

Appendix C

Proposed Revisions to NCWM Publication 14, Policy C, Product Families for Meters – By Henry Oppermann and Mike Keilty Following October 2009 Sector 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.

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
Test B: To cover a range of the following products, test with one product having a low specific gravity and test with a second product having a high specific gravity. The Certificate of Conformance will cover <u>all products in all product categories listed in the table</u> within the specific gravity range tested.			Test F – To cover a range of the following products, test with one product having a specified conductivity. The Certificate of Conformance will cover all products in both of the families with conductivity equal to or above the conductivity of the tested liquid.		Test C - To cover a range of products <u>within each product category</u> , test with one product having a low viscosity and test with a second product having a high viscosity <u>within each category</u> . The Certificate of Conformance will cover <u>all products in the product category</u> within the viscosity range tested.		Test E – To cover a range of products <u>within each product category</u> , test with one product having a low kinematic viscosity and test with a second product having a high kinematic viscosity <u>within each category</u> . The Certificate of Conformance will cover <u>all products in the product category</u> within the kinematic viscosity range tested.	
Typical Products	Specific Gravity* (60 °F)	Product Category	Typical Products	Product Category	Product Category: Fuels, Lubricants, Industrial and Food Grade Liquid Oils (FL&O)		Product Category: Fuels, Lubricants, Industrial and Food Grade Liquid Oils (FL&O)	
Asphalt		FL&O	Gasoline	FL&O	Typical Products	Reference Viscosity* (60 F)	Typical Products	Reference Viscosity* (60 °F)
Asphalt		Heated	JP4	FL&O		Centipoise (cP)		Centipoise (cP)
Avgas		FL&O	Jet A-1	FL&O	Gasoline	0.28	Gasoline	0.28
Jet A		FL&O	JP7 & JP8	FL&O	JP4	1.02	JP4	1.02
Jet B		FL&O	Kerosene	FL&O	Jet A-1	1.36	Jet A-1	1.36
Spindle Oil		FL&O	JP5	FL&O	JP7 & JP8	1.82	JP7 & JP8	1.82
Adjuvants	0.7 to 1.2	CC	Corn Oil	FL&O	Kerosene	1.94	Kerosene	1.94

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
Banvel	0.7 to 1.2	CC	Cooking Oils	FL&O	JP5	1.94	JP5	1.94
Fumigants	0.7 to 1.2	CC	Diesel Fuel	FL&O	Corn Oil	4	Corn Oil	4
Fungicides	0.7 to 1.2	CC	Biodiesel above B20	FL&O	Cooking Oils	9.93	Cooking Oils	9.93
Herbicides	0.7 to 1.2	CC	Light Oil	FL&O	Diesel Fuel	10	Diesel Fuel	10
Insecticides	0.7 to 1.2	CC	Sunflower Oil	FL&O	Biodiesel above B20	10.12	Biodiesel above B20	10.12
Paraquat	0.7 to 1.2	CC	Soy Oil	FL&O	Light Oil	13.47	Light Oil	13.47
Prowl	0.7 to 1.2	CC	Olive Oil	FL&O	Sunflower Oil	90.1	Sunflower Oil	90.1
Round-up	0.7 to 1.2	CC	Vegetable Oil	FL&O	Soy Oil	90.6	Soy Oil	90.6
Touchdown	0.7 to 1.2	CC	Bunker Oil	FL&O	Olive Oil	116.8	Olive Oil	116.8
Treflan	0.7 to 1.2	CC	Avgas	FL&O	Vegetable Oil	133	Vegetable Oil	133
Ammonia Nitrate	1.16 to 1.37	Fert	Jet A	FL&O	Bunker Oil	11,200	Bunker Oil	11,200
Crude Oil	0.79 to 0.97	FL&O	Jet B	FL&O	Avgas	1.5 to 6	Avgas	1.5 to 6
Lubricating Oils	0.80 to 0.90	FL&O	Asphalt	FL&O	Jet A	1.5 to 6	Jet A	1.5 to 6
Peanut Oil	0.9 to 1.0	FL&O	Peanut Oil	FL&O	Jet B	1.5 to 6	Jet B	1.5 to 6
Hexane	0.66	Sol Gen	SAE Grades	FL&O	Asphalt	100 to 5000	Asphalt	100 to 5000
Diesel Fuel	0.72	FL&O	Lubricating Oils	FL&O	Peanut Oil	11 to 110	Peanut Oil	11 to 110
Gasoline	0.72	FL&O	Crude Oil	FL&O	SAE Grades	192 to 3626	SAE Grades	192 to 3626
Kerosene	0.75	FL&O	6 Oil (#5, #6)	FL&O	Lubricating Oils	20 to 1000	Lubricating Oils	20 to 1000
Jet A-1	0.76	FL&O	Fuel Oil (#1, #2, #3, #4)	FL&O	Crude Oil	3 to 1783	Crude Oil	3 to 1783
JP4	0.76	FL&O	Spindle Oil	FL&O	6 Oil (#5, #6)	66 to 13,000	6 Oil (#5, #6)	66 to 13,000
JP5	0.76	FL&O	Acetone	Sol Gen	Fuel Oil (#1, #2, #3, #4)	8 to 88	Fuel Oil (#1, #2, #3, #4)	8 to 88
JP7 JP8	0.76	FL&O	Hexane	Sol Gen	Spindle Oil		Spindle Oil	
Ethanol	0.79	Alc Gly	Acetates	Sol Gen	Product Category: Solvents General (Sol Gen)		Product Category: Solvents General (Sol Gen)	
Isopropyl	0.79	Alc Gly	MEK	Sol Gen	Typical Products	Reference Viscosity* (60 °F)	Typical Products	Reference Viscosity* (60 °F)
Acetone	0.8	Sol Gen	Toluene	Sol Gen		Centipoise (cP)		Centipoise (cP)
Methanol	0.80	Alc Gly	Xylene	Sol Gen	Acetone	0.34	Acetone	0.34

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements		
Butanol	0.81	Alc Gly	Ethylacetate	Sol Gen	Hexane	0.34	Hexane	0.34	
Isobutyl	0.81	Alc Gly	Methylene-Chloride	Sol Chl	Acetates	0.44	Acetates	0.44	
MEK	0.81	Sol Gen	Trichloro-Ethylene	Sol Chl	MEK	0.45	MEK	0.45	
Biodiesel above B20	0.86	FL&O	Carbon Tetra-Chloride	Sol Chl	Toluene	0.62	Toluene	0.62	
Light Oil	0.86	FL&O	Perchloro-Ethylene	Sol Chl	Xylene	0.86	Xylene	0.86	
Toluene	0.87	Sol Gen	Methanol	Alc Gly	Ethylacetate	1.36	Ethylacetate	1.36	
20 % Aqua-Ammonia	0.89	Fert	Ethanol	Alc Gly	Product Category: Solvents Chlorinated (Sol Chl)		Product Category: Alcohols, Glycols & Water Mixes Thereof (Alc Gly)		
Xylene	0.89	Sol Gen	Isopropyl	Alc Gly	Typical Products	Reference Viscosity* (60 F) Centipoise (cP)	Typical Products	Reference Viscosity* (60 F) Centipoise (cP)	
6 Oil (#5, #6)	0.9	FL&O	Butanol	Alc Gly					
Fuel Oil (#1, #2, #3, #4)	0.9	FL&O	Isobutyl	Alc Gly	Methylene-Chloride	0.46	Methanol	0.64	
SAE Grades	0.9	FL&O	Ethylene glycol	Alc Gly	Trichloro-Ethylene	0.6	Ethanol	1.29	
Corn Oil	0.91	FL&O	Propylene glycol	Alc Gly	Carbon Tetra-Chloride	0.99	Isopropyl	2.78	
Cooking Oils	0.92	FL&O	Demineralized	Water	Perchloro-Ethylene	1	Butanol	3.34	
Olive Oil	0.92	FL&O	Deionized	Water	Product Category: Alcohols, Glycols & Water Mixes Thereof (Alc Gly)		Isobutyl	4.54	
Vegetable Oil	0.92	FL&O	Asphalt	Heated	Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)	Ethylene glycol	25.5	
Acetates	0.93	Sol Gen	Bunker C	Heated			Propylene glycol	54	
Soy Oil	0.93	FL&O	Test D – To obtain coverage for a product category: Test with one product in the product category. The Certificate of Conformance will cover all products in the category.		Methanol	0.64	Compressed liquids: Fuels and Refrigerants, NH ₃		
								Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)
Sunflower Oil	0.93	FL&O				Ethanol	1.29	Propane	0.098
							Anhydrous Ammonia	0.188	

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
Ethylacetate	0.96	Sol Gen			Isopropyl	2.78	Butane	0.19
Bunker Oil	0.99	FL&O			Butanol	3.34	Freon 11	0.313
Beverages	1.0	Water	Tap water	Water	Isobutyl	4.54	Freon 12	0.359
Deionized	1.0	Water	Potable	Water	Ethylene glycol	25.5	Freon 22	1.99
Demineralized	1.0	Water	Nonpotable	Water	Propylene glycol	54	Ethane	
Juices	1.0	Water	Juices	Water	Product Category: Clear Liquid Fertilizers (Liq Fert)		Test A – The following products must be individually tested and noted on the Certificate of Conformance.	
Milk	1.0	Water	Beverages	Water	Typical Products	Reference Viscosity* (60 °F)		
Nonpotable	1.0	Water	Water mixes of alcohols & glycols	Alc Gly		Centipoise (cP)	Typical Products	Product Category
Potable	1.0	Water	Urea	Fert	Urea	1	Methylene-Chloride	Sol Chl
Tap Water	1.0	Water	Ammonia Nitrate	Fert	Ammonia Nitrate	11.22	Trichloro-Ethylene	Sol Chl
Propylene glycol	1.04	Alc Gly	10-34-0	Fert	10-34-0	48	Carbon Tetra-Chloride	Sol Chl
Hydrochloric Acid	1.1	Chem	20 % Aqua-Ammonia	Fert	20 % Aqua-Ammonia	1.1 to 1.3	Perchloro-Ethylene	Sol Chl
Ethylene glycol	1.19	Alc Gly	Chlear Liquid Fert	Fert	Chlear Liquid Fert	31 to 110	Urea	Liq Fert
Liquid Molasses	1.25	Liq Feed	Nitrogen Solution	Fert	Nitrogen Solution	31 to 110	Ammonia Nitrate	Liq Fert
9-18-9	1.32	Fert	28 %, 30 % or 32 %	Fert	28 %, 30 % or 32 %	31 to 110	10-34-0	Liq Fert
Methylene-Chloride	1.34	Sol Chl	N-P-K solutions	Fert	N-P-K solutions		20% Aqua-Ammonia	Liq Fert
10-34-0	1.39	Fert	9-18-0	Fert	9-18-0		Chlear Liquid Fert	Liq Fert
Trichloro-Ethylene	1.47	Sol Chl	4-4-27	Sus Fert	Product Category: Suspension Fertilizers (Sus Fert)		Nitrogen Solution	Liq Fert
Carbon Tetra-Chloride	1.6	Sol Chl	3-10-30	Sus Fert	Typical Products	Reference Viscosity* (60 °F)	28 %, 30 % or 32 %	Liq Fert
Perchloro-Ethylene	1.6	Sol Chl	Molasses plus Phos Acid and/or Urea (TreaChle)	Liq Feed		Centipoise (cP)	N-P-K solutions	Liq Fert

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
Sulfuric Acid	1.83	Chem	Liquid Molasses	Liq Feed	4-4-27	20 to 215	9-18-0	Liq Fert
Phosphoric Acid	1.87	Chem	Sulfuric Acid	Chem	3-10-30	100 to 1000	4-4-27	Sus Fert
Urea	1.89	Fert	Phosphoric Acid	Chem	Product Category: Liquid Feeds (Liq Feed)		3-10-30	Sus Fert
Bunker C	1.99	Heated	Hydrochloric Acid	Chem	Typical Products	Reference Viscosity* (60 °F)	Molasses plus Phos Acid and/or Urea (TreaChle)	Liq Feed
Fungicides	1 to 1.2	CC	Herbicides	CC-A		Centipoise (cP)	Liquid Molasses	Liq Feed
Micronutrients	1 to 1.2	CC	Round-up	CC-A	Molasses plus Phos Acid and/or Urea (TreaChle)	2882	Asphalt	Heated
Molasses plus Phos Acid and/or Urea (TreaChle)	1.1 to 1.3	Liq Feed	Touchdown	CC-A	Liquid Molasses	8640	Bunker C	Heated
3-10-30	0.9 to 1.65	Liq Fert	Banvel	CC-A	Product Category: Heated Products (Heated)		Sulfuric Acid	Chem
4-4-27	0.9 to 1.65	Liq Fert	Treflan	CC-A	Typical Products	Reference Viscosity* (60 °F)	Phosphoric Acid	Chem
Micronutrients	0.9 to 1.65	Liq Fert	Paraquat	CC-A		Centipoise (cP)	Hydrochloric Acid	Chem
28%, 30% or 32%	1.28 to 1.32	Fert	Prowl	CC-A	Asphalt	100 to 5000	Herbicides	CC-A
N-P-K solutions	1.2 – 1.4	Fert	Herbicides	CC-A	Bunker C	11,200	Round-up	CC-A
Chlear Liquid Fert	1.17 to 1.44	Fert	Fungicides	CC-B	Product Category: Chemicals (Chem)		Touchdown	CC-A
Nitrogen Solution	1.17 to 1.44	Fert	Insecticides	CC-B	Typical Products	Reference Viscosity* (60 °F)	Treflan	CC-A
Test D – To obtain coverage for each of the following product categories, test with one product in each product category. The Certificate of Conformance will cover all of the products in the product category in which a product was tested.			Adjuvants	CC-B			Banvel	CC-A
			Fumigants	CC-B	Sulfuric Acid	1.49	Paraquat	CC-A
			Fungicides	CC-C	Phosphoric Acid	161	Prowl	CC-A

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
Product Category	Typical Products	Specific Gravity* (60 F)	Micronutrients	CC-D	Hydrochloric Acid	0.80 to 1.0	Herbicides	CC-A
Comp gas	Compressed Natural Gas (CNG)	0.6 to 0.8 (1=Air)			Product Category: Crop Chemicals (Type A) (CC-A)		Fungicides	CC-B
					Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)	Insecticides	CC-B
Comp liq	Anhydrous Ammonia	0.61					Adjuvants	CC-B
Comp liq	Butane	0.595			Herbicides	4 to 400	Fumigants	CC-B
Comp liq	Ethane				Round-up	4 to 400	Fungicides	CC-C
Comp liq	Freon 11	1.49			Touchdown	4 to 400	Micronutrients	CC-D
Comp liq	Freon 12	1.33			Banvel	4 to 400	Dual	Flow
Comp liq	Freon 22	1.37			Treflan	4 to 400	Bicep	Flow
					Paraquat	4 to 400	Marksman	Flow
Comp liq	Propane	0.504			Prowl	4 to 400	Broadstrike	Flow
					Product Category: Crop Chemicals (Type B) (CC-B)		Doubleplay	Flow
Cryo LNG	Liquefied Natural Gas				Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)	Topnotch	Flow
Cryo LNG	Liquefied Oxygen	0.66					Guardzman	Flow
Cryo LNG	Nitrogen	0.31			Fungicides	0.7 to 100	Harness	Flow
					Insecticides	0.7 to 100	NH ₃	
					Adjuvants	0.7 to 100	Test D – To obtain coverage for a product category: Test with one product in the product category. The Certificate of Conformance will cover all products in the category.	
					Fumigants	0.7 to 100		
					Product Category: Crop Chemicals (Type C) (CC-C)			
					Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)	Tap Water	Water
							Deionized	Water
					Fungicides	20 to 900	Demineralized	Water

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
					Product Category: Crop Chemicals (Type D) (CC-D)		Potable	Water
					Typical Products	Reference Viscosity* (60 °F)	Nonpotable	Water
						Centipoise (cP)	Juices	Water
					Micronutrients	20 to 1000	Beverages	Water
					Product Category: Flowables (Flow)		Milk	Water
					Typical Products	Reference Viscosity* (60 °F)	Liquefied Oxygen	Cryo LNG
						Centipoise (cP)	Nitrogen	Cryo LNG
					Dual	20 to 900	Liquefied Natural Gas	Cryo LNG
					Bicep	20 to 900		
					Marksman	20 to 900		
					Broadstrike	20 to 900		
					Doubleplay	20 to 900		
					Topnotch	20 to 900		
					Guardman	20 to 900		
					Harness	20 to 900		
					Product Category: Compressed Liquids: Fuels and Refrigerants (Comp liq)			
					Typical Products	Reference Viscosity* (60 °F)		
						Centipoise (cP)		
					Propane	0.098		
					Anhydrous Ammonia	0.188		
					Butane	0.19		
					Freon 11	0.313		
					Freon 12	0.359		
					Freon 22	1.99		
					Ethane			

Mass Meter Product Category & Test Requirements			Magnetic Flow Meter Product Category & Test Requirements		Positive Displacement Flow Meter Product Category & Test Requirements		Turbine Flow Meter Product Category & Test Requirements	
					Test D – To obtain coverage for a product category: Test with one product in the product category. The Certificate of Conformance will cover all products in the category.			
					Product Category: All Water (Water)			
					Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)		
					Tap Water	1.0		
					Deionized	1.0		
					Demineralized	1.0		
					Potable	1.0		
					Nonpotable	1.0		
					Juices	1.0		
					Beverages	1.0		
					Milk	1.0		
					Test A – The following products must be individually tested and noted on the Certificate of Conformance.			
					Product Category: Cryogenic Liquids and Liquefied Natural Gas (Cryo LNG)			
					Typical Products	Reference Viscosity* (60 °F) Centipoise (cP)		
					Liquefied Oxygen	0.038		
					Nitrogen	1.07		
					Liquefied Natural Gas			

Product Family Table – Category Abbreviations	
Abbreviation	Product Categories
FL&O	Fuels, Lubricants, Industrial and Food Grade Liquid Oils
Solv Gen	Solvents General
Solv Cl	Solvents Chlorinated
Alc Gly	Alcohols, Glycols & Water Mixes thereof
Water	Water
Fert	Fertilizers
CC-A	Crop Chemicals (<i>Type A</i>)
CC-B	Crop Chemicals (<i>Type B</i>)
CC-C	Crop Chemicals (<i>Type C</i>)
CC-D	Crop Chemicals (<i>Type D</i>)
Flow	Flowables
Sus Fert	Suspension Fertilizers
Liq Feed	Liquid Feeds
Chem	Chemicals
Heated	<u>Heated Products</u>
Comp liq	<u>Compressed Liquids: Fuels and Refrigerants NH₃</u>
Comp gas	<u>Compressed Gases</u>
Cryo LNG	<u>Cryogenic Liquids and Liquefied Natural Gas</u>

¹Note: 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.

²The 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/m³ (or 998 kg/m³)

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.

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.”

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