Appendix B

National Type Evaluation Technical Committee
Measuring Sector

October 3 - 4, 2008 – Atlanta, Georgia
Annual Meeting Summary

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Measuring Sector Annual Meeting Summary

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Carryover Items

1. Table of Key Characteristics of Products in Product Families for Meters Table

Source: Carryover Item – 2007 Measuring Sector Agenda

Background: At its 2006 Annual Meeting, then-NTEP Director Steve Patoray submitted a number of comments concerning the Product Families for Meters Table in NCWM Publication 14. Steve noted that, while improvements had been made to the table in past years, there were still a number of areas where additional improvements are needed to ensure consistent application of the table. For example, the basis for viscosity values are not clear, there is a lack of reference temperatures for viscosity values, and when possible source documents are consulted for these values, there are differences in viscosity values listed for the same product. In addition, Steve noted that the numerous special notes and separate product categories make the table difficult to follow. As a result of discussions at its 2006 meeting, the Measuring Sector tasked a small work group (WG) to address these issues and report back to the Sector.

At its 2007 Annual Meeting, the work group gave a progress report to the Sector and presented a number of proposed revisions that were being considered (see the 2007 Final Summary of the Measuring Sector for details of that proposal). The WG noted that additional work was needed to list the various liquids, describing the viscosity, specific gravity, and conductance. After hearing comments on the proposed changes, the Sector agreed that the WG should continue developing this item and present its recommendations for discussion at the 2008 Measuring Sector meeting.

Recommendation: The Sector was asked to consider the latest proposal from the WG, which was distributed in two attachments: (1) Attachment #1: a proposed a table listing product families/groups along with typical product names and their corresponding viscosities and specific gravities (shown in Appendix 1 to this meeting summary); and (2) Attachment #2: a proposed revision to the Product Families Table outlining test requirements for different meter types within each product family (shown as Appendix 2 to this meeting summary).

Note: See also agenda Items 7 (Categorization of Liquid CO_2 in the Product Families for Meters Table) and 8 (Product Families for Meters Table, Inclusion of Milk and Dairy Products), both of which which address topics related to the Product Families Table.

Discussion: Mike Keilty (Endress and Hauser), Sector Chairman, explained that the WG took the approach of separating the test requirements and product characteristics, including viscosity and specific gravity, into two separate tables. The proposed revisions were not intended to change what is currently in Publication 14, but rather to make the information more usable. The group did note that there may be a need to discuss the category of compressed liquids in greater detail once the general approach for revising the tables is agreed upon; beyond this, they did not identify a need to change any of the proposed test criteria. With regard to product characteristics, Mike indicated that the WG was unable to find a single definitive source for the values listed in that table, but was able to gather representative values from published sources, including product manufacturers, application guides, and other industry sources, for most of the products; there are a few products for which values must still be identified. The WG also found information indicating that some of the trade names listed in the original tables under the agrichemicals section are no longer relevant; thus, these names were deleted from the proposed revision. Mike noted that the WG had difficulty determining how to address conductance of products in the criteria and decided to first focus efforts on viscosity values. The WG wanted to see if the NTEP measuring laboratories would find the approach of separating the information into two easier to follow and apply tables.

The Sector acknowledged that there are currently differences in the way that CCs state what is covered and Sector members share the common goal of improving consistency in the CCs. The Sector recognized that the tables respond to the Sector's 2007 discussions regarding the need to improve references to product characteristics in the Product Families Table. Sector members, particularly the NTEP laboratories, generally expressed appreciation for the more detailed information on product viscosities and specific gravities provided in Attachment #1. The Sector also recognized that the list of products is not an all-inclusive list, but rather an attempt to identify some common products in each category in an attempt to assist laboratories and manufacturers in identifying typical products for a particular category.

The Sector spent considerable time during the first day of its meeting debating the merits of the proposed revisions and the format of the two tables. There were some questions about the "Normal Liquids" category and testing with low and high viscosity products. Some commented that the two attachments don't appear to correlate because one attachment has five categories, whereas the other attachment has many more. The Sector considered combining the two tables by adding columns to list typical products and associated characteristics, but felt that this would add significant length to the basic table and may make it more difficult to follow. Based on the comments made during the first day of the meeting, Marc Buttler (Emerson) and Mike Keilty agreed to work on the tables during the evening and invited participation by others. The Sector agreed that the footnotes in the current table need to remain in any revision, including the statement regarding temperature references. The Sector also noted that better information is needed for product conductivities for magnetic flow meters, particularly since conductivity may vary for different batches of product. The Sector agreed that this should be addressed separately as a future effort.

On the second day of its meeting, the Sector members present received a hardcopy of revisions prepared by Mike Keilty, Marc Buttler, Dmitri Karimov (Liquid Controls), and Tina Butcher (NIST Weights and Measures Division, Sector technical advisor) with input from several others overnight. The revisions proposed reorganizing the information to create three tables: Table C.1. Tests to be Conducted (identifying tests to be conducted); Table C.2. Product Families Table (outlining product families broken down by meter technology and referencing tests from Table C.1.); and Table C.3. Typical Product Family Characteristics (listing typical products in each product family and the viscosity and specific gravity of each, taken from agenda Attachment #1). The group had discussed various approaches, including combining the tables, but felt that maintaining separate tables would allow more flexibility to add new "typical" products at a later date.

The Sector reviewed these revisions and made multiple changes to the draft in "real-time" by viewing the changes on a projected screen as the technical advisor made participants' suggested modifications. Key changes included reversing the order of Tables C.1. and C.2.; re-inserting a note regarding LPG and NH_3 under the PD meter and turbine meter columns (previously, these references were in a single cell); reinstating the footnotes in the Product Families Table; deleting the reference to "centistokes;" and correcting the abbreviation for "centipoise."

Maurice Forkert (Tuthill Transfer Systems) noted that the original table in Pub 14 includes a viscosity range for "Fungicides;" however, there is no value listed in the new table for Fungicides. He also suggested including crop chemicals after water for better flow of information. Mike Keilty observed that additional input is needed from those with expertise in agrichemicals; in the meantime, he noted this should not create any conflicts since there are presently no values listed for many of these products. Dmitri Karimov suggested working toward combining "crop chemicals" into a single category for simplification. In the meantime, the Sector agreed to differentiate groups as Crop Chemicals 1, 2, 3, and 4 to provide a correlation with the old table.

The Sector identified other editorial and content changes to be addressed or considered:

- Flowables is missing from the table.
- Suggest putting crop chemicals after water to make the table flow better.
- The terms in Table C.2. and Table C.3. should match for the various product families.
- Listing the items in order from lowest to highest viscosity would make the table easier to follow.

Though acknowledging the need for revision to some sections of the table (for example, improving the categorization of crop chemicals), the NTEP laboratories indicated that the changes thus far represent major progress. They noted that they will need to try using the new format to assess how well it will work, but anticipated that it should be much easier to use. Other Sector members agreed that the proposed revisions are an improvement over the current version, even if there remain areas requiring additional work.

Dmitri Karimov stated that the note for a single test to cover NH_3 and LPG should apply to turbine meters as well as PD meters, commenting that the original table did not specify that the note applied to PD meters only and noting that he has found CCs for turbine meters on which both products were covered based upon a single test. Other manufacturers agreed with this point of view. The labs believe that the original table had a note requiring only one test and that the note was not specific as to either technology. However, the criteria in "Test A" require a test for each product. By virtue of this point, the labs have raised the point that the note would not apply. Several of the labs further noted that they don't have a lot of experience with turbines and are not certain whether it is appropriate to include both based on a single test. They feel they would need additional information to make that assessment.

After the morning's discussion, the Sector agreed that they have reached a consensus on the layout of the table, but acknowledged there are still some content and editorial changes that need to be made as described above. During lunch, Mike Keilty and Tina Butcher worked on revisions to the table based on the Sector's morning comments and presented the revisions to the Sector. In addition to minor refinements based on the Sector's morning discussions, key changes made or still needing to be addressed include the following:

Summary of Key Changes Made or Needed:

- The original table in Pub 14 includes a viscosity range for fungicides; however, there is no value listed in the new table for fungicides. Until specific values can be included, these are to be identified as crop chemicals 1, 2, 3, and 4.
- "Flowables" is missing from the table.
- Consider putting crop chemicals after water and other changes to make the table flow better.
- The order of the tables originally numbered C.1. and C.2. was reversed for better flow.
- The note for a single test to cover NH_3 and LPG should also apply to turbine meters. The original table did not specify that the note applied to PD meters only. *(**Note:** This was a point of contention that was not resolved during the meeting, as referenced earlier.)*
- The terms in Table C.2. and Table C.3. (original numbers) should match for the various product families.
- The term for "centipoise" needs to be consistent.
- The term "centistokes" was deleted from the headers.
- The footnotes from the original Product Families Table were pulled back into Table C.2. (original number).

The following "maintenance" issues requiring further work and development were also identified:

Maintenance Issues:

- Start to combine the "crop chemicals" into a single category.
- There is no reference to heated products below 50 °C.
- If you list the items in order from lowest to highest viscosity, it would make the table easier to follow. By viscosity? By specific gravity? Alphabetically by name?
- Need to include references to the footnotes included in Table C.1.

The Sector reviewed these changes and made a few additional modifications. The latest version of the table as of the end of the Sector meeting appears in Appendix 3 to the Sector Summary.

The labs indicated they welcome any additions to Table C.3. However, with regard to the combination of some of the categories, they expressed a desire to see the information before it becomes final. Paul Glowacki (Murray Equipment) proposed eliminating from the table those products that are no longer used. Dmitri Karimov reported difficulty locating information for some of the products listed in the current table. Several Sector members noted that some crop chemicals may still be used; however, they may be labeled under a different name. Dmitri volunteered to assist in obtaining information on crop chemicals, noting that he had previously contacted the Fertilizer Association of America and they promised to send additional information. Jim Truex (NTEP Director) also suggested contacting NCWM members representing Dow Chemical, Cargill, and other chemical manufacturers to see if they can assist in providing information.

Rich Tucker (RL Tucker Consulting) asked about the "juices and beverages" category, noting that it was not referenced in the new Table C.3., though it is referenced in the current Product Families Table for magnetic flow

meters. The Sector discussed how to handle this category and agreed that "juices and beverages" can be added to the "water/milk" category for other meter technologies. Tina Butcher noted that an additional maintenance issue to consider is how to handle other food products such as corn syrup, etc. since these are not presently referenced in the table. The Sector agreed that this could be handled as a maintenance issue.

At the conclusion of the meeting, the Sector once again agreed that a consensus had been reached on the general revisions to the format, but that additional content changes are needed. The Sector recognized the amount of work put into developing the revised format and identifying corrections needed to improve consistent application of the criteria. Sector members present expressed a reluctance to wait an entire year to implement these corrections. Some members noted that ballots on more complicated topics have been successfully distributed in the past and suggested that changes identified at the meeting be made and the Sector balloted. The Sector agreed that the best approach to ensuring continuity of the work would be to have a small number of people work to make editorial corrections in the areas identified and distribute it to the entire Sector via letter ballot in the hopes of getting sufficient consensus to move the revisions into the 2009 Edition of NCWM Publication 14. Mike Keilty and Dmitri Karimov agreed to take on the task of following up on these changes, preparing a revised version, and forwarding it to the technical advisor for balloting of the Sector members.

The Sector agreed that maintenance issues can be addressed at a future point following additional research and discussion.

Conclusions:

- The Sector agreed on the revised format, noting that it is an improvement over the current version. However, there is additional work to be done. Mike Keilty and Dmitri Karimov will work together to better define the crop chemicals category. They will do a search of existing CCs for the specific product names and determine if these names are still used. They will also go to product manufacturers who have products listed and ask for information on the products. They will also add the category for "water, milk, juices, and beverages" to Table C.3. The proposed revisions are to be sent to the Sector technical advisor by November 24, and the Sector will be balloted with a response requested by December 12. Comments will be incorporated and, assuming Sector agreement, submitted to the NTEP Committee by the NCWM Interim Meeting for proposed incorporation into the 2009 Edition of NCWM Publication 14.
  *[**Note from Technical Advisor:** The Sector was balloted prior to the NCWM Interim Meeting on additional proposed changes to the criteria; however, the results of the vote (8 affirmative, 6 negative, and 4 abstain) indicated a lack of consensus to support these additional changes. Consequently, while the Sector supported the revised format, there was not support for the additional changes without further review and discussion.]*
- The Sector agreed to add "juices and beverages" to the "water/milk" category for other product types (PD and turbine).
- The Sector agreed to address other food products like corn syrup, etc. for the next Sector meeting as a maintenance/updating issue.

2. NTEP Checklist for Hydrocarbon Gas Vapor Meters in Sub-metering Applications

Source: NTEP Director

Background: At its 2006 meeting, the Measuring Sector was asked by the NTEP Committee to consider and develop a checklist for residential hydrocarbon gas vapor meters. These devices will most likely be used for submetering. At that meeting, the Sector heard that several states had recently contacted NTEP regarding these devices. California already has evaluation and certification of these devices in their state. The Sector was asked to review the procedures used by California (which were included as Appendix D of the 2006 meeting agenda) and rework them into a format acceptable for NCWM Publication 14. At its 2006 meeting, the Sector agreed the best approach for developing a Publication 14 checklist for LPG vapor meters would be the utilization of a WG made up of technical experts and other interested parties. Dan Reiswig, California NTEP laboratory, was to provide a list of vapor meter manufacturers to be contacted for participation in the WG.

At the time of development of the 2007 meeting agenda no information had been received from the WG. At the meeting, the Sector reviewed a recommendation and considered changes to Publication 14 deemed appropriate. After reviewing a draft presented by the California NTEP laboratory, the Sector agreed that "LPG" in the title should be changed to "Hydrocarbon Gas" so that the measurement of natural gas would be included. The California NTEP laboratory and the NTEP Director were to continue to develop this checklist for presentation and discussion at the next Sector meeting.

Recommendation: The Sector was to hear an update at the Sector's 2008 meeting from from the California NTEP laboratory and the NTEP Director on the progress on this issue.

Discussion: Steve Patoray (Consultants on Certification), past NTEP Director, indicated that this issue originally arose because some states indicated an interest in having NTEP conduct evaluations on these devices as a result of pending legislation in some of those states to put sub-meters under weights and measures' authority. In the NTEP laboratory discussion of this issue, the labs asked the Sector to raise the question to manufacturers of whether or not there is interest in developing this checklist; the California laboratory representatives noted that they receive only one or two requests per year for this type of evaluation. From an NTEP management perspective, Jim Truex questioned whether it is necessary for NTEP to address these devices given the small number of devices submitted for evaluation over the last five years and the fact that states may be willing to accept California's Certificate of Approval in lieu of an NTEP CC.

Dan Reiswig (California) reported that the draft checklist was given to members of industry to review and the feedback was positive; however, the manufacturers who commented indicated that they did not have any products affected by the proposed checklist. Steve Patoray noted that, should the work continue, a decision must be made regarding the placement of the criteria into Publication 14; for example, should it be placed into a new section or incorporated into the LMD chapter.

Ralph Richter (NIST, WMD) reported that the American Gas Association is revising the ANSI standard for all of the natural gas distribution system, though he noted that the proposed revisions should only affect utility-type meters, not sub-meters. Ralph indicated that he believes that the issue of hydrocarbon gas vapor sub-meters is very much like that for water sub-meters in that there are numerous meters in use in landlord-tenant applications including residential as well as commercial, such as strip malls; however, the bulk of weights and measures inspections in the country as a whole are limited primarily to complaints rather than routine inspection. Jim Truex noted that some weights and measures authorities may not have jurisdiction over some of these meters.

There was little discussion of the proposed checklist among Sector members during the meeting. Mike Keilty suggested that, because of the limited interest, the Sector should consider removing the item from its agenda as a carryover item if no progress to finalize a checklist is made within the next year.

Jim Truex reported that he received an e-mail from Maurice Van Puten, PhD, whose company manufactures a digital hydrocarbon vapor meter recently approved by California and Massachusetts. Dr. Van Puten offered his help and indicated an interest in becoming a member of the Sector. Dan Reiswig indicated that the bulk of the remaining work is in reformatting the checklist to fit within the Publication 14 structure and stated the California laboratory could look at this over the next year.

Conclusion: The Sector agreed that the California NTEP laboratory will work to reformat the checklist into a Publication 14 format. Norma Ingram (California) agreed to coordinate with Maurice Van Puten and Jim Truex to work on this issue between now and the next Sector meeting.

3. Testing Meters Made of Different Materials

Source: California NTEP Laboratory – Carryover from 2007 Measuring Sector Agenda

Background: The Sector reviewed this issue at its 2007 meeting, but was unable to reach a consensus on the item. Consequently, the item was carried over for review at the 2008 Sector meeting. The Sector was asked to revisit this issue and interested parties to report on any updates or new information that might assist the Sector in bringing this

issue to a resolution. The background information and discussion from the Sector's 2007 Final Meeting Summary is included below for reference.

Excerpt from Item 5 of the 2007 Measuring Sector Final Meeting Summary:

Background/Discussion: The California NTEP laboratory is conducting an NTEP evaluation of a family of meters using multiple products in different product families. The meter family includes meters made of aluminum and stainless steel. Because Publication 14 does not specifically address this scenario, the laboratory is asking for input from the Sector before testing starts.

At the 2006 meeting the Sector discussed the scenario described above. The following proposal was offered as a possible solution. The Sector reviewed the proposal for possible forwarding to the NTEP Committee for inclusion in Publication 14.

Proposal: Add a new Section F. to the Publication 14 Technical Policy as follows and renumber subsequent sections:

U. Meters Made of Different Materials within the Same Family

When multiple meters made of different materials within a meter family are submitted for evaluation all meters will be tested with at least one product from each product family to be included on the CC and at least one meter will be tested with the range of products required in the Product Families Table for the meter type (e.g., positive displacement, turbine, mass meter, etc.) submitted for evaluation.

The MMA provided the following white paper for Sector consideration during the discussion:

Meter Manufacturers Association

Speaking as experienced manufacturers of PD Meters, Turbine Meters, and Mass Meters, it is our experience that the materials of construction do not affect the quality of measurement over the specified operating range of a particular metering technology, as these have been considered and accounted for during the design phase of the meter.

It is the manufacturer's responsibility to ensure that the meter meets type; additionally, material selection is the manufacturer's responsibility and is typically driven by the requirements of chemical compatibility with the liquid products that are being measured or by industry regulations (e.g., non-ferrous meters for aircraft refueling).

Materials are not selected or modified for reasons of accuracy. The market does identify and eliminate the inferior products through the normal surveillance process as well as the manufacturer's warranty process.

It is normal industry practice to include material varieties such as stainless steel, aluminum, cast iron, plastic, etc., into one meter; for example, some of our PD meters have cast steel outer housings, stainless steel bearings, cast iron rotors, anodized aluminum blades or cast iron blades or plastic blades. Non-ferrous aircraft meters will utilize aluminum cast components and SS bearings. We manufacture turbine meters with stainless steel housings and aluminum rotors. The point being the measurement accuracy is a function of the manufacturing process, not the materials used.

It is not the intent of HB 44 to differentiate between measurement technologies, only the intended application.

Doesn't material selection fall under measurement technology?

Where do you draw the line on NTEP lab decisions on the materials of construction?

The manufacturers believe that the answer to the question is in the **LONG** history of meters themselves. There are hundreds of thousands of meters in service in the United States used for direct sales (e.g., home heating oil delivery, loading rack wholesale deliveries, aircraft refueling, agriculture chemical deliveries, etc.). These meters

are verified routinely by the local W&M agencies, and if problems are detected (accuracy out of range) then they are taken out of service.

Summary: The meter manufacturers make determination of materials of construction. Meter manufacturers make the determination of what particular attributes of a meter enable it to be considered as part of a family.

Questions that need to be answered in order to make an informed decision:

1.) Is there a real world problem that requires a solution by the inclusion of a new section specifically aimed at materials in Pub 14?

2.) Is there an inequity in the market, facilitation of fraud?

One of the NTEP laboratories stated that during an evaluation of a mass flow meter the performance was different for two meters with different "tube" materials. Two mass flow meter manufacturers stated that if both meters were calibrated for the product being measured there should be no difference in performance due to "tube" material. Another laboratory stated that the permanence test of a meter conducted after 30 days is not a true indicator of long-term permanence. Another member stated that NTEP should be interested in testing key characteristics and metrologically significant components.

After further discussion at the 2006 meeting, the Sector agreed that the best approach for resolving the issue of what components are "metrologically significant" and require additional evaluation was to include the discussion and development of a proposal for Sector consideration in the tasks of the WG formed to develop a new Family Product Table approach, as discussed in agenda Item 5.

Recommendation/Discussion: At the time of development of the 2007 meeting agenda no information had been received from the WG nor was any formal update presented at the meeting. One industry member suggested the item be withdrawn. The Sector technical advisor cautioned the group that withdrawing the item would not resolve the question as to whether or not a change in material used in the construction of a meter would require that the model be resubmitted for NTEP evaluation in order to maintain a valid CC. The manufacturers present at the meeting met following the conclusion of the first day's agenda and came back with some suggestions for resolving the problem. One suggestion was for the manufacturer to submit a drawing listing material used, similar to what is done with Underwriters Laboratories, Inc. (UL), who evaluates or tests what they consider to be the worst case. Another suggestion was to include ASTM specifications for the original material and any replacement material. Some of the NTEP laboratories believed that changing material constitutes a change of design and, therefore, requires a new model designation.

Discussion: Steve Patoray described (from his perspective as past NTEP Director) the scenario discussed at the 2006 and 2007 Sector meetings. He noted that materials used in devices are considered metrologically significant for weighing applications and questions were raised about whether or not materials are metrologically significant for metering applications. Some had suggested that using criteria similar to that used by Underwriters Laboratories might be considered. He indicated that many were uncomfortable with the concept of defining a "worst case" scenario for particular materials. He further noted that the question was raised of where to stop in the examination of device components: the body of the meter, or the seals, or other location? Manufacturers indicate that these questions are all part of the design process and inherent with assembling a device intended for a given application. Steve concluded his overview by noting that a key question is whether or not additional testing is needed based on variations in the materials used in the metering system and further commented that it is not likely that a field official will be able to determine these differences by visual examination. The inspector just needs to have confidence that the meter they are examining is covered by the CC. An overriding concern of NTEP is to ensure that the evaluation is fair and that the requirements are being applied consistently to all manufacturers. At present, NTEP has no guidance on how to handle these different scenarios.

Allen Katalinic (North Carolina) commented that while changes to significant components of a meter will make a difference, there are many parts in a meter where changes will not have any metrological impact. Mike Frailer (Maryland) noted that a key difficulty on the part of the evaluator is in assessing how to consistently assess whether a given change is metrologically significant, and Jim Truex noted that this depends on how one defines

"metrologically significant." Paul Glowacki commented that Jim's point touches on the basic issue, which is how to define what changes can be made without re-evaluation. A manufacturer may be confident that a change in material will not affect a meter's performance; however, an evaluator may not agree and may require re-evaluation. There have to be some guidelines because, at present, Paul feels as if every CC is a negotiation and what is applied to one company may be different than what is applied to another company. Tina Butcher commented that the technical policies in Publication 14 strive to minimize the amount of testing required for a manufacturer to list the maximum number of devices on a CC. She stated that, for the NTEP laboratories, key questions are: (1) whether the laboratories and NTEP management have adequate information to enable them to assess when additional testing is needed in order to list particular variations on the CC, and (2) how they can make that assessment consistently from manufacturer to manufacturer and from laboratory to laboratory. NTEP has developed experience with some basic types of changes to devices through trial and error and in consulting with manufacturers; the laboratories are asking for specific guidelines with regard to materials variation. Mike Keilty noted that manufacturers submit a sample(s) of a device in good faith and expect a rigorous evaluation; however, manufacturers are concerned that the amount of testing not be expanded beyond what is economically feasible.

Relaying discussions from the NTEP laboratory meeting prior to the Sector meeting, Jim Truex commented that the laboratories also have a dilemma in assessing how to avoid "horror stories" such as experiences with E85 while establishing reasonable guidelines. Jerry Butler (North Carolina) also noted that, while many manufacturers such as those who have long participated in NTEP Sector meetings and evaluations, are conscientious and laboratories may trust their judgment, laboratories are seeing an influx of equipment from sources (sometimes off-shore) with which they have had little experience and whose manufacturers sometimes have little if any experience with legal metrology requirements, let alone U.S. requirements. This concern was echoed by other laboratories who also noted confidence in manufacturers participating in this discussion, but recognized that policies must be in place to ensure fair treatment. Several manufacturers commented that the industry will take care of substandard products produced by competitors by bringing such instances to NTEP's attention; reputable manufacturers cannot afford to allow substandard products to undercut the market when they themselves are expending the resources needed to comply.

The Sector also had some discussions about replacement parts and how these affect metrological integrity, with some members noting that field officials are unable to determine when non-metrologically equivalent or inferior components are used by visual examination. Several members commented that this is not something that can be prevented by increased evaluation at the type evaluation level, but is rather addressed by performance testing in initial and subsequent verification. In addition, the manufacturer is equally concerned about unauthorized substitutions since this can affect the reputation of their product. In that same vein, a manufacturer would not make a change in materials unless he is confident that the change would not affect the performance of the device in his customer's application. Rodney Cooper (Actaris) pointed out that reputable manufacturers police themselves to ensure their customers' continued confidence. Norm Ingram pointed out that manufacturers have designed these products and know from experience what will work, so perhaps the best approach is to allow them to make these changes and allow the marketplace to take care of itself. Norm did note, however, as did Dan Reiswig (California), that even if the issue is tabled, the laboratories still need guidance on how to consistently approach proposed changes with regard to issuing CCs.

Dmitri Karimov and others pointed out that NTEP has largely relied on the integrity of the manufacturer in reporting changes to devices and that, in many cases, NTEP or a field official would never be able to tell the difference. For example, if a rotor is changed, there is no reasonable way that weights and measures officials can determine that the clearances are different. In addition, NTEP has also relied primarily on the manufacturer to provide guidance on when a particular change is metrologically significant. With regard to material, the manufacturer's concern is in making sure that the materials are compatible with the product being measured in the application. Mike Keilty questioned how conformity assessment might factor into this issue and contribute to resolving some of these questions.

Rich Tucker echoed an earlier comment by Norm Ingram, noting that most manufacturers change materials because of the products with which the meter will be used. When a manufacturer finds through experience that a particular change creates problems, manufacturers make adjustments accordingly to ensure continued performance. Rich even noted there were instances when NTEP passed a material in an evaluation and that material later proved to be problematic. The majority of the time, materials issues will resolve themselves and most of the testing requirements imposed by the Product Families Table are going to address any question about materials.

The Sector also discussed numerous examples of specific materials and their effect on metering of different product types; however, these discussions provided no insight on how to best address the materials issue. Steve Patoray reminded the Sector that its purpose is to advise the NTEP administrator, and Publication 14 will only be changed if the NTEP Committee agrees with the Sector's recommendations.

Will Wotthlie (Maryland) commented that the laboratories are putting their reputation on the line by issuing a CC and saying that it covers everything listed on the CC; the laboratories want to have confidence that the devices will work and field officials are, in turn, relying on that assurance. Will also questioned why NTEP is needed if the feeling is that everything in the field will take care of itself. Mike Keilty noted that a balance needs to be achieved between a system that can be practically executed and one that will still provide confidence; manufacturers are concerned about expanding testing beyond what is economically feasible.

Will Wotthlie suggested that an alternative is for the labs to simply list what is tested on the CC under the testing conditions section; however, some manufacturers indicated they want to continue to list materials of construction on the CC under the "Standard Features and Options" section. Jim Truex noted that a CC is not meant to be a marketing tool. Tina Butcher commented that, in its early days, NTEP decided that only metrologically significant things should be listed on the CC. If this position is to be maintained, then the Sector needs to decide whether or not to include the materials on the CC if all options are covered. If the Sector concludes that the material is not significant, then perhaps a statement needs to be included in Publication 14 to that effect. She also reminded the Sector that the laboratories are not only trying to assess whether or not a new variation in material can be covered on the CC, but also how to determine which of two meters to select for testing when they are made of different materials.

Some members, including NTEP laboratory representatives as well as manufacturers, stated that if the materials feature or attribute is not metrologically significant, it doesn't belong on the CC; the information can be listed in the test conditions, but not on the front of the CC under the "Standard Features and Options." Dmitri Karimov questioned why the information would be listed in the test conditions if it isn't metrologically significant. Others noted that this record may eliminate the need for additional testing should policies change at a later date. Jim Truex also pointed out that if the information is to be listed on the front of the CC, it will be necessary for the laboratory to determine the "worst case" scenario with regard to materials.

At present there is a great variation among existing CCs with regard to how materials are referenced. Steve Patoray noted that there are differences in how manufacturers request this information be reflected on their CCs; some want various model numbers listed, including different materials. Some believe that the only thing that should be listed on the CC is the product application for which the meter is approved, not the materials. Jerry Butler questioned why the manufacturers want to list all of these different products on the CC, commenting that it is up to the manufacturer and the customer to make sure the meter is right for the application. He further noted it would be helpful to have materials construction identified through the model designation.

Questions were raised by the manufacturers and laboratories about how CCs will be handled until the Sector can reach an agreement with regard to testing requirements for materials variations. Jim Truex reiterated that the purpose of a CC is not a marketing tool. Jim indicated that, as NTEP Director, he is not comfortable with listing all these different features unless the laboratory has tested them. Without taking a position on whether or not "materials" are considered a metrologically significant feature, Jim indicated that, for consistency purposes, NTEP will not list materials in the standard features and options; however, the information will be listed in the test conditions for the meter(s) tested during the NTEP evaluation(s). He noted this will be an administrative decision to ensure consistency. In response to a question about whether eliminating the reference to materials of construction in the "standard features and options" section would affect existing CCs that presently list this information, Jim stated that no changes would be made until the CC is being revised for other reasons.

After extensive debate on the first day of the meeting without resolution, the Sector returned to the discussion the following day with little additional progress. At that point, Mike Keilty noted that there are manufacturers who have product materials listed on their CCs and those who do not have the materials listed. He commented that, in establishing guidelines, the Sector has tended to draw a broad brush across metering technologies and, in many instances, treated them as the same even though people know they are not made the same way. Manufacturers

generally make the materials of the meter to be compatible with the product to be measured and manufacturers may take different approaches in ensuring this compatibility. Andre Noel (Neptune) pointed out that some meters are made of different materials for different product applications, and the change in product necessitates an additional evaluation. Andre noted that a manufacturer can't make a meter out of bronze, for example, and use it to meter a caustic material because it will fail. Manufacturers take the product application and other application details into account when designing and choosing a meter for a given application base and will relay this information to the customer with regard to where the meter can be used. Andre further noted that this becomes a question of liability for the manufacturer since the customer will hold the manufacturer accountable. Some members also made note that the materials may be more significant for some meter technologies than for others.

The NTEP laboratories are asking for guidance to ensure consistency, but the Sector seems to be at an impasse with regard to how to provide that guidance. The Sector was not able to agree upon any general guidance that would assist the laboratories in understanding material construction and its impact on device performance. The laboratories need to be comfortable that the testing they have conducted supports the variations listed on the CC. Dennis Beattie (Measurement Canada) observed that the issue seems to focus on the question of how the materials affect the definition of what constitutes a "family" of devices. He also pointed out, in response to an example of a manufacturer choosing a lighter material for a vehicle-mounted than a stationary application, that some materials such as aluminum respond differently to changes in temperature.

Conclusion: The Sector had extensive discussion on both the first and second days of the meeting over specific examples of meter sizes, product applications, and component materials. There were clearly divided opinions regarding how these combinations should be addressed. Manufacturers generally seemed to feel that component materials relative to the intended meter application are a design issue and should be left to the manufacturer to address, particularly since they will ultimately be responsible for ensuring that the meters work accurately and their customers are satisfied. Some NTEP laboratory representatives were comfortable with the idea of allowing the marketplace to take care of this issue, whereas others were not, particularly citing their feeling of responsibility in attesting to the accuracy of what is listed on a CC. However, it was clear that all laboratories felt the need for additional guidance in how to handle variations with regard to the amount of testing required and on how to handle listing materials information on the CC to ensure consistency among all of the laboratories.

The Sector was unable to reach any consensus on this issue; however, the Sector acknowledged that the issue is not going to be eliminated from the Sector's agenda. Criteria (whatever that may be) regarding how to address materials must be included in Publication 14, and guidance needs to be given to the NTEP laboratories to ensure this issue is consistently addressed for all evaluations.

4. Add Testing Criteria to NTEP Policy U "Evaluating Electronic Indicators Submitted Separately from a Measuring Element"

Source: California NTEP Lab

Background: At its 2007 meeting, the Measuring Sector heard that Section U. of the NTEP Policy in NCWM Publication 14 allows for testing an indicator separately from a measuring element. However, specific test criteria had not been developed for this section. The Sector heard a recommendation to develop and add specific criteria for testing an indicator separately from a measuring element for this section. The California NTEP laboratory recommended using Canada's test criteria as a guideline to develop the tests outlined in that meeting agenda's Appendices A, B, and C.

The Sector agreed the California NTEP laboratory should lead a WG to develop a specific test procedure for review at the next Sector meeting. Members of the WG selected at the 2007 meeting are Dave Rajala (Veeder-Root Company), Rich Miller (FMC Technologies), Maurice Forkert (Tuthill Transfer Systems), Dmitri Karimov (Liquid Controls), Rodney Cooper (Actaris Neptune), and Ralph Richter (NIST WMD).

Recommendation: The Sector will hear an update on the progress of this work from the work group.

Discussion: Manufacturers want to be able to submit an indicating device separately and, while there is a checklist for meters in Publication 14, there are currently no similar provisions for electronic indicators. Currently, Publication 14 only includes criteria for addressing mechanical indicators.

Dan Reiswig reported that he has developed an initial draft of criteria for separate indicators. He emphasized that indicator manufacturers and people in the work group have provided a lot of help on the development of test criteria for these indicators thus far, particularly Rich Miller and Dmitri Karimov. Dan reported that the work group has also been fortunate to be able to consult with Canada's type evaluation laboratory staff, noting that the Canadian document for evaluating these devices is written more for people who regularly work in the lab and continually work with electronics.

Dan encountered some challenges in addressing variations with regard to amending CCs for previously approved indicators. One example given was how to address an indicator that has been approved for use with a positive displacement meter, but is to be used at a later point for mass flow applications. The "modularization" that has been done in the past has typically been done with the same technology, thus, Dan has expressed some uncertainty about how to handle such variations, noting the need for the criteria to address different technologies. Dan noted that the entire process is very complex, as he has learned from Measurement Canada's experiences.

An additional area that has posed some challenges is in addressing features such as multi-point calibration capability and how to define "approved and compatible" for an indicator with specific features. Dan raised the general question of whether or not we should be developing testing criteria for indicators alone and how extensive associated laboratory testing should be. He commented that putting an indicator on a meter and testing it in a field environment may not provide the best indication of the indicator's capabilities. The Sector must determine whether a laboratory and a field test are both needed or if one alone is sufficient.

Dan explained that the overarching goal of developing these criteria is to help ensure that the manufacturers and laboratories are all looking at the evaluation of indicators and their corresponding coverage on CCs from the same perspective. Rich Miller also noted the goal of establishing criteria that would allow modifications to be made to indicating elements, but not require unnecessary re-evaluations in the field for every modification.

He has distributed the checklist to some members of the work group, but has not received a response. General comments on the checklist from the Sector members at the meeting were favorable, with most, including Dan, noting that more work is needed with regard to test procedures and test equipment. The Sector had some limited discussion of specific aspects of possible test criteria before concluding that this conversation was best left to the work group to develop an initial proposal.

Steve Patoray noted that the material developed thus far has addressed technical policy issues related to the evaluation of separate indicators and also includes an initial start on a checklist; the next step is to develop detailed procedures regarding what the laboratories need to do to conduct a test on these components and what test equipment is required.

Dan reported including generic material from the General Code in the draft, but noted that these references need review from interested parties to ensure that the material is appropriate for these components. With regard to this point Steve Patoray noted that consideration needs to be given to the organization of the LMD checklist since the intent was to group General Code requirements together rather than repeating them to help ensure consistency in updating the criteria.

On the general issue of addressing separate components, Dennis Beattie suggested that, if the NCWM ultimately adopts criteria for temperature-compensated retail motor-fuel dispensers the Sector should consider addressing the automatic temperature compensation components separately. He noted that Measurement Canada was inundated with ATC kits and had to determine how to best address them in the type evaluation process.

Dan Reiswig commented that it is important to ensure a good cross section of the industry is represented in the work group, noting that this may not be the case with the current work group and encouraging participation from other segments of the industry, particularly from other device technologies such as mass flow meters and magnetic flow meters.

Dennis Beattie suggested that the work group concentrate more on the technology of the indicator rather than on the meter with which the indicator will be interfaced. He noted that referencing these other technologies may add unnecessary complexity, and he further noted that indicators are just devices that receive pulses. He pointed out that Canada's requirements are actually different from the U.S. requirements in that Canada requires dual pulses whereas the U.S. does not. Thus, the evaluation procedures and associated equipment used in Canada are not necessary.

Mike Keilty asked for a renewed commitment from the people who have volunteered for the work group and asked if others are interested in participating. He asked if the work group could have something concrete by the beginning of January so that the members of the work group who happen to be at the Interim Meeting can go through it, recognizing that not all members may be able to attend, but at least those who are there (and are perhaps at the Annual Meeting) can use the opportunity to continue the work. He also noted that the Meter Manufacturers' Association has met fairly regularly with each NCWM meeting and part of their allotted meeting time might be used to review the group's progress.

Conclusion: The work group will meet briefly at the conclusion of the 2008 Sector meeting and will begin working via e-mail and telephone calls. The work group established a goal of having an updated draft by the beginning of January 2009. Work group members who are able to attend the NCWM Interim Meeting and the Annual Meeting can meet to work further on the draft.

Dennis Beattie and Mike Keilty volunteered to join the work group. Sector technical advisor Tina Butcher asked to be copied on any correspondence so that she is kept abreast of the status of the work.

New Items

5. Recommendations to Update to NCWM Publication 14 to Reflect Changes to NIST Handbook 44

Source: NIST/WMD

Background: The 93rd National Conference on Weights and Measures (NCWM) adopted the following item that will be reflected in the 2009 Edition of NIST Handbook 44 and NCWM Publication 14. This item is part of the agenda to inform the Measuring Sector of the NCWM actions and recommend changes to NCWM Publication 14.

Recommendation: The Sector was asked to review and, if acceptable, recommend to the NTEP Committee adoption of the following changes to Publication 14 based on changes to NIST Handbook 44:

A. Checklist for Specific Criteria for Vehicle-Tank Meters, Section 28. Marking Requirements, Code Reference S.5.7. (LMD-49)

Add the following new code reference to Section 28. Marking Requirements:

Code Reference: S.5.7. Meter Size

28.5.	**Except for milk meters, if the meter model identifier does not provide a link to the meter size (in terms of pipe diameter) on an NTEP Certificate of Conformance, the meter shall be marked to show meter size.**	**Yes ☐ No ☐ N/A ☐**

Discussion: The Sector recognized that the decision to add paragraph S.5.7. to NIST Handbook 44 has already been made; however, there was some discussion regarding the technical aspects of the requirement during the meeting. Mike Keilty commented that, in a discussion of this item just prior to the Sector meeting, the manufacturers acknowledged that the markings are required only if other conditions are not met. Many companies correlate meter models to the size, and this relationship is explained in the CC for the meter. For those who choose not to make this link, the marking requirement would apply.

Will Wotthlie pointed out that historically many people have associated a given meter size with a general flow range. He gave the example of a 2-inch meter being associated with a minimum and maximum flow range of 20 gpm and 100 gpm, noting that the flow rate is what is of most significance when considering the product depletion test. This was echoed by several other Sector members. The Sector also discussed the variations that may exist among manufacturers in designating meter size and corresponding flow rates as well as the use of flanges and how this might impact the designation of meter size.

Tina Butcher noted that NEWMA has indicated it plans to develop a proposal to further modify Handbook 44 to base the tolerance on meter flow rate rather than on meter size, an approach supported by NIST WMD; however, no proposal has been developed to this point. Some members also commented on concerns that have been raised about inspectors having regular access to CCs.

The Sector briefly discussed the idea of developing a proposal that might be submitted to the SWMA for recommending revisions to the code to base the tolerance ranges on flow rates. However, while the Sector would support further development of a proposal by NEWMA, the Sector was not interested in taking on this task. Some members also noted that they would like to see any such proposal circulated among the regions and reviewed at a subsequent Sector meeting prior to it being presented for a vote.

There was some discussion about the merits of using meter size versus flow rate. Dennis Beattie noted that Measurement Canada bases their requirements on meter size and that the current tolerance based on size was patterned after Canada's criteria. He also noted that the break points also correlate to when a different size prover is needed for a test.

Conclusion: The Sector agreed to recommend to the NTEP Committee that the proposed language be included in Publication 14.

6. G-S.8.1. Access to Calibration and Configuration Adjustments, Proposed Changes to Language

Source: Marc Buttler, Emerson Process Management

Background: In the 2008 NCWM Publication 16, the NCWM S&T Committee considered a new paragraph G-S.8.1. as shown below.

Original Proposed Language for G-S.8.1. from 2008 NCWM Publication 16:

G-S.8.1. Access To Calibration and Configuration Adjustments. – A device shall be so designed that access to calibration and configuration modes, including external and remote access, are only permitted when:

(a) The application of the physical security seal shall ensure that the access to the calibration and configuration modes is disabled, or

(b) The calibration and configuration adjustments are protected by an approved category 1, 2, or 3 audit trail, and the device shall clearly and continuously indicate and print, if equipped with a printer, that the calibration and configuration adjustment modes are enabled.

(Nonretroactive as of January 1, 2009)

(Added 2008)

In the addendum sheets published by the NCWM S&T Committee at the 2008 Annual Meeting, changes were made to the proposed revisions to G-S.8. Provision for Sealing Electronic Adjustable Components, G-S.8.1. Access to Calibration and Configuration Adjustments. The submitter expressed concern that the revised paragraph would create a new requirement such that any device that does not automatically disable calibration and configuration mode when the physical security seal is applied must be a category 3 sealing device by requiring the device to have an approved audit trail. He further noted that there are currently approved devices, which are not category 3, but

that continuously indicate configuration mode is active or do not function, when the device is in configuration and calibration mode, preventing the accidental sealing of the device while still in configuration and calibration mode. These devices would no longer be allowed under the new wording.

At the 2008 NCWM Annual Meeting, the S&T Committee revised the proposed change to G-S.8.1. in its addendum sheets as follows (see the S&T Committee's addendum sheets for a complete summary of related changes to G-S.8.):

G-S.8.1. Access To Calibration and Configuration Adjustments. – A device shall be so designed that:

(a) The application of the physical security seal automatically disables the access, including external and remote access, to the calibration and configuration mode, or

(b) The ***calibration and configuration adjustments, including external and remote access, are protected by an approved audit trail, and in addition:***

- ***The device shall not provide metrological indications that can be interpreted, or transmitted into memory, or printed while it is in the calibration and/or configuration adjustment mode as a correct measurement value, or***
- ***The device shall clearly and continuously indicate that it is in the calibration and/or configuration adjustment mode and record such message if capable of printing in this mode.***

(Nonretroactive as of January 1, 2009)

(Added 2008)

Recommendation: The Sector was asked to consider submitting a proposal to request that the S&T Committee reinstate the previous wording from the original item in Pub 16 (2008) that also allows category 1 and 2 devices as long as they continuously and clearly indicate that the device is in calibration and configuration mode or do not provide a measurement value.

The S&T Committee, by their comments on this item in the addendum sheets, seemed to be trying to eliminate references to sealing categories of the device. If the purpose of this was to reduce language, the references could still be removed as long as the additional reference to an approved audit trail is also removed, because this reference is specifically requiring a category 3 sealing device, whether intentional or not.

Discussion: The Sector discussed some of the questions that had been posed about the current language in G-S.8. by various members of the weights and measures community. Steve Patoray described (from his perspective as past NTEP Director) the scenario which prompted questions to be raised about this paragraph among the NTEP laboratories, noting that he believes this issue is really a weighing issue. He stated that some weighing devices are equipped with a jumper located inside the case; the jumper is engaged and the calibration mode can then be entered via use of a password. The manual to the device would specify that you should disengage the jumper before putting the case back on the device. If the technician neglects to disengage the jumper, a physical security seal could be affixed to the device without putting the jumper in the "on" position.

Rich Miller commented that this method of operation is different from how his company's devices work, noting that the device could not be used in normal operation without first taking it out of the calibration mode. Others echoed Rich's comments regarding how other measuring devices work and some commented that the method of operation described by Steve Patoray should never have been approved.

Will Wotthlie noted that the NTEP measuring laboratories have historically applied the criteria to require the method of operation that Rich Miller described, commenting also that the labs also considered requirements for "facilitation of fraud" in their assessments. While this interpretation is consistent with the existing language in G-S.8., he doesn't believe that this is strictly a concern for the weighing laboratories. Will noted that, if the weighing laboratories are interpreting the criteria differently, manufacturers for new measuring applications may question those interpretations. Dan Reiswig noted that Publication 14 supports Will's statements.

Tina Butcher noted that the NIST Weights and Measures division believes that the existing language is clear and the interpretation used by the measuring laboratories is correct; however, there are people who are interpreting it differently. She pointed out that the current language states that a security seal must be broken before any metrologically significant change can be made. Tina further commented that the S&T Committee has struggled to find language that does not change the intent of the requirement. She and others noted that the NTEP laboratories have also had extensive discussions about this language and the labs and the S&T Committee would appreciate additional input from the Sector on a proposed approach.

The Sector returned to the more immediate issue before the Measuring Sector, which is the proposal to recommend that the S&T Committee reinstate the language originally printed in the 2008 Edition of NCWM Publication 16. Steve Patoray noted that the S&T Committee had pulled the item back from a Voting status at the 2008 NCWM Annual Meeting because of questions regarding the proposed wording, noting that the key issue is really how to address the application of the physical seal relative to the device being in the adjustment mode. He further stated that, for some weighing devices, the application of the physical seal does not do anything except give a visual indication of whether or not there is access to calibration. Marc Buttler noted that his concern regarding the implication that the device be able to sense that it has been left in the adjustment mode and the potential impact on existing devices. He noted that there are also many devices that simply won't function normally if left in the calibration mode. Dave Rajala and Rich Miller echoed this comment and suggested that the recommendation state that the device must not provide a measurement value while in the adjustment mode. Rodney Cooper also noted that his company's devices are designed such that it is necessary to exit the calibration mode before using it in normal operation. Dave supports maintaining the current language, noting that his company's equipment complies with it and suggesting that, if weighing applications have not been interpreting it this way, these applications should be fixed. However, he further noted that he would support the proposed language with the removal of the word "automatic."

The Sector also discussed the definition of an "audit trail" and the differences among various methods of sealing. Tina Butcher noted that the S&T Committee removed the reference to specific categories of audit trails because not all specific device codes use these same numerical references. She suggested that an alternative approach would be to say "an electronic means of sealing." She also directed the Sector to the audit trail criteria that was originally developed by Claude Bertrand and others at Measurement Canada and Henry Oppermann at NIST WMD and ultimately incorporated into NCWM Publication 14. Marc Buttler stated that this information helps to clarify the language used in G-S.8., and some members of the Sector observed that field inspectors may benefit from additional information regarding the criteria for an "approved" audit trail. Marc further suggested that perhaps the Sector should consider proposing amendments to bullet (b) in the proposal.

Multiple different options for modifying G-S.8.1. were considered, including replacing the text in the proposed (a) with the following and modifying (b) to include a generic reference to different device categories:

G-S.8.1. Access To Calibration and Configuration Adjustments. – A device shall be so designed that:

(a) Before the application of the physical security seal, means shall be taken to disable the access, including external and remote access to the calibration and configuration mode. **(Rich Miller)**

OR

Before the application of the physical security seal, the access, including external and remote access, to the calibration and configuration mode shall be disabled, or **(Dmitri Karimov)**

OR

The access, including external and remote access, to the calibration and configuration mode must be disabled before the application of a physical security seal, or **(Maurice Forkert)**

(b) The calibration and configuration adjustments, including external and remote access, are protected by an approved audit trail for the category of device, and in addition:

- ***The device shall not provide metrological indications that can be interpreted, or transmitted into memory, or printed while it is in the calibration and/or configuration adjustment mode as a correct measurement value, or***
- ***The device shall clearly and continuously indicate that it is in the calibration and/or configuration adjustment mode and record such message if capable of printing in this mode.***

(Nonretroactive as of January 1, 2009)

(Added 2008)

After extensive discussion by the Sector regarding possible alternatives, Judy Cardin (Wisconsin), NTEP Committee Chair, suggested that the Sector just communicate its concerns over the use of the word "automatically." Mike Keilty concurred, noting that many different alternatives could be written, but since the basic concern seems to stem from the use of the word "automatically," just noting the Sector's concern might be helpful to the S&T Committee in assessing alternatives.

Conclusion: The Sector is concerned that the term "automatically" may be misinterpreted. The Sector did not agree upon specific language to suggest, but encourages the S&T to find alternative language for this term.

7. Product Families for Meters Table, **Categorization of Liquid CO_2**

Source: Marc Buttler, Emerson Process Management

Background: Liquid carbon dioxide is not clearly addressed in the Product Families for Meters Table in NCWM Publication 14 (see Technical Policy, Section C, LMD-3). Clarification is required regarding the correct product family for liquid CO_2 in order to guide correct certification for liquid CO_2. Categorizing liquid CO_2 in the family of cryogenic products was considered, but the typical temperature of liquid CO_2 is above the defined maximum temperature for cryogenic fluids of 120 Kelvin as defined in NIST Handbook 44.

Recommendation: The Sector was asked to consider including liquid CO_2 as a compressed liquid and to increase the maximum density for compressed liquids to 1.1 to include the typical density of liquid CO_2.

Discussion: Marc Buttler summarized the history of the issue, noting that there is currently nothing in the Product Families Table to address CO_2. Marc also noted that he had checked with Dick Suiter (who was the Sector's technical advisor prior to his retirement in 2008) regarding categorization of CO_2 and Dick had suggested that it be addressed as a compressed liquid. Marc noted that CO_2 exists at temperatures well above the threshold specified in NIST Handbook 44 for "cryogenics," citing typical temperature ranges of –50 ºC to –30 ºC. The Sector discussed typical temperature and pressure ranges for liquid CO_2 and generally concurred that it does not fall into the category of a cryogenic based upon the definition referenced above.

The California laboratory has the most experience testing CO_2 meters; however, Dan Reiswig noted California's experience is primarily limited to tests of turbine meters rather than mass flow meters. With regard to categories currently included in the table, Norm Ingram expressed the opinion that CO_2 belongs in the compressed liquids category; however, he noted that there is no specific gravity listed for either compressed gases or cryogenic liquids and the specific gravity for carbon dioxide is not within the range currently listed in the compressed liquids category.

The Sector discussed the relative tolerances specified in NIST Handbook 44 for cryogenic liquids, mass flow meters, and LPG and NH_3 and considered how this might impact the inclusion of CO_2 in an existing product family. If CO_2 is included in a family which is subject to different tolerances, the Sector will need to assess how to apply tolerances in testing. For example, would the most stringent tolerance be used to cover all products in the family? The Sector also discussed the fact that Section 3.34. in the Cryogenics Code does not apply to meters dispensing liquefied natural gas.

The Sector also discussed the question of what testing would need to be done to get the products listed under the family. Test D is specified for both the compressed liquids family and cryogenic liquids family. Mike Frailer noted that if you test with one product from the family, Test D would require testing with only one product from the family. This needs to be considered in conjunction with the issue of tolerances to be applied. Dan Reiswig noted that historically tests conducted by the California laboratory of turbine meters included separate tests for cryogenics and CO_2. Will Wotthlie pointed out that CO_2 has not previously been included in the Product Families Table and suggested an alternative might be to create a separate category for CO_2 with a Test D specified.

Related to the issue of the test specified in the Product Families Table is the question of specific test procedures. Because product is transferred through these meters via gravity discharge, Will Wotthlie noted that the testing is more complex; one must take great care to ensure that pressures are consistent and other parameters are monitored. The uncertainty in the testing process is one reason that a larger tolerance is allowed. While expressing a desire to avoid more testing than is absolutely necessary, Dan Reiswig and others laboratories noted that experience testing meters using gravity discharge in NTEP is rather limited. Dan expressed concern about including CO_2 in an existing product family category and, thereby, "grandfathering" it into an existing CC because of this limited experience and the lack of data to support doing so.

Jim Truex asked if Measurement Canada had experience with these meters and Dennis Beattie indicated they do not have any data to share. Marc Buttler reported that no tests have yet been conducted in the field, which led to the conclusion that more data is needed. Marc reported having a customer waiting for a resolution of this issue, and Dan Reiswig offered to work with Marc to look at a device near the California laboratory for the purposes of collecting additional data. Since limited or no data seems to be available, Jim Truex, noted that a test case is needed in order to collect data that will enable the Sector to assess what changes to the table can be supported. Marc suggested the Sector table the issue until additional data is collected and examined. The Sector agreed that additional data is needed to make an assessment of any proposed changes to the table with respect to CO_2.

Conclusion: The Sector agreed to table the issue until more data is available to suggest the best approach to use for including CO_2 in the Product Families Table and for defining the test criteria.

8. Product Families for Meters Table, Inclusion of Milk and Dairy Products

Background: The product family for milk is not clearly identified in the Product Table in Pub 14. HB 44 and Pub 14 have specific sections regarding milk meters, but it is unclear what the product family and test requirements are for milk.

The following points were offered for the Sector to consider in its discussion of this issue:

- The "Mass Flow Meters" category in the current table does not include any additional guidance regarding "milk and dairy products" or any other food-grade products.

- Milk and dairy products would presumably fall under the test requirements category of "Normal Liquids" for mass flow meters since the remaining categories of "Heated Products," "Compressed Liquids," "Compressed Gases," and "Cryogenic Liquids and LNG" would clearly not include milk and dairy products.

- The majority of mass flow meters with NTEP CCs for dairy applications were tested with milk.

- Past Sector summaries and discussions do not appear to have any reference to discussions of how milk and other dairy products would fit into the Product Families Table for MFMs or for any other meter technologies. Milk does not appear to be discussed in any recent discussions (in the past few years) on the Product Families Table categories for MFMs.

- There is reference to various food-grade oils and there are subcategories for Magnetic Flow, PD, and Turbine meters that include reference to "industrial and food-grade liquid oils." However, no other reference is made in the table to other types of food products.

- The LMD checklist is very sketchy on evaluation criteria for milk metering applications in general. So, a related Sector issue may be the need to strengthen the checklist criteria on milk meters. This point could be addressed with this agenda item or as part of a separate effort.

- A related issue (more for HB 44 than for NTEP) is that the MFM Code in HB 44 includes few references to milk meter applications. The MFM Code may need to be reviewed to determine if any additional requirements for milk meter applications from the NIST Handbook 44 Milk Meters Code might need to be proposed for inclusion in the MFM Code. It is questionable if this was done when the MFM Code was added to HB 44.

- Where does a food product such as high fructose corn syrup (which may sometimes be heated) fit in the existing table? There is a category for liquid feeds such as molasses, but not for corn syrup.

Recommendation: Identify clearly which product family milk falls into for each metering technology. Alternatively, the Sector might consider creating a separate product family just for milk and dairy products.

Discussion: Dmitri Karimov reported that one reference to milk that he observed on the internet cites an approximate 87.7 % water content. Thus, milk is most appropriately included in the "water" product category. For reference, Rich Miller also noted that R 117 has a section that addresses beer and other foaming liquids (which includes milk) under a single category for liquid foods.

Will Wotthlie agreed with Dmitri's assessment, noting that he is also speaking for Ross Andersen (New York) who asked Will to relay his point of view. Will went on to comment, that with regard to test liquid, he believes that testing done in the laboratory with water is adequate to cover applications for either water or milk. Additionally, a test with water in a field application is appropriate to cover either water or milk applications on the CC. Will also commented that, because of the need to test complete systems, including any peripheral equipment typically associated with milk meters, if a manufacturer selects a field site that is normally used to meter milk, then milk must be used as the test liquid for the evaluation.

The Sector generally agreed that testing in a laboratory with water is adequate to cover both milk and water applications. Dennis Beattie noted that even if milk was brought into a lab, problems would likely arise because of product foaming. Dennis also commented that Measurement Canada doesn't approve a meter alone, rather they approve systems, which includes an evaluation of the control components of the system. The Sector acknowledged that milk metering systems include peripheral equipment that is essential to ensuring accurate metering and that testing in a laboratory environment with water may not include testing with this peripheral equipment. However, several members made the point that initial and subsequent verification tests in the field will be conducted with all peripheral equipment that is necessary to ensure accurate measurement and further commented that milk must be used for the test liquid in such tests. The Sector also briefly discussed how CCs reflect associated peripheral equipment in milk metering systems, with some comments that there may be some inconsistency in previously issued CCs.

The Sector then went on to discuss the merits of NTEP testing with water versus milk in field applications. Echoing Will's comments, the Sector agreed that NTEP tests in field applications can be conducted with either water or milk to cover both applications. However, when the field site selected is an application that is normally used to meter milk (for example an installation at a farm site), then the Sector believes that, whether the test is an NTEP test or an initial or subsequent verification, the test liquid must be milk and all associated peripheral equipment must be included for the test.

There was some additional discussion regarding whether or not milk should be included in the category with water for all metering technologies. The Sector agreed that milk can be included in the same category as water for all technologies; however, because of the issue of conductivity, the Sector agreed that, for magnetic flow meters, milk should be included in the category with tap water rather than deionized water.

Conclusion: The Sector agreed on the following points:

- Add milk to the "water" product categories in the table. However, because of the issue of conductivity, for magnetic flow meters where there are two categories for water, add milk to the "tap water" category.
- A manufacturer can select a field site for either a water meter application or a milk meter application and have both products covered on the certificate. If the site selected is a site intended to meter milk, then milk must be used for the test liquid.

9. Next Meeting

Recommendation: The Sector was asked to develop a proposed date and location for the next meeting.

Discussion: The Sector discussed several options for the 2009 and future meetings, including options of holding Sector meetings in conjunction with the SWMA, the WWMA, and the CWMA Interim Meetings as well as holding Sector meetings separately. Because more NTEP measuring laboratory personnel routinely attend the SWMA, holding the meetings in conjunction with the SWMA would be more cost effective to those laboratories. Thus, the Sector agreed that the Sector meetings should continue to be held in conjunction with the SWMA as a general practice.

Conclusion: The Sector agreed to recommend that the next meeting be held in conjunction with the SWMA in 2009.

Additional Items as Time Allows

10. Temperature Compensation for Liquid Measuring Devices Code

Source: NCWM S&T Committee

Background and Recommendation: The NCWM S&T Committee is considering a proposal to modify Section 3.30. Liquid-Measuring Devices (LMD) Code by modifying paragraphs S.2.6., S.2.7.1., S.2.7.3., N.4.1.1.(a) and (b), N.5., UR.3.6.1.1., and UR.3.6.1.2., to add new paragraphs S.1.6.8., S.2.7.2., S.4.3., UR.3.6.1.3., and UR.3.6.4., and to renumber other existing paragraphs as appropriate to recognize temperature compensation for retail devices. The Sector was asked to provide input to the S&T Committee on these proposed changes if time permitted. The proposed changes were included in the Sector's 2008 agenda and can be found in the NCWM S&T Committee's 2009 Interim agenda and 2009 Interim Report under Item 330-1.

Conclusion: Time did not permit the Sector to discuss the proposed changes. Consequently, the Sector took no position on these proposals.

11. Water Meters – S.1.1.3. Value of the Smallest Unit

Source: Western Weights and Measures Association (WWMA)

Background and Recommendation: The NCWM S&T Committee is being asked to consider a proposal from the WWMA to modify paragraph S.1.1.3. Value of the Smallest Unit in Section 3.36. Water Meters in NIST Handbook 44 to harmonize with American Water Works Association (AWWA) standards. The Sector was asked to provide input to the S&T Committee on these proposed changes if time permitted. The proposed changes were included in the Sector's 2008 agenda and can be found in the NCWM S&T Committee's 2009 Interim agenda and 2009 Interim Report under Item 336-1.

Conclusion: Time did not permit the Sector to discuss the proposed changes. Consequently, the Sector took no position on these proposals.

12. Water Meters – N.4.1.1. Repeatability Tests and T.1. Tolerance Values

Source: Southern Weights and Measures Association (SWMA)

Background and Recommendation: The Southern Weights and Measures Association is developing a proposal to change requirements for test draft sizes specified in NIST Handbook 44 Section 3.36. Water Meters. The proposal recommends modifications to paragraph N.3., Tables N.4.1. and N.4.2., and paragraph T.1.1.; as well as the addition of several new tables in the Notes and Tolerances sections specifying separate requirements for utility and non-utility meters.

The Sector was asked to provide input to the S&T Committee on these proposed changes if time permitted. The proposed changes were included in the Sector's 2008 agenda and can be found in the NCWM S&T Committee's 2009 Interim agenda on the Developing Items agenda and in the 2009 Interim Report under Item 336-3.

Conclusion: Time did not permit the Sector to discuss the proposed changes. Consequently, the Sector took no position on these proposals.

13. Water Meters T.1.1. Repeatability, Tables T.1.1. and T.1.2.

Source: Western Weights and Measures Association (WWMA)

Background and Recommendation: The WWMA submitted a proposal to amend Table T.1.1. Repeatability and add new Tables T.1.1. and T.1.2. in NIST Handbook 44 Section 3.36. to specify test draft sizes for tests of water meters. A copy of the proposal was included in the Sector's agenda with the request that the Sector review the proposal and provide any comments and recommended changes to the NCWM S&T Committee.

Conclusion: Time did not permit the Sector to discuss the proposed changes. Consequently, the Sector took no position on these proposals.

[**Technical Advisor's Note:** This proposal can be found in the 2009 Interim agenda of the S&T Committee under Item 336-2. This item was subsequently withdrawn by the S&T Committee as reflected in its 2009 Interim Report, with the recommendation that the WWMA address the issue in conjunction with the WWMA's continued work on a related S&T Committee Developing item, Part 4, Item 1.]

14. Draft Code Section 3.3X. Hydrogen Gas-Measuring Devices

Source: NCWM S&T Committee

Background: The NCWM S&T Committee's agenda added a new item to its Developing Items to recognize work being done to develop a code for commercial hydrogen gas-measuring devices by the U.S. National Work Group for the Development of Commercial Hydrogen Measurement Standards. The work group, which presently includes weights and measures officials, manufacturers and users of hydrogen measuring devices, and federal agency representatives, is looking for input and participation from the weights and measures community in the development of the code and associated test procedures. The most current version of the draft code can be found on NIST WMD's home page at http://ts.nist.gov/WeightsAndMeasures/Developing-Commercial-Hydrogen-Measurement-Standards.cfm.

This web page will be the U.S. weights and measures and hydrogen communities' source for the latest information and status of ongoing work to develop uniform and appropriate legal metrology standards for commercial hydrogen measurements.

Conclusion: The Sector took no action on this item. This item was included on the Sector's agenda to make the Sector aware of the work and to encourage input and participation from Sector members.

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Appendix 1 – Attachment #1 from 2008 Measuring Sector Agenda

Proposed Product Families and Typical Product Characteristics

Table X.X.X. Product Families and Typical Product Characteristics			
Product Group	**Liquid Name**	**Viscosity (60 ºF) Centipoises/Centistokes**	**Specific Gravity (60 ºF)**
Normal Liquids			
Fuels, Lubricants, Industrial and Food-Grade Liquid Oils	Diesel Fuel	10 cps	0.72
	Distillate		
	Gasoline	0.28 cps	0.72
	Fuel Oil (#1, #2, #3, #4)	8 to 88 cPs	0.9
	Kerosene	1.94 cps	0.75
	Light Oil	13.47 cps	0.86
	Spindle Oil		
	Lubricating Oils	20 to 1000 cPs	0.80 to 0.90
	SAE Grades	192 to 3626 cps	0.9
	Bunker Oil	11 200 cps	0.99
	6 Oil (#5, #6)	66 to 13 000 cPs	0.9
	Crude Oil	3 to 1783 cps	0.79 to 0.97
	Asphalt	100 to 5000 cPs	
	Vegetable Oil	133 cps	0.92
	Biodiesel above B20	10.12 cps	0.86
	Avgas	1.5 to 6 cPs	
	Jet A	1.5 to 6 cPs	
	Jet A-1	1.36 cps	0.76
	Jet B	1.5 to 6 cPs	
	JP4	1.02 cps	0.76
	JP5	1.94 cps	0.76
	JP7 JP8	1.82 cps	0.76
	Cooking Oils	9.93 cps	0.92
	Sunflower Oil	90.1 cps	0.93
	Soy Oil	90.6 cps	0.93
	Peanut Oil	11 cPs to 110 cPs	0.9 to 1.0
	Olive Oil	116.8 cps	0.92
	Corn Oil	4.0 cps	0.91
Normal Liquids			
Solvents General	Acetates	0.44 cps	0.93
	Acetone	0.34 cps	0.8
	Esters		
	Ethylacetate	1.36 cps	0.96
	Hexane	0.34 cps	0.66
	MEK	0.45 cps	0.81
	Toluene	0.62 cps	0.87
	Xylene	0.86 cps	0.89
Normal Liquids			
Solvents Chlorinated	Carbon Tetra-Chloride	0.99 cps	1.6
	Methylene-Chloride	0.46 cps	1.34
	Perchloro-Ethylene	1	1.6
	Trichloro-Ethylene	0.6 cps	1.47

Table X.X.X. Product Families and Typical Product Characteristics			
Product Group	**Liquid Name**	**Viscosity (60 ºF) Centipoises/Centistokes**	**Specific Gravity (60 ºF)**
Normal Liquids			
Alcohols, Glycols & Water Mixes Thereof	Ethanol	1.29 cps	0.79
	Methanol	0.64 cps	0.80
	Butanol	3.34 cps	0.81
	Isopropyl	2.78 cps	0.79
	Isobutyl	4.54 cps	0.81
	Ethylene glycol	25.5 cps	1.19
	Propylene glycol	54 cps	1.04
Normal Liquids			
Water	Tap Water	1.0 cPs	1.0
	Deionized	1.0 cPs	1.0
	Demineralized	1.0 cPs	1.0
	Potable	1.0 cPs	1.0
	Nonpotable	1.0 cPs	1.0
Normal Liquids			
Clear Liquid Fertilizers	Nitrogen Solution		
	28 %, 30 % or 32 %		
	20 % Aqua-Ammonia		
	Urea	1.0 cps	1.89
	Ammonia Nitrate	11.22 cps	1.16 to 1.37
	N-P-K solutions		
	10-34-0	48 cps	1.39
	9-18-9		1.32
Normal Liquids			
Crop Chemicals	Herbicides		
	Round-up	1.0	1.01
	Touchdown		1.4
	Banvel		1.19
	Treflan		1.12
	Paraquat		1.12
	Prowl		1.06
Normal Liquids			
Crop Chemicals	Fungicides		
	Insecticides		
	Adjuvants		
	Fumigants		
	Dual		1.11
	Bicep		1.11
	Marksman		1.16
	Broadstrike		1.12
	Doubleplay		
	Topnotch	140 to 400 cps	1.16
	Guardsman		1.12
	Harness		1.11

Table X.X.X. Product Families and Typical Product Characteristics			
Product Group	**Liquid Name**	**Viscosity (60 ºF) Centipoises/Centistokes**	**Specific Gravity (60 ºF)**
Normal Liquids			
Crop Chemicals	Fungicides		
Normal Liquids			
Crop Chemicals	Micronutrients		
Normal Liquids			
Suspension Fertilizers	3-10-30		
	4-4-27		
Normal Liquids			
Liquid Feeds	Liquid Molasses	8640 cps	1.25
	Molasses plus Phos Acid and/or Urea (Treacle)	2882 cps	1.1 to 1.3
Normal Liquids			
Chemicals	Sulfuric Acid	1.49 cps	1.83
	Hydrochloric Acid	1.0 to 0.80 cps	1.1
	Phosphoric Acid	161 cps	1.87
Heated Products			
	Bunker C	11 200 cps	1.99
	Asphalt	100 to 5000 cPs	
Compressed Liquids			
Fuels and Refrigerants	LPG		
	Propane	0.098 cps	0.504
	Butane	0.19 cps	0.595
	Ethane		
	Freon 11	0.313 cps	1.49
	Freon 12	0.359 cps	1.33
	Freon 22	1.99 cps	1.37
Compressed Liquids			
NH_3	Anhydrous Ammonia	0.188 cps	0.61
Compressed Gases			
	Compressed Natural Gas (CNG)		0.6 to 0.8 (1=Air)
Cryogenic Liquids and Liquefied Natural Gas			
	Liquefied Oxygen	0.038 cps	0.66
	Nitrogen	1.07 cps	0.31
	~~Liquefied Natural Gas~~		

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Appendix 2 – Attachment #2 from 2008 Measuring Sector Agenda

Test Requirements for Product Families

Table X.X.X. Test Requirements for Product Families	
Product Family	**Flowmeter Test Requirements**
Normal Liquids	**Magnetic Flowmeters – Use Test F for Fuels, Lubricants, Industrial and Food-Grade Liquid Oils, Solvents General, Solvents Chlorinated, Pure Alcohols & Glycols, Water (De-mineralized & De-ionized), Heated Products (above 50 ºC);** **Magnetic Flowmeters – Use Test D for Water (Tap, Potable & Non-potable), Water Mixes of Alcohols & Glycols, Juices, Beverages, Clear Liquid Fertilizers, Crop Chemicals, Suspensions Fertilizers, Liquid Feeds, Chemicals** **Mass Flowmeters – Use Test B** **Positive Displacement Flowmeters – Use Test C** **Turbine Flowmeters – Use Test E** **Other Flowmeter Types – Use Test A**
Heated Products (above 50 °C)	**Magnetic Flowmeters – Use Test F** **Mass Flowmeters – Use Test D** **Positive Displacement Flowmeters – Use Test D** **Other Flowmeter Types – Use Test A**
Compressed Liquids	**Mass Flowmeters – Use Test D** **Positive Displacement Flowmeters – Use Test D** **Turbine flowmeters – Use Test E** **Other Flowmeter Types – Use Test A**
Cryogenic Liquids and Liquefied Natural Gas	**Mass Flowmeters – Use Test D** **Turbine flowmeters – Use Test D** **Other Flowmeter Types – Use Test A**
Compressed Gases	**Mass Flowmeters – Use Test D** **Other Flowmeter Types – Use Test A** **Note: CNG is only included in Section 3.37. Mass Flow Meters of Handbook 44.**

Tests to be Conducted:

Test A Products must be individually tested and noted on the Certificate of Conformance.

Test B To obtain coverage for a range of products within a family: Test with one product having a low specific gravity; test with a second product having a high specific gravity. The Certificate of Conformance will cover all products in the family within the specific gravity range tested.

Test C To obtain coverage for a range of products within a family: Test with one product having a low viscosity; test with a second product having a high viscosity. The Certificate of Conformance will cover all products in the family within the viscosity range tested.

Test D To obtain coverage for a product family: Test with one product in the product family. The Certificate of Conformance will cover all products in the family.

Test E To obtain coverage for a range of products within a family: Test with one product having a low kinematic viscosity; test with a second product having a high kinematic viscosity. The Certificate of Conformance will cover all products in the family within the kinematic viscosity range tested.

Test F To obtain coverage for a range of products within a family: Test with one product having a specified conductivity. The Certificate of Conformance will cover all products in the family with conductivity equal to or above the conductivity of the tested liquid.

Appendix 3 – Attachment #3 from 2008 Measuring Sector Agenda

Revisions to NCWM Publication 14 LMD Checklist
Technical Policy Part C – Product Families for Meters
Discussed by the Sector at its October 2008 Meeting

C. Product Families for Meters

When submitting a meter for evaluation, the manufacturer must specify the product family and critical parameters for which the meter is being submitted.

~~The product family and the specific product subgroup covered by the Certificate are to be identified on page 1 of the Certificate of Conformance. More detailed information, including the typical product types found in the subgroup, is to be included in the application section of the Certificate.~~

~~Tests are to be conducted as described in Table C.1. Tests to Be Conducted.~~ **Testing must be completed for each product family in order for that product family to be covered on the Certificate.** Table C.~~2~~1. Product Families Table identifies which of these tests apply to various metering technologies and product families. ~~For meter technologies not already specified in Table C.2., use "Test A."~~ **Tests are to be conducted as described in Table C.2. Tests to Be Conducted. For meter technologies not already specified in Table C.2., use Test A**. Table C.3. Typical Product Family Characteristics gives viscosity and specific gravity values for typical products in each product family.

The "Application" section of the Certificate of Conformance will identify product families or specific products covered under the Certificate.

Table C.1. Product Families and Test Requirements

<table>
<tr><th>Mass Flow Meters
~~Product Family & Test Requirements (Test B unless otherwise noted)~~</th><th>Magnetic Flow Meters
~~Product Family & Test Requirements (Test D unless otherwise noted)~~</th><th>Positive Displacement
~~Product Family & Test Requirements~~Meters
~~(Test C unless otherwise noted)~~</th><th>Turbine Meters
~~Product Family & Test Requirements (Test A unless otherwise noted)~~</th></tr>
<tr><td rowspan="5">Test B
Normal Liquids
Includes the following for Mass Flow Meters:

Fuels, Lubricants, Industrial and Food-Grade Liquid Oils,

Solvents General,

Solvents Chlorinated,

Alcohols, Glycols, and Water Mixes Thereof,

Water,</td><td rowspan="4">Test F ~~permitted~~
Fuels, Lubricants, Industrial and Food-Grade Liquid Oils,
Solvents
General,
Solvents
Chlorinated,
Pure Alcohols & Glycols,

Water (De-mineralized & de-ionized),
Heated Products
(above 50 °C)*</td><td>Test C
Fuels, Lubricants, Industrial and Food-Grade Liquid Oils</td><td>Test E ~~permitted~~
Fuels, Lubricants, Industrial and Food-Grade Liquid Oils</td></tr>
<tr><td>Test C
Solvents
General</td><td>Test E ~~permitted~~
Solvents
General</td></tr>
<tr><td>Test C
Solvents
Chlorinated</td><td>Test A
Solvents
Chlorinated</td></tr>
<tr><td rowspan="2">Test C
Alcohols, Glycols, & Water Mixes Thereof</td><td rowspan="2">Test E ~~permitted~~
Alcohols, Glycols, & Water Mixes Thereof</td></tr>
<tr><td>Test D
Water (Tap, Potable & Nonpotable), ~~Water Mixes of Alcohols & Glycols,~~</td><td>Test D ~~permitted~~
Water</td><td>Test D ~~permitted~~
Water</td></tr>
</table>

Table C.1. Product Families and Test Requirements

Mass Flow Meters ~~**Product Family & Test Requirements (Test B unless otherwise noted)**~~	**Magnetic Flow Meters** ~~**Product Family & Test Requirements (Test D unless otherwise noted)**~~	**Positive Displacement** ~~**Product Family & Test Requirements**~~**Meters** ~~**(Test C unless otherwise noted)**~~	**Turbine Meters** ~~**Product Family & Test Requirements (Test A unless otherwise noted)**~~
(continued) Juices, Beverages, Clear Liquid Fertilizers, Crop Chemicals, Flowables Suspensions Fertilizers, Liquid Feeds, Chemicals	(continued) Glycols, and Water Mixes Thereof, Juices, Beverages, Clear Liquid Fertilizers, Crop Chemicals, Suspensions Fertilizers, Liquid Feeds, Chemicals	**Test C** Clear Liquid Fertilizers	**Test A** Clear Liquid Fertilizers
		Test C Crop Chemicals 1	**Test A** Crop Chemicals 1
		Test C Crop Chemicals 2	**Test A** Crop Chemicals 2
		Test C Flowables	**Test A** Flowables
		Test C Crop Chemicals 3	**Test A** Crop Chemicals 3
		Test C Crop Chemicals 4	**Test A** Crop Chemicals 4
		Test C Suspensions Fertilizers	**Test A** Suspensions Fertilizers
		Test C Liquid Feeds	**Test A** Liquid Feeds
		Test C Chemicals	**Test A** Chemicals
Test B Heated Products (above 50 °C)	*See above (for heated products above 50 °C)	**Test C** Heated Products (above 50 °C)	**Test A** Heated Products (above 50 °C)
Test D Compressed Liquids, Fuels and Refrigerants, NH_3	Not Applicable (conductivity too low)	**Test C** Compressed Liquids, Fuels and Refrigerants	**Test E** Compressed Liquids, Fuels and Refrigerants
		Test C NH_3 Anhydrous Ammonia **Note:** If a meter is certified for anhydrous ammonia the same meter type may also be certified for LPG without further testing.	**Test A** NH_3 Anhydrous Ammonia **Note:** If a meter is certified for anhydrous ammonia the same meter type may also be certified for LPG without further testing.
Test D Compressed Gases	**Note:** CNG is only included in Section 3.37. Mass Flow Meters of Handbook 44. ~~CNG~~		

Table C.1. Product Families and Test Requirements

Mass Flow Meters ~~Product Family & Test Requirements (Test B unless otherwise noted)~~	Magnetic Flow Meters ~~Product Family & Test Requirements (Test D unless otherwise noted)~~	Positive Displacement ~~Product Family & Test Requirements~~ Meters ~~(Test C unless otherwise noted)~~	Turbine Meters ~~Product Family & Test Requirements (Test A unless otherwise noted)~~
Test D Cryogenic Liquids and Liquefied Natural Gas	Not Applicable (conductivity too low)	**Test A** Cryogenic Liquids and Liquefied Natural Gas	**Test D ~~permitted~~** Cryogenic Liquids and Liquefied Natural Gas

[1] Note: The Typical Products listed in this table are not limiting or all-inclusive; there may be other products and product trade names, which fall into a product family. Water and a product such as stoddard solvent or mineral spirits may be used as test products in the fuels, lubricants, industrial, and food-grade liquid oils product family.

[2] The specific gravity of a liquid is the ratio of its density to that of water at standard conditions, usually 4 °C (or 40 °F) and 1 atm. The density of water at standard conditions is approximately 1000 kg/m^3 (or 998 kg/m^3)

[3] Diesel fuel blends (biodiesel) with up to 20 % vegetable or animal fat/oil.

[4] Gasoline includes oxygenated fuel blends with up to 15 % oxygenate.

$$\text{Centistokes} = \frac{\text{Centipoise}}{\text{Specific Gravity}}$$

[5] Kinematic viscosity is measured in centistokes (cSt).

Source for some of the viscosity value information is in the Industry Canada – Measurement Canada "Liquid Products Group, Bulletin V-16-E (rev. 1), August 3, 1999."

Table C.2. Tests to be Conducted

Test A – Products must be individually tested and noted on the Certificate of Conformance.

Test B – To obtain coverage for a range of products within a family: Test with one product having a low specific gravity; test with a second product having a high specific gravity. The Certificate of Conformance will cover all products in the product family within the specific gravity range tested.

Test C – To obtain coverage for a range of products within a family: Test with one product having a low viscosity; test with a second product having a high viscosity. The Certificate of Conformance will cover all products in the product family within the viscosity range tested.

Test D – To obtain coverage for a product family: Test with one product in the product family. The Certificate of Conformance will cover all products in the family.

Test E – To obtain coverage for a range of products within a family: Test with one product having a low kinematic viscosity; test with a second product having a high kinematic viscosity. The Certificate of Conformance will note coverage for all products in the family within the kinematic viscosity range tested.

Test F – To obtain coverage for a range of products within a family: Test with one product having a specified conductivity. The Certificate of Conformance will note coverage for all products in both of the families with conductivity equal to or above the conductivity of the tested liquid.

Table C.3. Typical Product Family Characteristics			
Product Families	**Typical Products**	**Reference Viscosity* (60 ˚F) Centipoise~~/Centistokes~~ (cP)**	**Reference Specific Gravity* (60 ˚F) (1 = water, except where noted)**
Normal Liquids, Fuels, Lubricants, Industrial and Food-Grade Liquid Oils	Diesel Fuel	10 **cP**~~cps~~	0.72
	Distillate		
	Gasoline	0.28 **cP**~~cps~~	0.72
	Fuel Oil (#1, #2, #3, #4)	8 to 88 **cP**~~cPs.~~	0.9
	Kerosene	1.94 **cP**~~cps~~	0.75
	Light Oil	13.47 **cP**~~cps~~	0.86
	Spindle Oil		
	Lubricating Oils	20 to 1000 **cP**~~cPs.~~	0.80 to 0.90
	SAE Grades	192 to 3626 **cP**~~cps~~	0.9
	Bunker Oil	11 200 **cP**~~cps~~	0.99
	6 Oil (#5, #6)	66 to 13 000 **cP**~~cPs.~~	0.9
	Crude Oil	3 to 1783 **cP**~~cps~~	0.79 to 0.97
	Asphalt	100 to 5000 **cP**~~cPs~~	
	Vegetable Oil	133 **cP**~~cps~~	0.92
	Biodiesel above B20	10.12 **cP**~~cps~~	0.86
	Avgas	1.5 to 6 **cP**~~cPs.~~	
	Jet A	1.5 to 6 **cP**~~cPs.~~	
	Jet A-1	1.36 **cP**~~cps~~	0.76
	Jet B	1.5 to 6 **cP**~~cPs.~~	
	JP4	1.02 **cP**~~cps~~	0.76
	JP5	1.94 **cP**~~cps~~	0.76
	JP7 JP8	1.82 **cP**~~cps~~	0.76
	Cooking Oils	9.93 **cP**~~cps~~	0.92
	Sunflower Oil	90.1 **cP**~~cps~~	0.93
	Soy Oil	90.6 **cP**~~cps~~	0.93
	Peanut Oil	11 **cP**~~cPs.~~ to 110 **cP**~~cPs~~	0.9 to 1.0
	Olive Oil	116.8 **cP**~~cps~~	0.92
	Corn Oil	4.0 **cP**~~cps~~	0.91
Normal Liquids, Solvents General	Acetates	0.44 **cP**~~cps~~	0.93
	Acetone	0.34 **cP**~~cps~~	0.8
	Esters		
	Ethylacetate	1.36 **cP**~~cps~~	0.96
	Hexane	0.34 **cP**~~cps~~	0.66
	MEK	0.45 **cP**~~cps~~	0.81
	Toluene	0.62 **cP**~~cps~~	0.87
	Xylene	0.86 **cP**~~cps~~	0.89

Table C.3. Typical Product Family Characteristics			
Product Families	**Typical Products**	**Reference Viscosity* (60 ˚F) Centipoise~~/Centistokes~~ (cP)**	**Reference Specific Gravity* (60 ˚F) (1 = water, except where noted)**
Normal Liquids, Solvents Chlorinated	Carbon Tetra-Chloride	0.99 **cP**~~cps~~	1.6
	Methylene-Chloride	0.46 **cP**~~cps~~	1.34
	Perchloro-Ethylene	1.0	1.6
	Trichloro-Ethylene	0.6 **cP**~~cps~~	1.47
Normal Liquids, Pure Alcohols, Alcohols, Glycols & Water Mixes Thereof	Ethanol	1.29 **cP**~~cps~~	0.79
	Methanol	0.64 **cP**~~cps~~	0.80
	Butanol	3.34 **cP**~~cps~~	0.81
	Isopropyl	2.78 **cP**~~cps~~	0.79
	Isobutyl	4.54 **cP**~~cps~~	0.81
	Ethylene glycol	25.5 **cP**~~cps~~	1.19
	Propylene glycol	54 **cP**~~cps~~	1.04
Normal Liquids, Water	Tap Water	1.0 **cP**~~cps~~	1.0
	Deionized	1.0 **cP**~~cps~~	1.0
	Demineralized	1.0 **cP**~~cps~~	1.0
	Potable	1.0 **cP**~~cps~~	1.0
	Nonpotable	1.0 **cP**~~cps~~	1.0
Normal Liquids, Clear Liquid Fertilizers	Nitrogen Solution		
	28 %, 30 % or 32 %		
	20 % Aqua-Ammonia		
	Urea	1.0 **cP**~~cps~~	1.89
	Ammonia Nitrate	11.22 **cP**~~cps~~	1.16 to 1.37
	N-P-K solutions		
	10-34-0	48 **cP**~~cps~~	1.39
	9-18-9		1.32
Normal Liquids, Crop Chemicals 1	Herbicides		
	Round-up	1.0 **cP**	1.01
	Touchdown		1.4
	Banvel		1.19
	Treflan		1.12
	Paraquat		1.12
	Prowl		1.06
Normal Liquids, Crop Chemicals 2	Fungicides		
	Insecticides		
	Adjuvants		
	Fumigants		
Normal Liquids, Crop Chemicals 3	Fungicides		
Normal Liquids, Crop Chemicals 4	Micronutrients		
Normal Liquids, Flowables	Dual		1.11
	Bicep		1.11
	Marksman		1.16
	Broadstrike		1.12
	Doubleplay		
	Topnotch	140 to 400 **cP**~~cps~~	1.16
	Guardsman		1.12
	Harness		1.11

Table C.3. Typical Product Family Characteristics			
Product Families	**Typical Products**	**Reference Viscosity* (60 ˚F) Centipoise~~/Centistokes~~ (cP)**	**Reference Specific Gravity* (60 ˚F) (1 = water, except where noted)**
~~Normal Liquids Crop Chemicals~~	~~Fungicides~~		
~~Normal Liquids Crop Chemicals~~	~~Micronutrients~~		
Normal Liquids, Suspension Fertilizers	3-10-30		
	4-4-27		
Normal Liquids, Liquid Feeds	Liquid Molasses	8640 **cP**~~cps~~	1.25
	Molasses plus Phos Acid and/or Urea (Treacle)	2882 **cP**~~cps~~	1.1 to 1.3
Normal Liquids, Chemicals	Sulfuric Acid	1.49 **cP**~~cps~~	1.83
	Hydrochloric Acid	1.0 to 0.80 **cP**~~cps~~	1.1
	Phosphoric Acid	161 **cP**~~cps~~	1.87
	Asphalt	100 to 5000 **cP**~~cPs~~	
Compressed Liquids, Fuels and Refrigerants, NH_3	LPG		
	Propane	0.098 **cP**~~cps~~	0.504
	Butane	0.19 **cP**~~cps~~	0.595
	Ethane		
	Freon 11	0.313 **cP**~~cps~~	1.49
	Freon 12	0.359 **cP**~~cps~~	1.33
	Freon 22	1.99 **cP**~~cps~~	1.37
	Anhydrous Ammonia	0.188 **cP**~~cps~~	0.61
Compressed Gases	Compressed Natural Gas (CNG)		0.6 to 0.8 (1 = Air)
Cryogenic Liquids and Liquefied Natural Gas	Liquefied Oxygen	0.038 **cP**~~cps~~	0.66
	Liquefied Nitrogen	1.07 **cP**~~cps~~	0.31
	Liquefied Natural Gas		

*Reference Fluid properties are not all inclusive and are representative examples only.

Summary of Key Changes:

- The original table in Pub 14 includes a viscosity range for fungicides; however, there is no value listed in the new table for fungicides. In the meantime identify these as crop chemicals 1, 2, 3, and 4.
- "Flowables" is missing from the table.
- Suggest putting crop chemicals after water and other changes to make the table flow better.
- The order of the tables originally numbered C.1. and C.2. was reversed for better flow.
- The note for a single test to cover NH_3 and LPG should also apply to turbine meters. The original table did not specify that the note applied to PD meters only. ***(Note:** This was a point of contention that was not resolved during the meeting, as referenced earlier.)*
- Terms in Table C.2. and Table C.3. (original numbers) should match for the various product families.
- The term for centipoise needs to be consistent.
- The term centistokes was deleted from the headers.
- The footnotes from the original Product Families Table were pulled back into Table C.2. (original number).

Maintenance Issues:

- Start to combine the "crop chemicals" into a single category.
- For magnetic flow meters we talk about beverages. However, we don't talk about it for other technologies.

- There is no reference to heated products below 50 ºC.
- If you list the items in order from lowest to highest viscosity, it would make the table easier to follow. By viscosity? By Specific gravity? Alphabetically by name?
- Need to include references to the footnotes included in Table C.1.

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Appendix 4 – 2008 Measuring Sector Meeting Attendees

'08 Measuring Sector Meeting Attendees

DoubleTree Club Hotel Atlanta – Atlanta, Georgia October 3 - 4

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'08 Measuring Sector Meeting Attendees

DoubleTree Club Hotel Atlanta – Atlanta, Georgia October 3 - 4

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