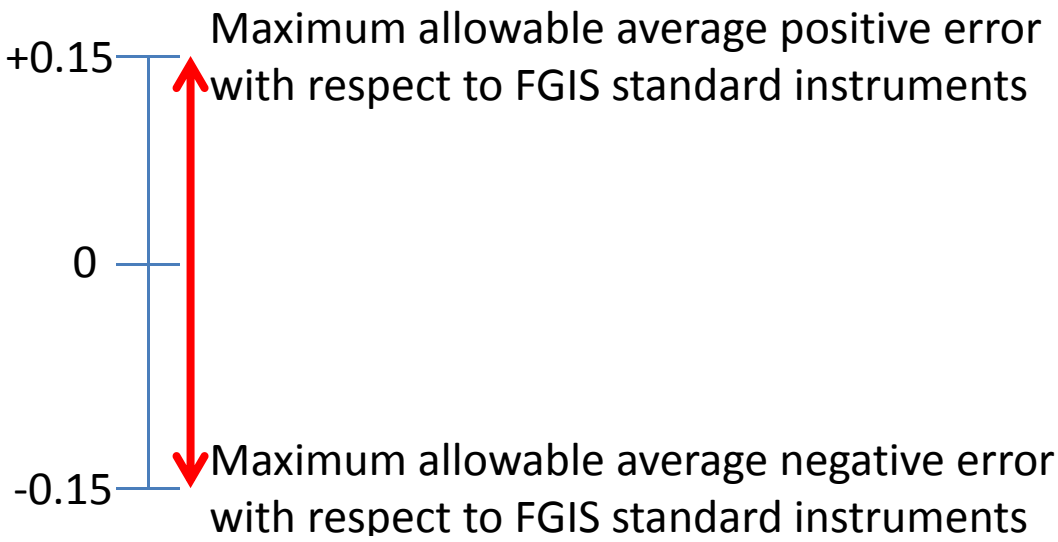
What are reasonable expectations for agreement among Official UGMA meters?

- At the same sample temperatures?
- At extremely different sample temperatures?

How closely should UGMA units agree at same sample temperature?

- Official check testing tolerances are +/- 0.15 % M for medium moisture HRWW (average of 5 tests at 22 C compared to FGIS master instruments)
  - Differences between official field units ***could*** be up to twice that, or +/- 0.30 at 22 C.
  - Most units agree much better than that.



How closely should UGMA units agree at same temperatures?

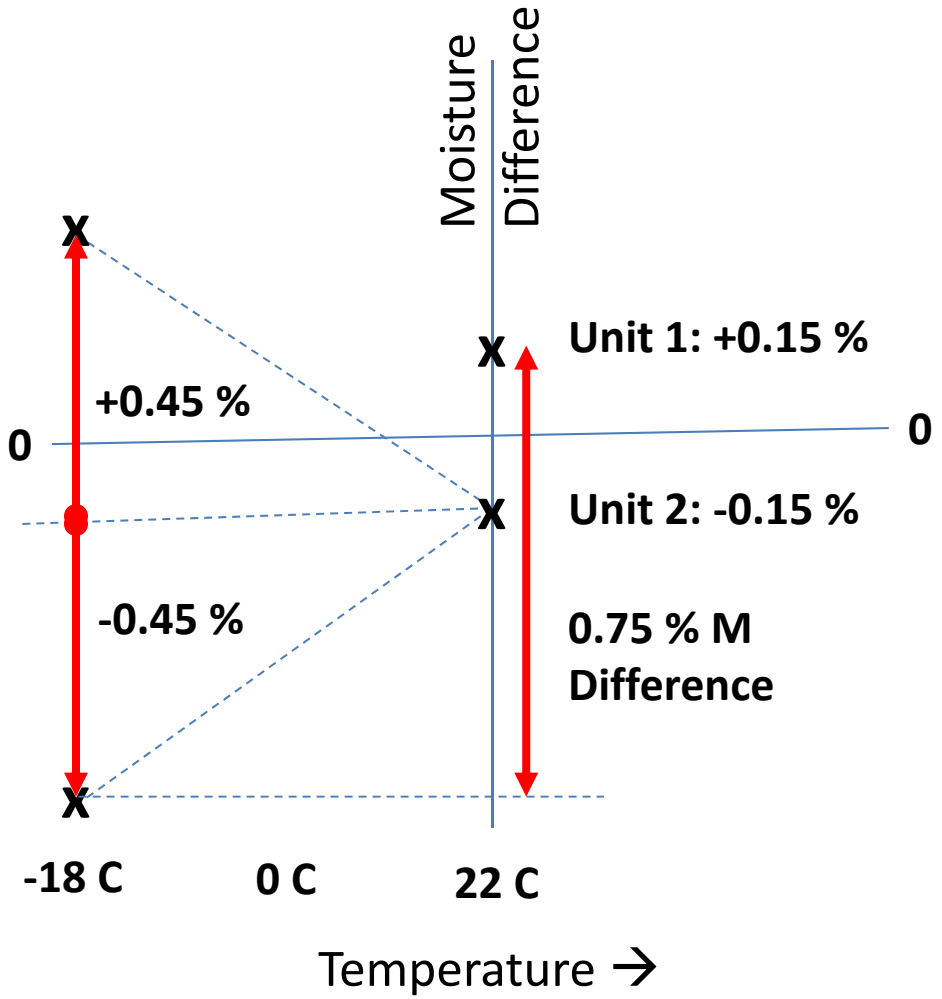
- Repeatability variability adds differences for individual tests.
  - Standard deviation for corn typically 0.2 % M.
    - 63 % of repeat tests within +/- 0.2 %M
    - 90 % of repeat tests within +/- 0.4 % M
    - 99 % of repeat tests within +/- 0.6 % M
  - Differences between repeated tests on same instrument under same conditions should be < 0.6 %M for 99 % of tests.
    - Example: A repeated test result for a corn sample that gave a result of 15.0 % should almost always be between 14.4 % and 15.6 %.

How closely should UGMA units agree when sample temperatures are different?

- NTEP tolerances allow average difference of +/- 0.45 %M from temperature extremes to 22 C.
  - Applies to tests performed on same unit.
  - Average difference for 6 samples, 3 tests each

Assumptions for Worst Case Average Difference at Temperature Extremes

- Two units that are on opposite extremes of check test tolerance (+ 0.15 % and -0.15 %).
- Sample temperature for the first unit is max allowed (40 C) different than for the other unit.
- Results could be +/-0.45 % different due just to temperature.
- Total error possible is the sum of the contributions.



How closely should UGMA units agree when temperatures are different?

- Temperature measurement error could contribute additional 0.1 % M for each degree C in temperature error.
- Generally, agreement is much, much better than these worst case estimates.
  - Few instruments are near edges of check test tolerances.
  - UGMA instruments generally perform considerably better than the NTEP tolerances.

Quality Assurance Tolerances (1/9)

(Eric Jabs)

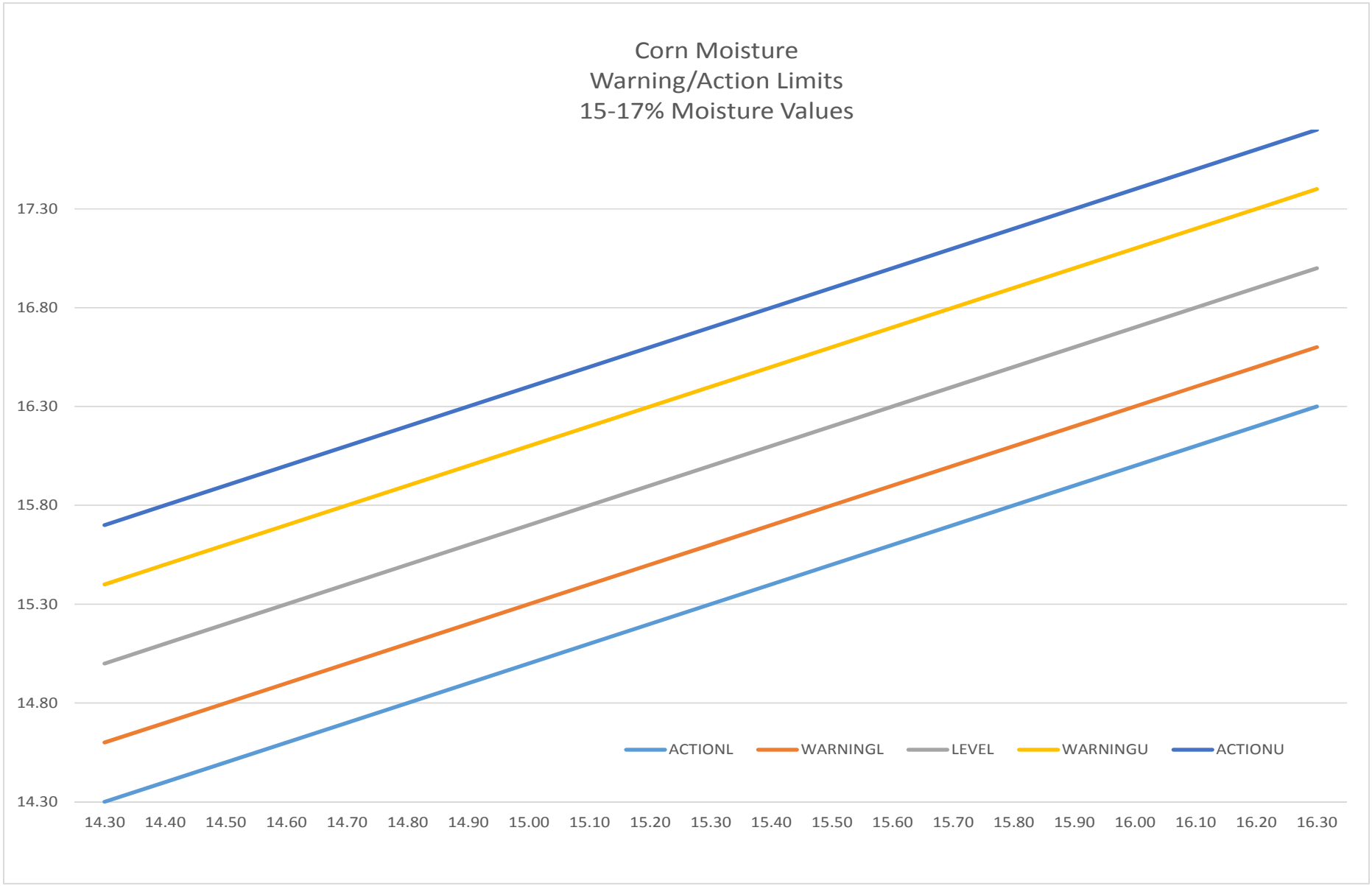
July 2014 Resolution

The Advisory Committee recommends that GIPSA review and update all the quality assurance tolerances utilized in the official inspection system. Specifically, the Advisory Committee recommends that the first to be reviewed reflect the Unified Grain Moisture Algorithm (UGMA) technology for moisture measurement.

Quality Assurance Tolerances (2/9)

- GIPSA formed a committee with TSD, FMD, and QACD representatives
- Reviewed inspection, moisture calibration, check test, and cu-sum data
- Evaluated variability components
- Defined evaluation priority
- Seeking additional information on current warning and action limit methodologies

Quality Assurance Tolerances (3/9)



Quality Assurance Tolerances (4/9)

- Warning Limits
  - 2 standard deviations from mean level (95% confidence)
  - Varies by factors and factor levels
  - Corn Moisture, ≤ -0.4% or ≥ 0.4%
    - Example: Original result: 15.0%; LL: 14.6%; UL, 15.4%

Quality Assurance Tolerances (5/9)

- Action Limits
  - 3 standard deviations from mean level (99% confidence)
  - Varies by factors and factor levels
  - Quality Assurance Report (QAR) issued to agency/field office
  - Corn Moisture, ≤ -0.7% or ≥ 0.7%
    - Example: Original result: 15.0%; LL: 14.3%; UL, 15.7%

Quality Assurance Tolerances (6/9)

- Components of Variability
  - Instrument Repeatability
    - Variability of a single instrument when a sample of known value is tested repeatedly on the same instrument.
  - Instrument Reproducibility
    - Variability in the alignment of multiple instruments when a sample of known value is tested across multiple instruments.
  - File Sample Variability
    - Variability of file sample differences that are inherent between an original inspection sample and a supervised file sample.

Quality Assurance Tolerances (7/9)

- Data
  - Pre-UGMA:
    - 9/10/2010 to 9/9/2012: Corn, Soy, Soybeans, and Sunflowers
    - 5/1/2011 to 4/30/2013: Remaining grains
    - Example: Standard deviation for corn moisture is 0.276%
    - Calculated WL is +/- 0.552%; AL is +/- 0.828%

Quality Assurance Tolerances (8/9)

- Post-UGMA:
  - 9/10/2012-Present: Corn, Soy, Soybeans, and Sunflowers
  - 5/2013-Present: Remaining grains
  - Example: Standard deviation for corn moisture is 0.260%
  - Calculated WL is +/- 0.520%; AL is +/- 0.780%

Quality Assurance Tolerances (9/9)

- Next Steps
  - Research warning/action limit methodologies
  - Determine variability components for old/new instrumentation
  - Evaluate relationship with cu-sum tolerances
    - (Starting Values/Breakpoints)
  - Determine if adjustments to limits are warranted
  - Monitor data at federal and agency levels
  - Evaluate additional tolerances
    - Grain priority is corn, soybeans, and wheat
    - Factor priority is damage and foreign material

Why do other meter models not necessarily agree with UGMA meters?

- NTEP-certified moisture meter models generally agree closely (on the average), but…
- Different instrument technologies respond differently to interfering factors such as temperature, density, kernel shape, and grain composition.
- Density variation in corn is a very significant source of differences among technologies.