OilDoc Conference & Exhibition

Lubricants
Maintenance
Tribology

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Is NIST SRM2806b Responsible for the Sudden Increase in Particle Counts you have Seen on your Oil Analysis Reports?

Alistair Geach, CLS, OMA I, MLA/MLT I, LLA I
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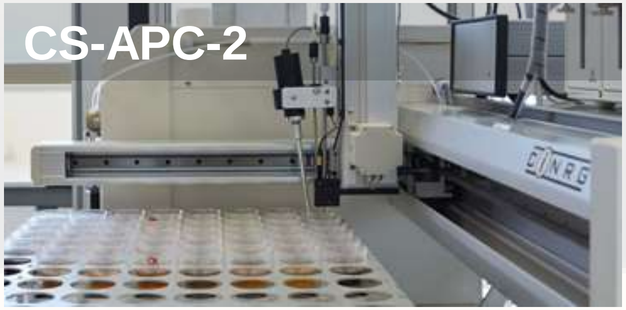
CINRG Systems Inc., Burlington, ON, CANADA

Don't just automate, innovate.

CINRG Systems Inc. offers a range of flexible laboratory solutions. Our latest product offerings are a fully automated auto-diluting particle counter and a robotic Houillon viscometer automation system that was developed in partnership with WearCheck International.



The Authors

Alistair Geach, Operations Manager

Alistair has been in the oil analysis industry for 20 years, formerly with SetPoint Technologies in Africa. Alistair's unique skills in chemistry, physics and engineering have helped him in his career of laboratory automation and instrument development.
STLE CLS, OMA I Certified
ILMA MLA I, MLT I, LLA 1 Certified

Bill Quesnel, President

Bill Quesnel has been in the oil analysis industry for 24 years. Bill is president and former laboratory manager for WearCheck in Toronto, Ontario and graduated from the University of Waterloo in pre-med with minors in Biology, Chemistry and Computer Science.
STLE CLS, OMA I, OMA II Certified
ILMA MLA I/II/III, MLT I/II, LLA 1 Certified

What is our Goal?

NIST2806b **Particle Count Increase**

Conforms to ASTM D7647
“Automatic Particle Counting using Dilution Method”

Calibrated to ISO 11171:2016

Produces results for Fluid Cleanliness based on ISO 4406:1999
“3-Tier ISO Cleanliness Code (i.e. 19/17/14)”

CS-APC-2 Automated Auto-Diluting Particle Counter

Repeatable & Reproducible ISO Cleanliness Codes

Consistent results regardless of technician or laboratory location

What is our Goal?

Educate the Oil Analysis Community

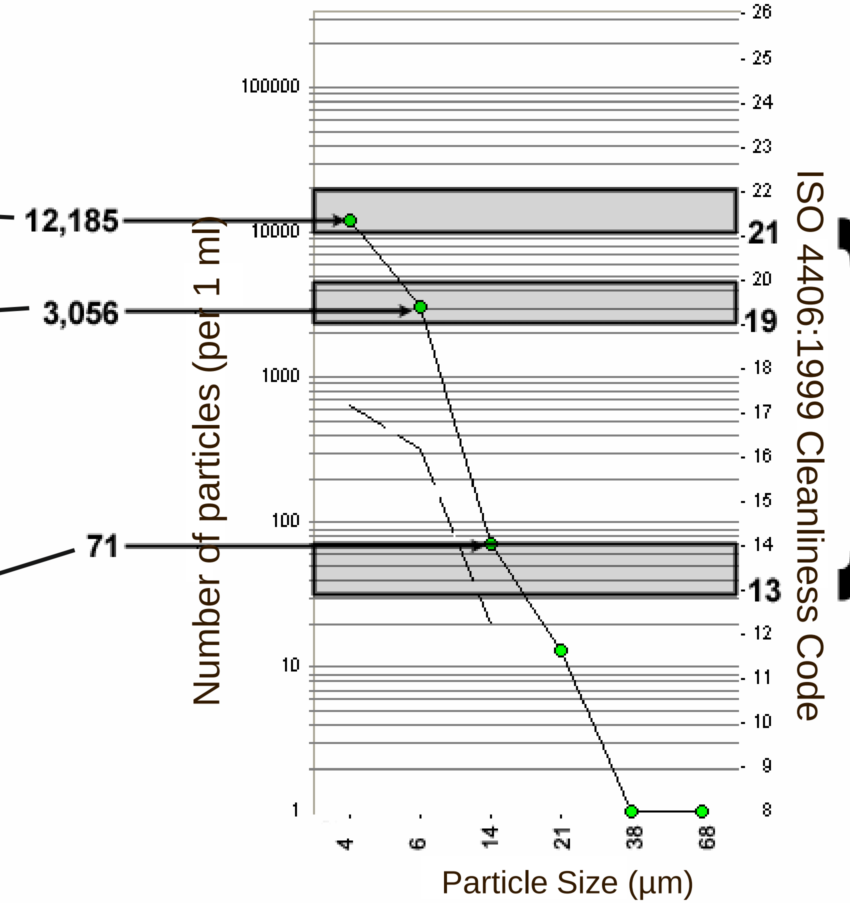
Changes to Calibration Fluids for ISO 11171 and the impact on ISO 4406

How is Oil Cleanliness Measured?

The ISO Cleanliness Code is an industry accepted method of evaluating the cleanliness of a lubricated component. When the ISO Code indicates an increase by more than one ISO code steps need to be taken to investigate the cause.

ISO 4406 Cleanliness Code

ISO Code	More than	Up to
25	160,000	320,000
24	80,000	160,000
23	40,000	80,000
22	20,000	40,000
21	10,000	20,000
20	5,000	10,000
19	2,500	5,000
18	1,300	2,500
17	640	1,300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	4	10
9	2.5	4
8	1.25	2.5



21/19/13

ISO 4406:1999 report as Number of particles (Np) >4µm(c) over the Np >6µm(c) over the Np >14µm(c)

19/13

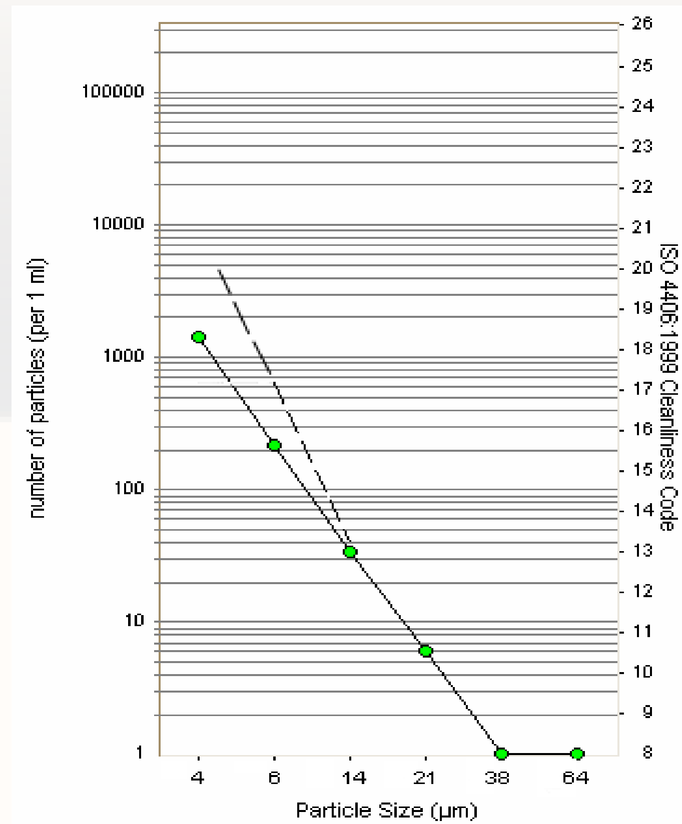
ISO 4406:1987 report as Number of particles (Np) >5µm over the Np >15µm

Ref: WearCheck

Particle Count (PC) ISO 4406:1999 (ISO 11171)

Particle count measurements are taken on typically 10 mL of oil with the results averaged to 1 mL. Prior to counting, the particles in the oil sample must be homogenized which can be accomplished in a combination of ways including shaking, sonication, de-gassing, etc. Most important is that sample preparation be carried out consistently. Once prepared the sample is loaded into a syringe and the contents of the oil are driven through the laser sensor at a controlled flow rate. The sensor "counts" the number of particles at the different size ranges for the duration of the test.

- Verify effectiveness of filtration
- Detect process contamination



Example

Breather filters and improved oil filtration have brought the cleanliness of this system down from 20/18/16 to 18/15/13 *(sample is from a large hydraulic reservoir using Esso Nuto H 68).*

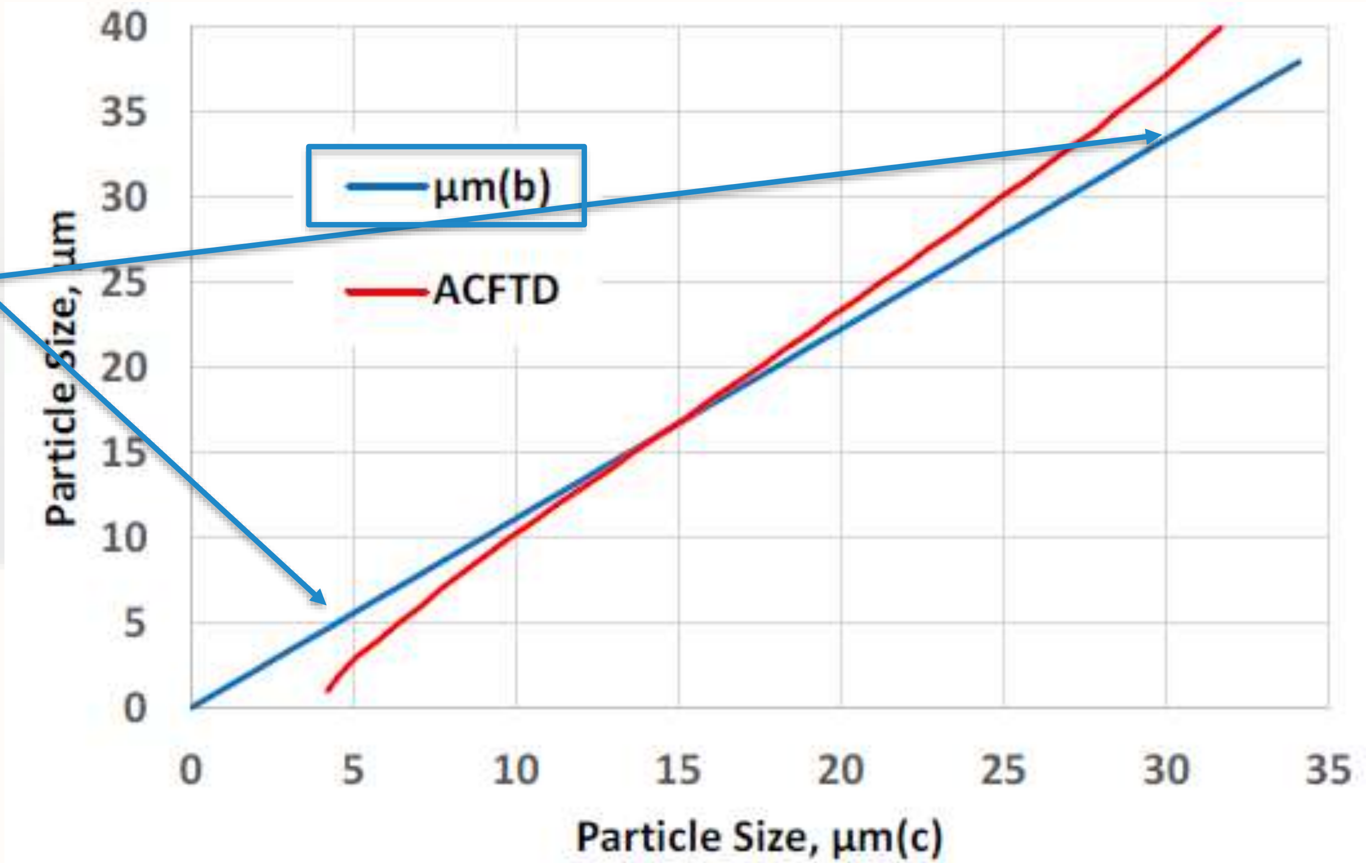
Test	Target	Current	3 months ago	6 months ago
>4µm	5,000	1,865	3,465	8,432
>6µm	1,300	254	868	2217
>14µm	160	46	187	402
ISO 4406	19/17/14	18/15/13	19/17/15	20/18/16

APC
Calibration Fluid History

Material	ISO Standard	Certificate Date	Reason for Revision	Expiration Date
ACFTD	4402:1991	1960 – 1999	AC Fine Test Dust (ACFTD) no longer commercially available	
ISO MTD SRM2806-0	11171:1999	10-Dec-97	ISO Medium Test Dust (MTD) - NIST Traceable Standard - Original Certificate	
ISO MTD SRM2806-1	11171:1999	1-Mar-99	Revised uncertainties and change of >30µm values to information values	
ISO MTD SRM2806-2	11171:1999	9-Aug-00	Revision of expiration date.	
ISO MTD SRM2806-3	11171:1999	16-Nov-04	Decrease in expiration date due to instability.	17-Sep-04
ISO MTD SRM2806a-0	11171:1999	13-Oct-04	Original Certificate	
ISO MTD SRM2806a-1	11171:1999	29-Jan-07	Update of expiration date and editorial changes.	
ISO MTD SRM2806a-2	11171:1999	16-Dec-08	Extension of certification period.	
ISO MTD SRM2806a-3	11171:2010	30-May-13	Extension of certification period; editorial changes.	31-Dec-14
ISO MTD SRM2806b-0	11171:2016	12-Jun-14	Original Certificate	31-Dec-20

1998 - Effect of ISO MTD replacing ACFTD

- Counts < 10µm increased
- Counts > 10µm decreased



Ref: Barry Verdegan, Cummins Filtration

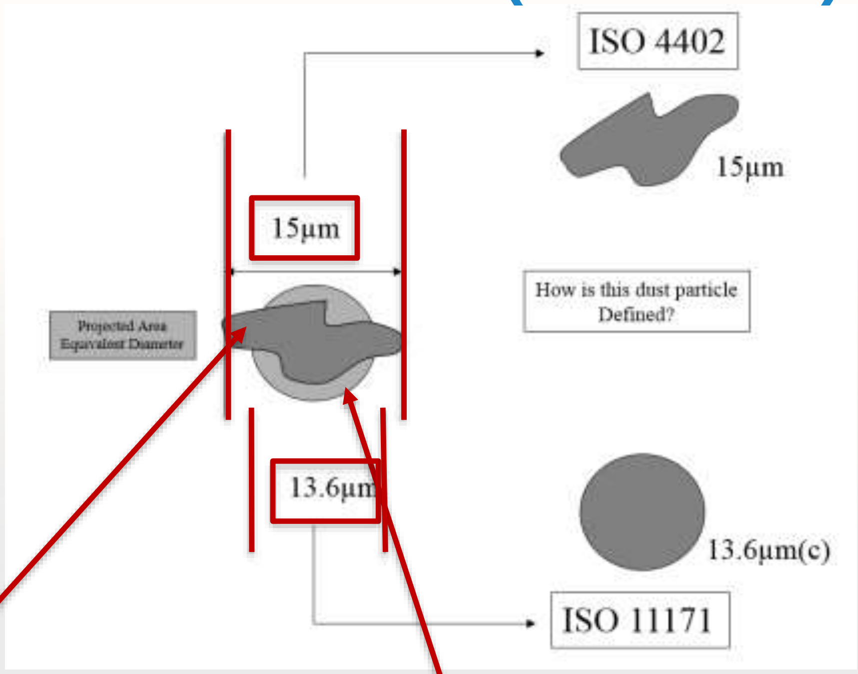
NIST2806b **Particle Count Increase**

ISO 4406:1987 (ISO 4402) ⟶ ISO 4406:1999 (ISO 11171)

ACFTD (Air Cleaner Fine Test Dust)

Replaced By

ISO MTD (Medium Test Dust)



Original Sizes		Replaced By
2µm	→	4µm(c)
5µm	→	6µm(c)
15µm	→	14µm(c)

APC
Calibration Fluid History

Material	ISO Standard	Certificate Date	Reason for Revision	Expiration Date
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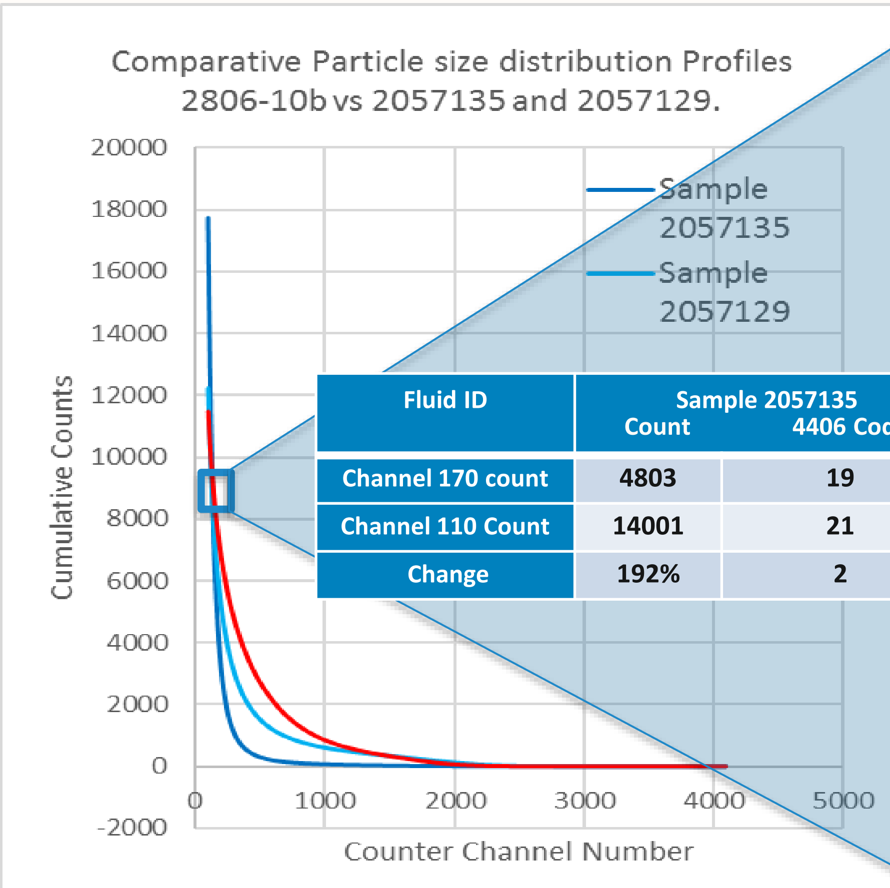
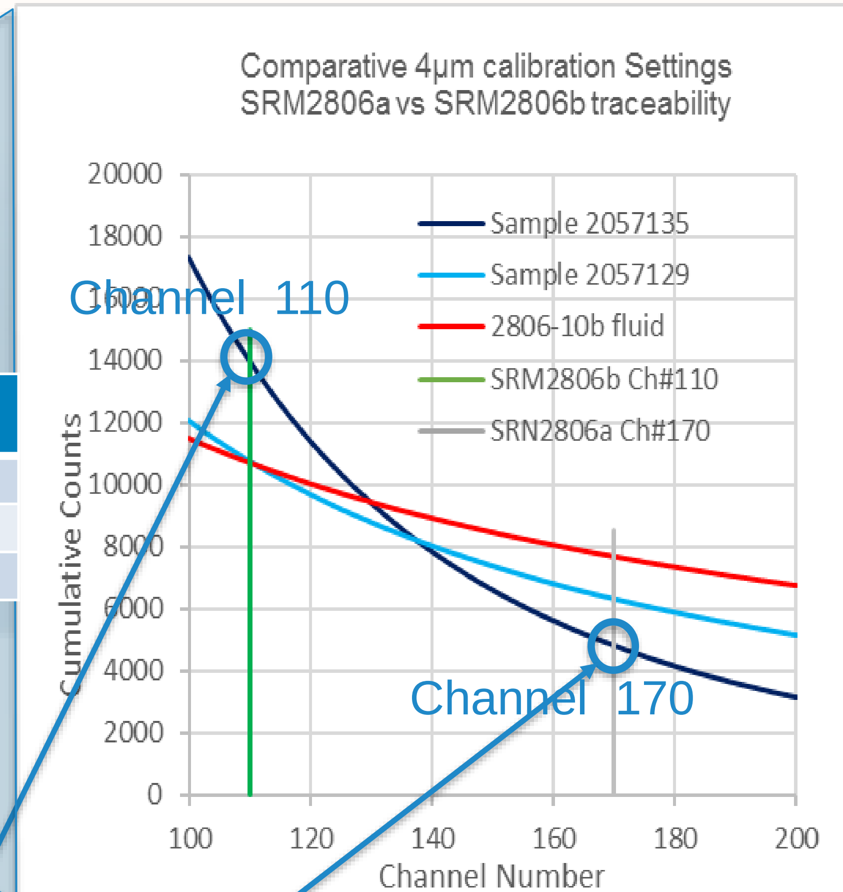
How will smaller particles be affected (4, 6, 14, 21µm)?



Fluid ID	Sample 2057135 Count	4406 Code
Channel 170 count	4803	19
Channel 110 Count	14001	21
Change	192%	2



4µm = 14,001 vs. 4,803

Estimate of Certification "Error"

Relative contribution of increased test dust concentration and certification "error" to the increase in counts.

Particle Size	SRM2806a (3.3mg/l) Certified Counts	SRM2806b (3.5mg/l) Certified Counts	Overall Count Increase	Expected Counts 3.3mg/l x 1.062	Unexpected Increase	Change from "Certification Error"
>4µm	7300.5	10864	49%	7753.1	3110.9	**40%**
>6µm	2907.9	4210	45%	3088.2	1121.8	**36%**
>14µm	209.8	389.3	86%	222.8	166.5	**75%**

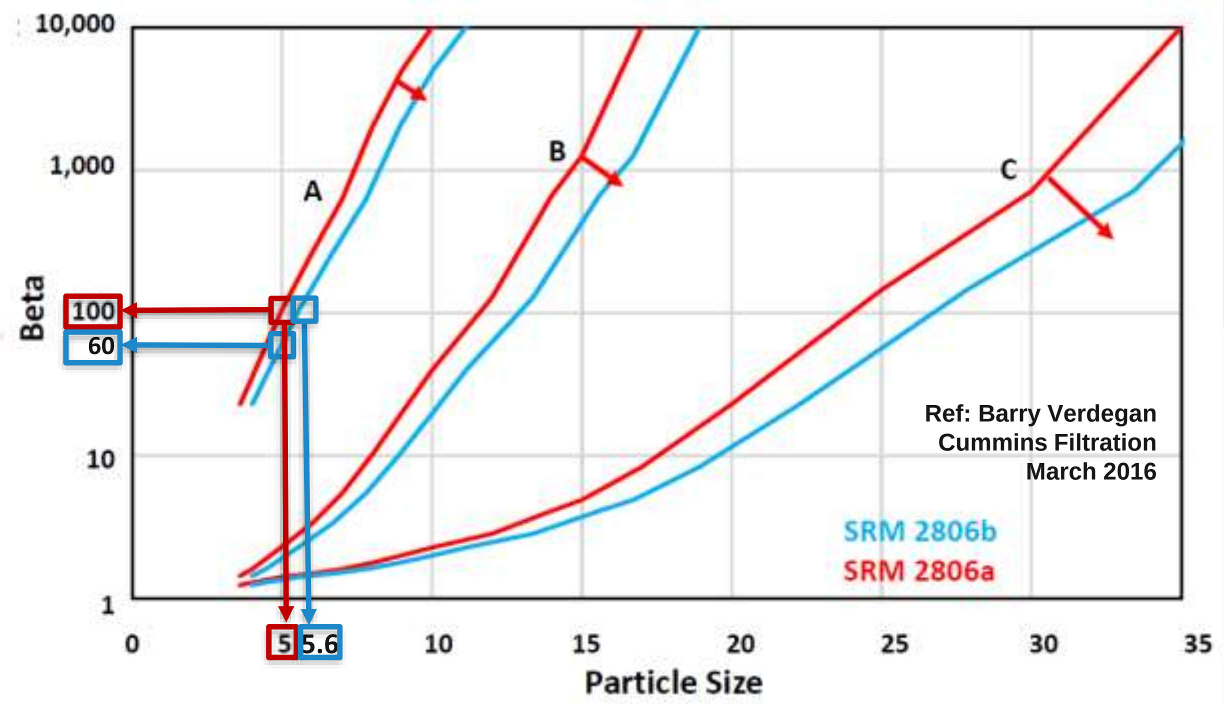
>4µm = 7300 + 6.2% = 7753(from 10864) = 3110 / 7753 = 40%

NOTE: The "error" is with SRM2806a <u>not with</u> SRM2806b

Affect of new SRM2806b on Filter Beta Ratios

ISO Codes for Various Dust Size Distributions as Determined by Indicated SRM						
	ISO MTD		ISO UFTD		Multipass Downstream	
Size, μm(c)	2806a	2806b	2806a	2806b	2806a	2806b
4	18	19	20	21	12	14
6	17	18	19	20	9	10
14	13	14	11	13	3	4

- SRM2806b will cause a decrease in beta ratios (poorer performance) or an increase in the beta micron size.



Comparative Counts for

Sensor Calibrations traceable to SRM2806a and SRM2806b

Sample Number	2806 Cal	Count >4µm	Count >6µm	Count >14µm	Cleanliness Code	Component Sampled
2057337	a	447	156	15	16/14/11	Hydraulic System
	b	702	226	25	17/15/12	
2057341	a	321	121	12	16/14/11	Hydraulic System
	b	496	170	20	16/15/12	
2057382	a	384	114	12	16/14/11	Wind Turbine Gearbox
	b	698	171	18	17/15/11	
2057613	a	618	179	19	16/15/11	Gas Turbine
	b	1085	277	32	17/15/12	
2057380	a	355	86	10	16/14/10	Wind Turbine Gearbox
	b	728	137	15	17/14/11	
2057353	a	312	138	12	16/14/11	Excavator Hydraulics
	b	1250	230	20	17/15/11	
2057333	a	648	162	14	17/15/11	Hydraulic System
	b	1186	262	24	17/15/12	
2057384	a	686	187	16	17/15/11	Wind Turbine Gearbox
	b	1252	294	27	17/15/12	
2057437	a	1198	166	8	17/15/10	Hydraulic System
	b	3606	325	13	19/16/11	
2057390	a	1256	218	9	17/15/10	Wind Turbine Gearbox
	b	2475	419	15	18/16/11	
2057335	a	1548	456	53	18/16/13	Hydraulic System
	b	2752	687	79	19/17/13	
2057135	a	4803	375	14	19/16/11	Steam Turbine Bearing
	b	14001	874	26	21/17/12	
2057129	a	6336	1726	261	20/18/15	Hydraulic System
	b	10783	2734	357	21/19/16	
2057440	a	14104	1255	46	21/17/13	Excavator Hydraulics
	b	32024	3018	74	22/19/13	

Increase
0-25%
>25%
>50%
>100%

Increase
0 ISO
1 ISO 1
1 ISO 2
2 ISO

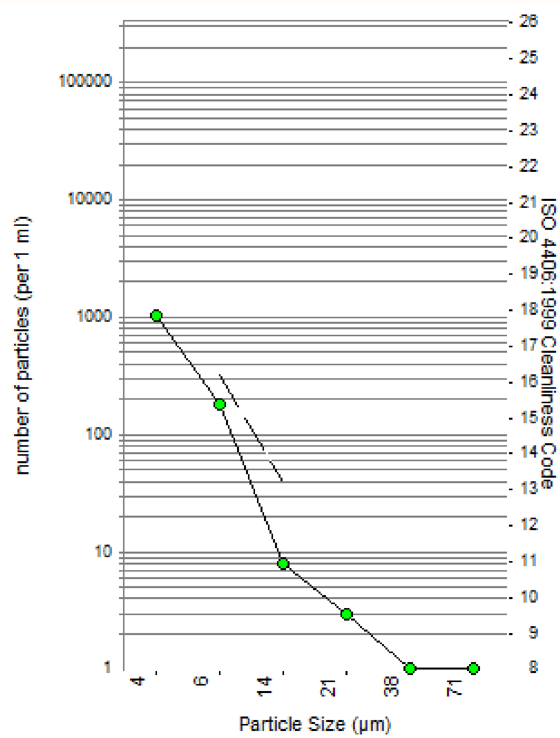
Ref: WearCheck Canada Inc.

NIST2806b **Particle Count Increase**

What is the issue?

- Same Oil Sample
- Results are different because they are based on two different ISO Particle Count calibrations
- SRM2806a vs. SRM2806b

ISO 4406:1999 17/15/10



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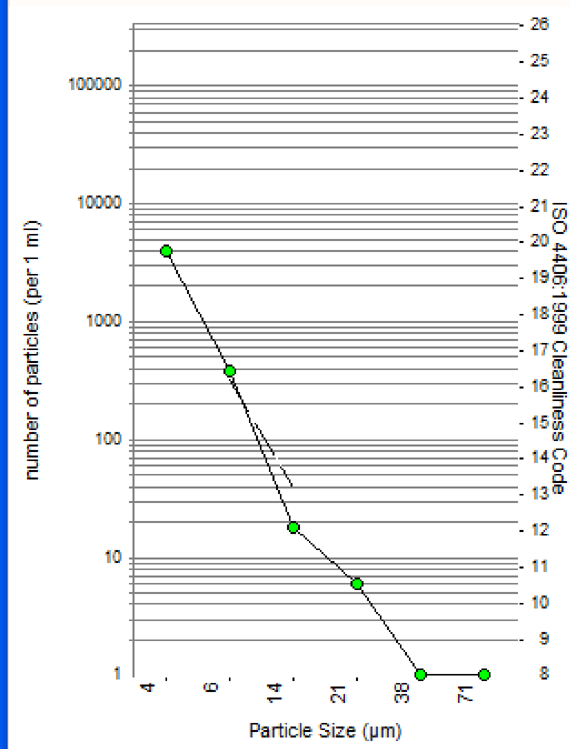
ISO 4406:1999 19/16/11



2 x tech x 3 hrs
+ Oil Filter

$700.00 x 133

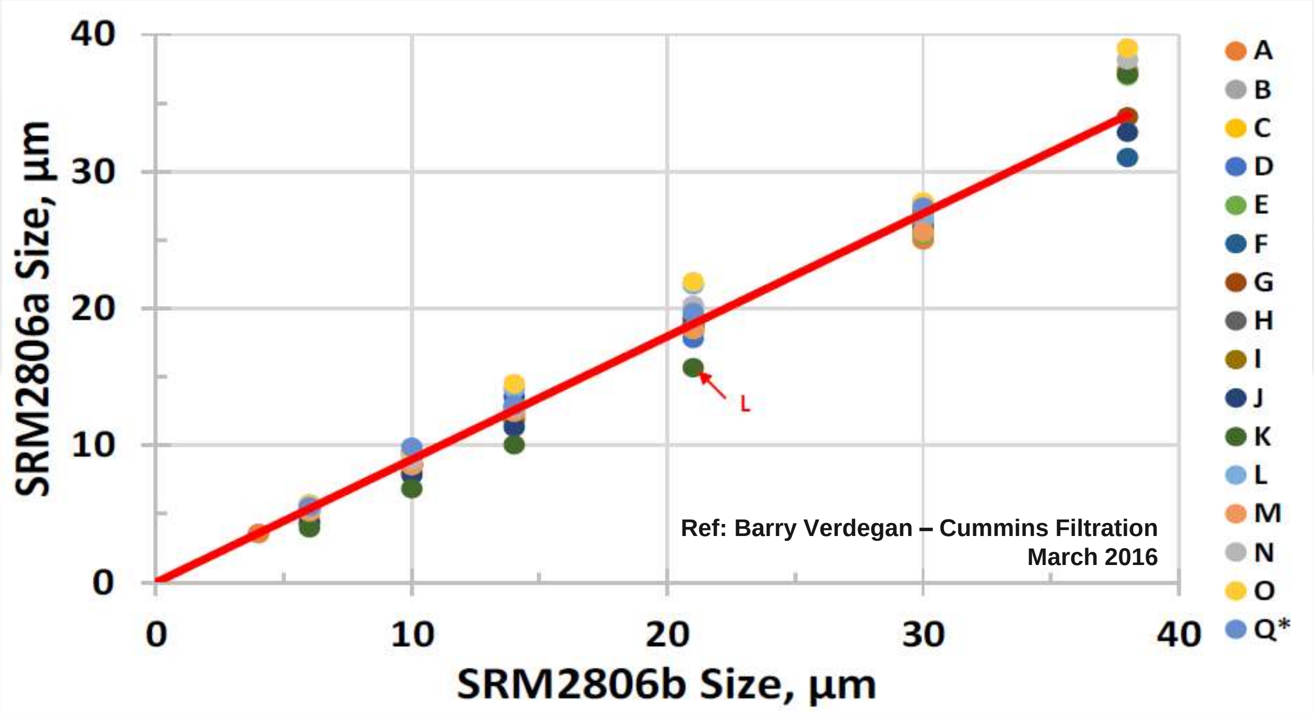
= $93,100.00

Ref: G. Tapp – GE Wind

Calibration (b) to (c) Conversion Factor

Lab	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Mean	s
m	0.886	0.875	0.927	0.844	0.891	0.882	0.904	0.873	0.895	0.880	0.880	0.938	0.859	0.948	0.987	---	0.924	**0.898**	**0.037**
R^2	0.978	0.999	0.994	0.998	0.985	0.985	0.996	0.997	0.997	0.997	0.973	0.980	0.998	0.995	0.990	---	0.994	**1.0**	**0.01**

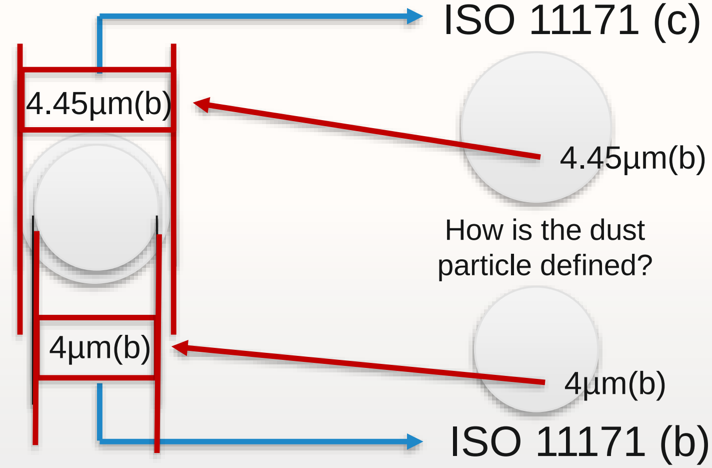
- Round-robin with 15 labs in 4 countries (secondary samples from 7 sources)
- Linear relationship from 0-38µm
- Beyond 38µm can use latex spheres for calibration.



What is the solution?

$$d_c = 0.898 d_b$$

Projected Area Equivalent Diameter



- Draft revision to ISO1171
- *Ability to report to SRM2806a: 4µm(c), 6µm(c), 14µm(c) using 4.45µm(b), 6.68µm(b), 15.6µm(b)
- Ability to report to SRM2806b: 4µm(b), 6µm(b), 14µm(b)

***Size Equivalence**

Micron(c)	Micron(b)
4µm(c)	4.45 µm(b)
6µm(c)	6.68 µm(b)
14µm(c)	15.6 µm(b)

NOTE: Relationship determined using round robin results from 15 laboratories using secondary samples from 7 different sources in 4 countries.
- FDIS ballot of 11171 will be out soon.
- ISO TC131/SC6 will meet to vote in next few months.

Calculating SRM2806c Values from SRM2806b Table

Certificate Values (b)

Particles >µm(b)	SRM 2806b Counts/ml
2	33064
3	17714
4	10864
5	6681.2
6	4210.2
7	2852.3

Multiply by conversion factor as per FDIS 11171:2016

x 0.898 =
x 0.898 =
x 0.898 =
x 0.898 =
x 0.898 =
x 0.898 =

Calculated Sizes (c)

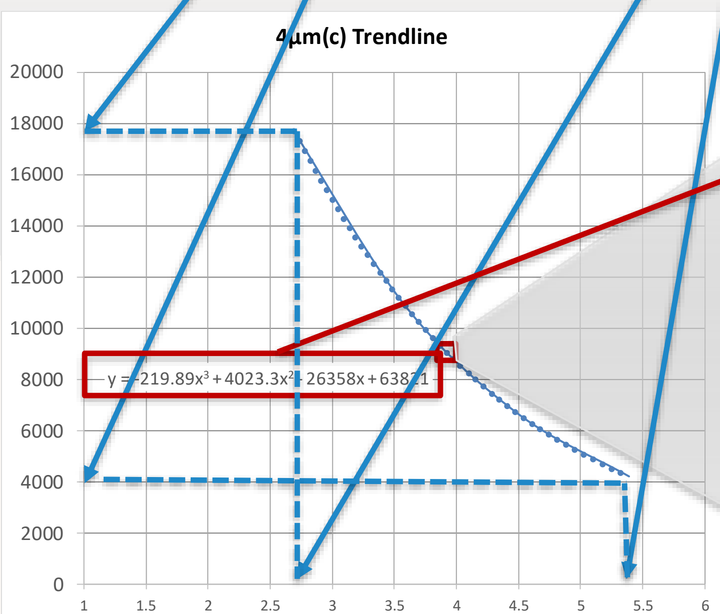
Theoretical >µm(c)	SRM 2806b Counts/ml
1.796	33064
2.694	17714
3.592	10864
4.490	6681.2
5.388	4210.2
6.286	2852.3

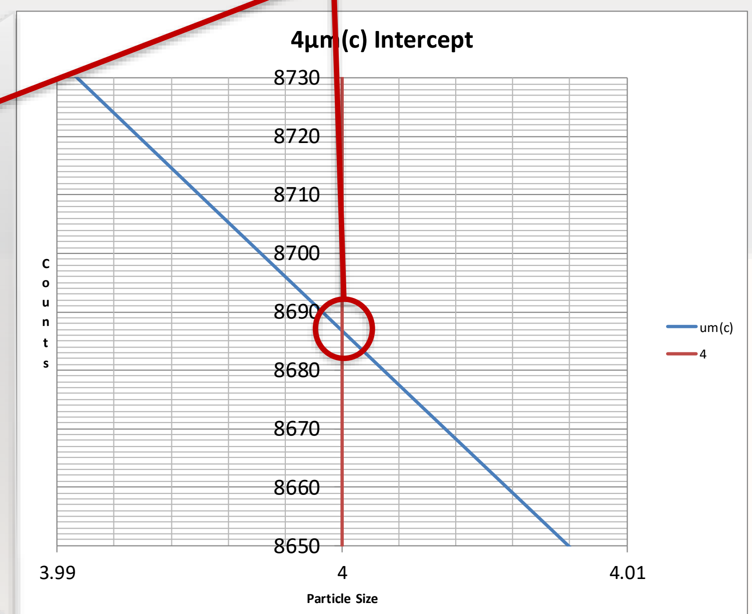
Determined Values (c)

Particles >µm(c)	Theoretical Counts/ml(c)
2	na
3	na
4	8686
5	5109
6	3208
7	2151

Determined Values (c) from polynomial curve

Particles >µm(c)	Theoretical Counts/ml(c)
2	na
3	na
4	8689
5	5108
6	3184
7	2147





Comparative Counts for

Sensor Calibrations traceable to SRM2806a and using FDIS11171(c)

Sample Number	2806 Cal	Count >4µm	Count >6µm	Count >14µm	Cleanliness Code	Component Sampled
2057337	a	447	156	15	16/14/11	Hydraulic System
	c	503	175	17	16/15/11	
2057341	a	321	121	12	16/14/11	Hydraulic System
	c	361	135	14	16/14/11	
2057382	a	384	114	12	16/14/11	Wind Turbine Gearbox
	c	445	128	14	16/14/11	
2057613	a	618	179	19	16/15/11	Gas Turbine
	c	719	205	22	17/15/12	
2057380	a	355	86	10	16/14/10	Wind Turbine Gearbox
	c	428	98	12	16/14/11	
2057353	a	312	138	12	16/14/11	Excavator Hydraulics
	c	737	163	14	17/15/11	
2057333	a	648	162	14	17/15/11	Hydraulic System
	c	763	187	17	17/15/11	
2057384	a	686	187	16	17/15/11	Wind Turbine Gearbox
	c	805	214	19	17/15/11	
2057437	a	1198	166	8	17/15/10	Hydraulic System
	c	1567	200	9	18/15/10	
2057390	a	1256	218	9	17/15/10	Wind Turbine Gearbox
	c	1518	266	10	18/15/10	
2057335	a	1548	456	53	18/16/13	Hydraulic System
	c	1802	516	60	18/16/13	
2057135	a	4803	375	14	19/16/11	Steam Turbine Bearing
	c	6485	481	17	20/16/11	
2057129	a	6336	1726	261	20/18/15	Hydraulic System
	c	7338	1981	290	20/18/15	
2057440	a	14104	1255	46	21/17/13	Excavator Hydraulics
	c	17997	1629	53	21/18/13	

Increase
0-25%
>25%
>50%
>100%

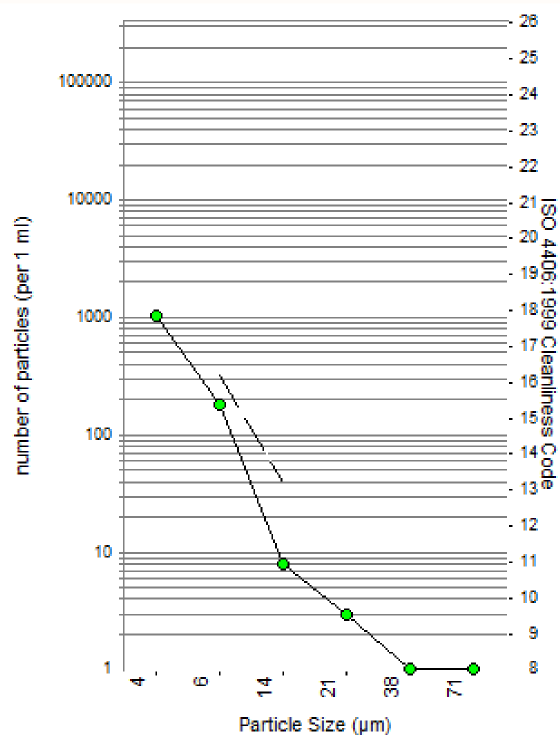
Increase
0 ISO
1 ISO 1
1 ISO 2
2 ISO

Ref: WearCheck Canada Inc.

What is the issue?

- Same Oil Sample
- Results are only slightly different because of revisions to ISO 11171
- SRM2806b using size modification to report as 4µm(c),6µm(c),14µm(c)

ISO 4406:1999 17/15/10



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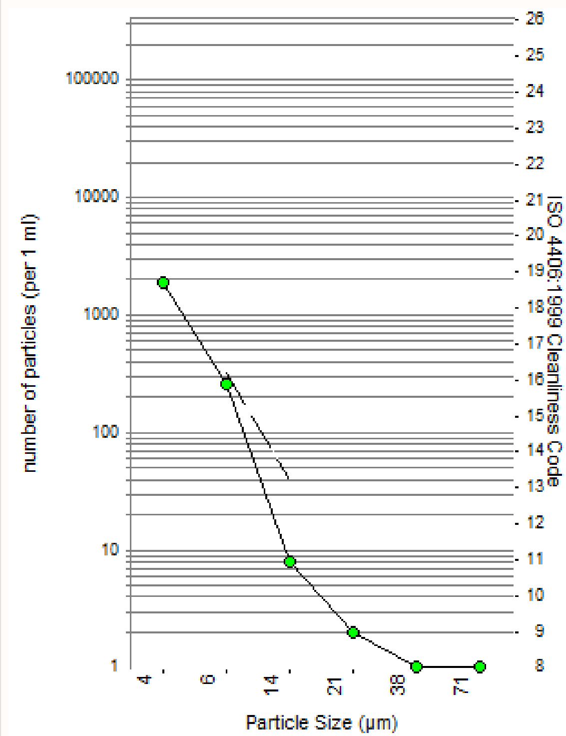
ISO 4406:1999 18/15/10



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Summary

- 1998 Discontinuation of ACFTD leads to change in calibration method ISO 4402 -> ISO 11171
- Due to change in accuracy of certification standards particle sizes are redefined: 2/5/15 -> 4/6/14
- 2016 New ISO MTD SRM2806b, no availability of SRM2806a may lead to a new ISO11171:2016 revision
- Due to further improvement in accuracy we may see particle sizes redefined again (*but only for calibration purposes*).
- Ability to report to either standard;
  4µm(c), 6µm(c) 14µm(c)
  or
  4µm(b), 6µm(b) 14µm(b)
- No change to larger particle calibration. Still using PSL fluid.
- If you want to get involved contact your national representative to ISO TC131/SC6. Advise them of your concerns and support the FDIS.

ISO 11171 Calibration Procedure – An Overview

Factory Calibration

- Annex A : Preliminary checks – Determine **noise level** by running *super clean fluid* (SCF) until < 1 count/sec. Determine **volume accuracy** by measuring series of 20ml samples and comparing counts.
- Annex B : Coincidence error – Start with theoretical limit of sensor and make up samples 10%, 20%, 30% & 40% of this limit. Plot the linear regression curve of the 4µm. Make up 50% - 150% samples of limit. Plot these values against linear regression and 95% confidence line. **Coincidence error** is where this curve crosses the regression lines.
- Annex C : Flow rate limit determination – Determine the upper and lower limit of flow rate where there is <3% deviation from the results.
- Annex D : Resolution – Set-up 4 channels 1.5x noise level, best 10µm guess, 0.72 & 1.32 x guess. Use this moving window method until determine center of 10µm peak. Set up additional 0.9 and 1.1 x 10µm peak and adjust until < 15% variation from count, < 5% between 0.9 and 1.1. For multi-channel (i.e. 4,096) much easier to perform.
- Annex E : Verification of particle count accuracy – Make up sample of 1mg UFTD/ml. Measure 6 sizes between 5 – 15µm. Values must all fall between results shown in Table A.1. This must be done using (c) counts.
- Section 6 : Sizing calibration – Use secondary standard (RM2806b). Continue to measure 20ml samples to initially determine new channel settings and until there is minimal variability between successive sample runs.

Laboratory Calibration

- Section 6 : Sizing calibration

- Annex E : Verification of particle count accuracy – Make up sample of 1mg UFTD/ml. Measure 6 sizes between 5 – 15µm. Values must all fall between results shown in Table A.1. This must be done using (c) counts.

Requires instrument (c) calibration because of Table A1 in ISO 11171:2016

Table A.1 — Particle size distribution for sensor performance verification (see A.6 and B.4)

Particle size µm(c)	Particle concentration (particles/mL greater than indicated size for a 1 mg/l sample of RM 8632) shall be	
	greater than or equal to	less than or equal to
5	3 300	4 500
6	1 500	2 500
7	660	1 400
8	280	760
9	120	410
10	58	220
11	28	120
12	14	63
13	7,4	34
14	4,1	19
15	2,3	11

- Revise ISO 11171 procedure to include an additional UFTD verification table (currently Table A1 for (c) calibration values) for (b) calibration values.

NIST Traceable Primary Calibration Fluid - SRM2806b

National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 2806b

Medium Test Dust (MTD) in Hydraulic Fluid

This Standard Reference Material (SRM) is intended for use in the calibration of instrumental resp… test dust suspended in hydraulic fluid. A unit of SRM 2806b consists of two bottles containing… irregularly shaped mineral dust suspended in approximately 400 mL of hydraulic fluid each.

Certified Values: Certification of this SRM is in terms of the projected area particle diameters of the… particles from the hydraulic fluid. The diameters are made traceable to the NIST Line Scale Inter… through a NIST calibration of a Geller MRS-4XY pitch standard. The certified diameters are con… numeric concentration of particles greater than each diameter, referred to as cumulative numb… distribution. The mean cumulative particle concentrations versus certified diameter values from 1 µ… given in Table 1 and plotted in Figure 1. A NIST certified value is a value for which NIST… confidence in its accuracy, all known or suspected sources of bias have been investigated or taken int…

Information Values: Values given in Table 2 are provided for information only and are not… information value is considered to be a value that may be of use to the SRM user, but insufficient… available to … performed [1]…

SRM 2806b … ISO 11171:20… [2].

Expiration … specified, unt… in this certific… damaged, con…

Maintenance … substantive te… notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

The coordination of the technical measurements culminating in certification of SRM 2806b was led b… of the NIST Materials Measurement Science Division.

Design and scanning electron microscopy (SEM) imaging was performed by N.W.M. Ritchi… developed the image processing software and provided the image analysis. R.A. Fletcher provide… testing, sample selection, preparation and data analysis. The aforementioned staff members are… Materials Measurement Science Division.

Statistical consultation including experimental design and uncertainty determination was provided… and W.F. Guthrie of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Offic… Materials.

John … Materials Measurement S…

Gaithersburg, MD 20899
Certificate Issue Date: 12 June 2014

Robert L. Watt… Office of Refe…

SRM 2806b — Page 1 of 6

June 12, 2014

ISO 11171:2010 (E)

SRM 2806b

Table 1. Certified Values, Sources of Uncertainty, and Combined and Expanded Uncertainties for Projected-Area Particle Diameter in SRM2806b

Projected Area Particle Diameter[a] (µm)	Mean Cumulative Particle Concentration [b] (n = 12) (particles/mL)	Standard Uncertainty of Mean Cumulative Particle Concentration Due to Sampling Reproducibility[c] (n = 12) (particles/mL)	Standard Uncertainty in Projected Area Particle Diameter Due to Sampling Reproducibility[c] (n = 12) (µm)	Standard Uncertainty in Projected Area Particle Diameter Due to Image Digitization[d] (µm)	Combined Standard Uncertainty in Projected Area Particle Diameter (µm)	Coverage Factor, k[e]	Expanded Uncertainty, U, in Projected Area Particle Diameter (µm)
1	80 755	1 318.7	0.012 7	0.219 4	0.219 8	1.179 8	0.26
2	33 064	530.9	0.022 9	0.219 4	0.221 0	1.247 6	0.28
3	17 714	305.2	0.032 2	0.219 3	0.222 2	1.310 3	0.29
4	10 864	253.5	0.048 4	0.878 3	0.879 9	1.176 3	1.0
5	[illegible]	127.6	0.041 0	0.878 8	0.879 8	1.164 1	1.0
6	4 210.2	82.78	0.046 7	0.878 1	0.879 5	1.174 9	1.0
7	2 852.3	61.18	0.057 9	0.877 7	0.880 2	1.193 5	1.1
8	2 007.0	38.64	0.059 0	0.879 2	0.881 4	1.193 7	1.1
9	1 476.4	27.90	0.064 3	0.878 9	0.881 9	1.203 1	1.1
10	1 114.8	18.00	0.059 8	0.878 6	0.880 9	1.195 3	1.1
11	857.22	13.61	0.059 3	1.756 6	1.758 1	1.146 4	2.0
12	649.63	11.09	0.063 8	1.758 5	1.759 9	1.149 0	2.0
13	500.66	10.12	0.079 7	1.758 7	1.760 5	1.162 2	2.0
14	389.26	10.74	0.106 7	1.758 5	1.762 6	1.185 3	2.1
15	299.96	8.79	0.112 6	1.758 2	1.761 8	1.190 9	2.1
16	230.39	7.98	0.134 7	1.759 4	1.765 8	1.207 7	2.1
17	179.37	6.99	0.163 0	1.761 0	1.770 7	1.230 6	2.2
18	142.77	6.09	0.189 2	1.758 2	1.770 2	1.254 4	2.2
19	114.45	5.12	0.210 8	1.758 6	1.774 6	1.271 7	2.3
20	93.177	4.53	0.247 9	1.758 7	1.779 6	1.303 4	2.3
21	77.143	4.14	0.297 2	1.756 9	1.786 7	1.341 4	2.4
22	65.135	3.53	0.319 0	1.759 6	1.792 8	1.358 7	2.4
23	54.701	3.2	0.355 9	1.758 2	1.799 4	1.387 1	2.5
24	46.830	2.95	0.409 7	1.759 3	1.816 3	1.424 7	2.6
25	40.307	2.64	0.437 3	1.758 2	1.822 8	1.441 4	2.6
26	34.677	2.39	0.471 6	1.760 2	1.835 5	1.465 2	2.7
27	30.094	2.17	0.502 0	1.758 7	1.843 5	1.487 5	2.7
28	26.006	1.98	0.521 6	1.758 7	1.848 0	1.497 8	2.8
29	22.490	1.79	0.575 5	1.757 9	1.866 9	1.533 2	2.9
30	19.698	1.64	0.640 1	1.758 3	1.895 7	1.568 6	3.0

[a] Stable particle projected area diameter [6].
[b] Number of particles per milliliter of hydraulic fluid greater than the indicated diameter (number per milliliter).
[c] Type A uncertainties evaluated by statistical methods. The standard uncertainty in column 3 is the standard deviation in the cumulative particle concentration divided by the square root of 12 (n=12).
[d] Type B uncertainties evaluated by other means.
[e] k value determined by Monte Carlo calculation.
The expanded uncertainty for the projected area particle diameter corresponds to a 95 % confidence interval.

SRM 2806b — Page 3 of 6

Secondary Calibration Fluid - RM2806a & RM2806b

Size µm(c)	Mean Particle Concentration (>Particles/mL)
>4	7300.5
>5	4385.6
>6	2907.9
>7	1939.9
>8	1273.8
>9	851.2
>10	599.8
>11	445.7
>12	361.6
>13	304.3
>14	209.8

October 3, 2013
ISO 11171:2010 (E)
NIST SRM2806a

Size µm(c)	Mean Particle Concentration (>Particles/mL)
>4	10850.8
>5	6792.3
>6	4500.5
>7	3073.4
>8	2138.2
>9	1516.8
>10	1094.7
>11	797.3
>12	594.6
>13	461.1
>14	367.4

March 11, 2016
ISO 11171:2010 (E)
NIST SRM2806b

Size µm(b)	Mean Particle Concentration (>Particles/mL)	Mean Particle Concentration For size µm(c)* (>Particles/mL)
>4	10196.6	8245.3
>5	6472.3	5102.4
>6	4289.1	3320.5
>7	2597.1	2240.7
>8	2095.0	1551.6
>9	1508.7	1095.5
>10	1099.1	786.5
>11	815.8	574.6
>12	615.5	428.9
>13	469.7	329.8
>14	370.1	264.2

October 24, 2016
ISO 11171:2016 (E)
NIST SRM2806b

- Section 6 : Sizing calibration – Use secondary standard (RM2806b). Continue to measure 20ml samples to initially determine new channel settings and until there is minimal variability between successive sample runs.

All commercial laboratories need to determine to what standard their current calibration fluid(s) comply. Will need to make an informed decision of how to proceed with future particle counter calibrations.

	A	B	C	D	E	F	G	H	I	J	K
1	Sample N	4(c)	6(c)	14(c)	21(c)	38(c)	70(c)	ISO4406(c	SO4406(c	ISO4406(c	ISO4406(c
2	2121907	4331	1304	151	48	4	1	19/18/14	19/17/14	19/18/14	19/18/14
3	2121432	592	180	21	8	2	1	16/15/12	17/15/12	16/15/12	16/15/11
4	2121904	26067	1302	31	11	1	0	22/18/12	22/18/12	22/18/12	22/17/12

	L	M	N	O	P	Q	R	S	T	U
1	4(b)	6(b)	14(b)	21(b)	38(b)	70(b)	ISO4406(b	SO4406(b	ISO4406(b	ISO4406(b)
2	5993	1741	205	66	4	1	20/18/15	20/18/15	20/18/15	20/18/15
3	811	240	27	11	2	1	17/15/12	17/15/12	17/15/12	17/15/12
4	48916	2816	46	16	1	0	23/19/13	23/19/13	23/19/13	23/19/13

Partial sample of CINRG CS-APC-2 output file.

- SRM2806b and RM2806b calibration certificates have the (b) calibration data and the calculated (c) values.
- Confirm that the calibration kit your are using for re-calibration meets the new ISO 11171:2016 specification and is NIST traceable to SRM2806b.
- Laboratories need to understand the difference between a (b) vs. (c) calibration and must decide whether to continue to report using the (c) calibration or to change to the (b) calibration.

Comparative Counts for Calibrations using SRM 2806b Fluid and ISO 11171:2016 calibrated to both (b) and (c) method

Sample Number	Method	Count >4µm	Count >6µm	Count >14µm	Count >21µm	Count >38µm	Count >70µm	Cleanliness Code	Component Sampled
2121907	(b)	5993	1741	205	48	4	1	20/18/15	Industrial Bearing
	(c)	4331	1304	151	66	4	1	19/17/14	
2121432	(b)	811	240	27	11	2	1	17/15/12	Wind Turbine Gearbox
	(c)	592	180	21	8	2	1	17/15/12	
2121904	(b)	48916	2816	46	16	1	0	23/19/13	Industrial Bearing
	(c)	26067	1302	31	11	1	0	22/18/12	
2120176	(b)	358	98	13	6	1	1	16/14/11	Wind Turbine Gearbox
	(c)	251	75	10	4	1	1	15/13/11	
2119579	(b)	720	159	20	6	1	0	17/15/11	Wind Turbine Gearbox
	(c)	478	116	14	5	1	0	16/14/11	
2121910	(b)	727	180	23	8	1	0	17/15/12	Industrial Bearing
	(c)	498	131	17	7	1	0	16/14/11	
2119575	(b)	15398	872	33	10	1	1	21/17/12	Wind Turbine Gearbox
	(c)	7475	477	23	8	1	1	20/16/12	
2119370	(b)	81882	17250	421	57	5	4	24/21/16	Marine Gearbox
	(c)	58066	10872	244	35	5	4	23/21/15	
2120177	(b)	10420	855	46	11	1	0	21/17/13	Wind Turbine Gearbox
	(c)	4058	564	30	8	1	0	19/16/12	
2121430	(b)	84937	7440	47	10	4	3	24/20/13	Wind Turbine Gearbox
	(c)	53491	3443	29	8	4	3	23/19/12	
2121613	(b)	116369	15859	38	8	5	4	24/21/13	Marine Gearbox
	(c)	86887	6669	21	7	5	4	24/20/12	
2121906	(b)	1436	274	25	8	1	0	18/15/12	Industrial Bearing
	(c)	901	194	17	6	1	0	17/15/11	
2121223	(b)	77261	393	18	4	0	0	23/16/12	Diesel Engine
	(c)	35453	186	11	3	0	0	22/15/11	
2121225	(b)	149735	51626	25	6	1	1	24/23/12	Diesel Engine
	(c)	129681	27495	16	4	1	1	24/22/11	

Increase
0-25%
>25%
>50%
>100%

Increase
0 ISO
1 ISO 1
1 ISO 2
2 ISO

Ref: WearCheck Canada Inc.

Recommendations

- SRM2806b and RM2806b calibration certificates have the (b) calibration data and the calculated (c) values.
- Revise ISO 11171 procedure to include an additional UFTD verification table (currently Table A1 for (c) calibration values) for (b) calibration values.
- Instrument manufacturers use NIST SRM2806b for calibration. Laboratories may use NIST SRM2806b or RM2806b secondary standards with the following caveats;
- Confirm that your current particle counting instrument is calibrated to the current ISO 11171:2016 standard using NIST traceable SRM2806b.
- Confirm that the calibration kit your are using for re-calibration meets the new ISO 11171:2016 specification and is NIST traceable to SRM2806b.
- Laboratories need to understand the difference between a (b) vs. (c) calibration and make an informed decision of whether or not to implement the change from (c) to (b).

CINRG Systems Inc.

Innovation in Automation

For Commercial Oil Analysis Laboratories