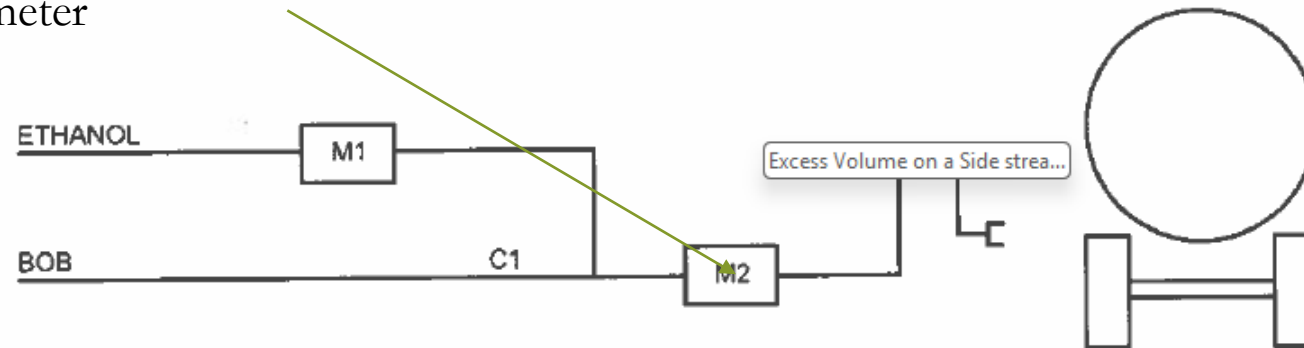
Additional **ESTIMATED** gallons
billed to the customer based on
API's 11.3.4 calculation

Excess Volume on a Side stream blend system

*****NO ADDITIONAL GALLONS ADDED*****

ADDITIONAL GALLONS CREATED DUE TO BLENDING ARE BEING
CAPTURED BY **A VERIFIABLE TRACEABLE METER.**

Gallons measured by a **verifiable and traceable**
Custody meter



VOLUMES

M1 - METERED COMPONENT

M2 - METERED COMPONENT

C1 - CALCULATED PRODUCT

*NOT APPLIED ON SIDE STREAM

Figure E.3—Side Stream Metering

Excess Volume on Hybrid Side Stream blend systems

*****NO ADDITIONAL GALLONS ADDED*****

ADDITIONAL GALLONS CREATED DUE TO BLENDING ARE
BEING CAPTURED BY **A VERIFIABLE
TRACEABLE METER**

Gallons measured by a **verifiable and traceable**
custody meter

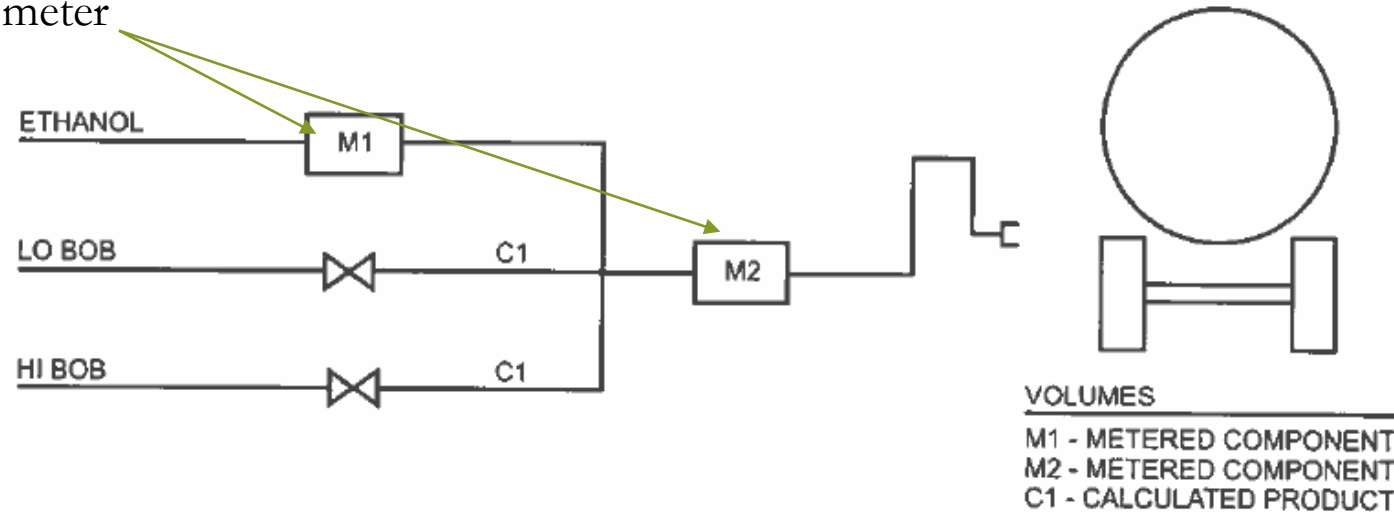


Figure E.5—Hybrid Side Stream Metering

Illustrative Example: Excess Volume Impact

- Blending 90,000 gallons of gasoline with 10,000 gallons of ethanol should yield 100,000 gallons.
- API 11.3.4 predicts ~100,200 gallons (a 0.2% increase).
- This additional volume exists **only as a model output** and is not verified by a prover, meter, or standard.

Consumer Implications

Bill of Lading examples prior to Illinois Stop-Use order on this Calculation.

Example 1 of Excess Volume on the Bill of Lading

Compartment 1 **3,014** Net Gallons Billed

307 (Ethanol)+ 2,701 (Gas)=3,008 Measured

6 extra gallons billed

Compartment 2 **1,511** Net Gallons Billed

154 (Ethanol)+ 1,354 (Gas)=1,508 Measured

3 extra gallons billed

Compartment 3 Diesel- No Excess
Calculation

Compartment 4 **2,508** Net Gallons Billed

255 (Ethanol) + 2,247 (Gas)= 2,502 Measured

6 extra gallons billed

This 1 truck was charged for **15 extra gallons** that are not explained anywhere on the Bill of Lading.

*Note this is on a day where temps are in the 60s

*Extra billed gallons not displayed on register during delivery and not accounted for on the Bill of Lading

| RECEIVED BY / CARRIER: [REDACTED] | | | | | | | |
|---|-------|---------------------------------|-------|---------------------------------|-------|------------------------------------|------------|
| WHERE THIS DOCUMENT CONSTITUTES A BILL OF LADING, AND AN EXCEPTION STATED IN 49 C.F.R. §172.204(B) IS NOT MET, THIS IS TO CERTIFY THAT THE BELOW - NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION. CARRIER CERTIFIES THAT THE CARGO TANK SUPPLIED FOR THIS SHIPMENT IS A LAWFUL CONTAINER FOR TRANSPORTATION OF THE LISTED COMMODITIES. CARRIER CERTIFIES THAT THE CARGO TANK WAS REASONABLY FREE OF EXCESSIVE RESIDUE OR OTHER CONTAMINATING MATERIALS WHEN PRESENTED FOR LOADING. | | | | | | | |
| SEE REVERSE FOR ADDITIONAL TERMS AND CONDITIONS | | | | | | | |
| [REDACTED] | | | | X | | :CARRIER'S AGENT (DRIVER) | |
| [REDACTED] | | | | | | CNN#: 13740 | |
| DOT SHIPPING NAME | | | | | | GALLONS | |
| UN1203,GASOLINE,3, PG II | | | | | | 7,047 | |
| NA1993,DIESEL FUEL,3, PG III | | | | | | 1,017 | |
| | | | | | | TOTAL QUANTITY 1 CARGO TANK: 8,064 | |
| PRODUCTS | | | | | | | |
| TRL / COMP | PROD | DESCRIPTION | GROSS | NET | TEMP | GRAV | SEE NOTES |
| 19309 / 1 | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 3,014 | 3,014 | 63.1 | 62.5 | 6,10,48,63 |
| | | ETHANOL | 308 | 307 | 65.3 | 47.0 | |
| | | 84 CONV | 2,706 | 2,701 | 62.9 | 64.3 | |
| 19309 / 2 | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 1,517 | 1,511 | 67.7 | 62.5 | 6,10,48,63 |
| | | ETHANOL | 155 | 154 | 64.9 | 47.0 | |
| | | 84 CONV | 1,362 | 1,354 | 68.0 | 64.3 | |
| 19309 / 3 | 10594 | #2 MV15 DIESEL B14 BLEND | 1,017 | 1,011 | 71.3 | 35.4 | G,49,140 |
| | | B99 BIODIESEL | 144 | 142 | 92.6 | 28.4 | |
| | | #2 MV15 DIESEL | 873 | 869 | 67.8 | 36.6 | |
| 19309 / 4 | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 2,516 | 2,508 | 67.7 | 62.5 | 6,10,48,63 |
| | | ETHANOL | 256 | 255 | 66.1 | 47.0 | |
| | | 84 CONV | 2,260 | 2,247 | 67.9 | 64.3 | |
| TOTALS: | | | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 7,047 | 7,033 | |
| | | | 10594 | #2 MV15 DIESEL B14 BLEND | 1,017 | 1,011 | |
| NOTES | | | | | | | |
| BY ACCEPTANCE OF THIS BOL I CONFIRM I HAVE AN EMERGENCY RESPONSE GUIDEBOOK (ERG) OR WAS PROVIDED EMERGENCY RESPONSE | | | | | | | |

* Note: The Bill of Lading serves as the delivery invoice and is the official transaction document.

Example 2 of Excess Volume on the Bill of Lading

Compartment 1 3,320 Net Gallons Billed

339 (Ethanol)+ 2,974 (Gas)=3,313 Measured

7 extra gallons billed

Compartment 2 1817 Net Gallons Billed

184 (Ethanol)+ 1,629 (Gas)=1,813 Measured

4 extra gallons billed

Compartment 3 1026 Net Gallons Billed

104 (Ethanol) + 920 (Gas)= 1,024 Measured

2 extra gallons billed

Compartment 4 2613 Net Gallons Billed

265 (Ethanol) + 2342 (Gas)= 2,607 Measured

6 extra gallons billed

This 1 truck was charged for **19 extra gallons** that are not explained anywhere on the Bill of Lading.

*Note this is on a day where product temps are in the 60s

*Extra billed gallons not displayed on the register during delivery and not explained on the Bill of Lading.

| DOT SHIPPING NAME | | | | | | GALLONS | |
|--|------|---------------------------------|--------------|--------------|------|---------|------------|
| UN1203,GASOLINE,3, PG II | | | | | | 8,772 | |
| TOTAL QUANTITY 1 CARGO TANK: | | | | | | 8,772 | |
| PRODUCTS | | | | | | | |
| TRL / COMP | PROD | DESCRIPTION | GROSS | NET | TEMP | GRAV | SEE NOTES |
| 19309 / 1 | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 3,317 | 3,320 | 61.5 | 63.9 | 6,10,48,63 |
| | | ETHANOL | 340 | 339 | 63.1 | 47.0 | |
| | | 84 CONV | 2,977 | 2,974 | 61.3 | 65.8 | |
| 19309 / 2 | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 1,815 | 1,817 | 61.2 | 63.9 | 6,10,48,63 |
| | | ETHANOL | 185 | 184 | 62.8 | 47.0 | |
| | | 84 CONV | 1,630 | 1,629 | 61.0 | 65.8 | |
| 19309 / 3 | 7844 | 93 OCTANE PREMIUM W/10% ETHANOL | 1,026 | 1,026 | 61.9 | 55.8 | 6,10,48,63 |
| | | ETHANOL | 105 | 104 | 63.1 | 47.0 | |
| | | 91 CONV | 921 | 920 | 61.8 | 56.8 | |
| 19309 / 4 | 7841 | 87 OCTANE REGULAR W/10% ETHANOL | 2,614 | 2,613 | 63.3 | 64.2 | 6,10,48,63 |
| | | ETHANOL | 266 | 265 | 63.0 | 47.0 | |
| | | 84 CONV | 2,348 | 2,342 | 63.3 | 66.2 | |
| TOTALS: | | | 7,746 | 7,750 | | | |
| | 7844 | 93 OCTANE PREMIUM W/10% ETHANOL | 1,026 | 1,026 | | | |
| NOTES | | | | | | | |
| BY ACCEPTANCE OF THIS BOL, I CONFIRM I HAVE AN EMERGENCY RESPONSE GUIDEBOOK (ERG) OR WAS PROVIDED EMERGENCY RESPONSE INFORMATION MEETING REQUIREMENTS OF 172.602 OF THE HMR, AND I HAVE OR HAVE BEEN PROVIDED THE CORRECT PLACARDS AND/OR MARKINGS FOR THIS HAZARDOUS MATERIAL AND HAVE THEM PROPERLY DISPLAYED PRIOR TO LEAVING THE FACILITY. | | | | | | | |
| THE VOLUME OF THE PRODUCT GIVEN IN THE NET COLUMN HAS BEEN ADJUSTED FOR TEMPERATURE VARIATIONS TO A VOLUME AT 15 °C (60 °F). | | | | | | | |
| DETERGENT-ADDITIZED GASOLINE. | | | | | | | |
| WINTER CG, E10: CONTAINS BETWEEN 9 AND 10 VOL % ETHANOL. | | | | | | | |
| THIS VOLUME OF NEAT OR BLENDED ETHANOL IS DESIGNATED AND INTENDED FOR USE AS TRANSPORTATION FUEL OR JET FUEL IN THE 48 U.S. CONTIGUOUS STATES AND HAWAII. ANY PERSON EXPORTING THIS FUEL IS SUBJECT TO THE REQUIREMENTS OF 40 CFR 80.1430. | | | | | | | |
| See next page for more information | | | | | | | |

Extra Gallons Not Accounted for on the Bill of Lading.

- Between these two examples, **34** gallons were added to the measured Ethanol and Gasoline Net gallons.
- There is no explanation on the Bill of Ladings for the **34** additional gallons.
- The location where this was found is estimated to be loading approximately **150** trucks daily.
- If each truck were loaded the same, (avg 17g) there would be an extra **2,550** Gallons billed per day based on this calculation.
 - **17,850** gallons over billed **per week.**
 - **71,400** gallons over billed **per month.**
 - **856,800** gallons over billed **per year.**

Regulatory and Legal Consequences

- Legal metrology requires that billed quantities be:
- Directly measured
- Traceable to recognized standards
- Reproducible and auditable
- Using a calculated estimate for custody transfer **violates these principles** and risks disputes, enforcement actions, and loss of consumer trust.

Simple solution

- The anticipated profit can be realized while maintaining compliance with metrological best practices, ensuring all measurements are traceable to established standards.

Conclusion: Reject Model-Based Billing

Only **traceable, directly measured volumes** should be used in commercial transactions.

Adopting API 11.3.4 would:

- Undermine traceability and auditability.
- Introduce unverifiable quantities into trade.
- Contradict established legal metrology standards.

Recommended Actions

- Have your metrology or analytical chemistry team review the underlying data and methodology of API 11.3.4.
- Request NIST to conduct an independent assessment of the standard's scientific validity and regulatory suitability.
- Oppose adoption of any standard that substitutes modeled estimates for traceable measurements in commercial billing

Questions?

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