Grease Particle Evaluation Working Group

Joe Kaperick - chair

NLGI Joint Working Group
San Diego, CA

June 6, 2023

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Agenda

- Code of Conduct/Antitrust statement
- WG Structure
- Results of survey
- Proposed White Paper
- Summary/background of work to date
- Proposed alternate Hegman evaluation method
- Additional discussion?
- Adjourn

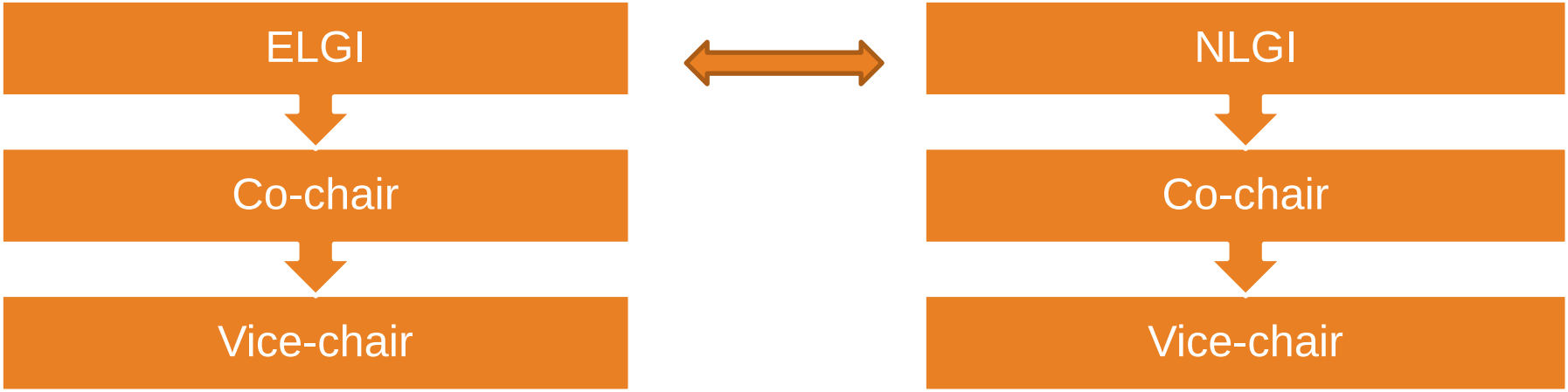
Code of conduct

- Antitrust Statement
- As participants in this meeting, we must refrain from activities prohibited by existing antitrust laws. Discussions of agreements that may restrain competition, the exchange of information concerning prices, rates, coverages, market practices, claim settlement practices, or any other competitive aspect of a company's operation are strictly prohibited.

Structure of WGs

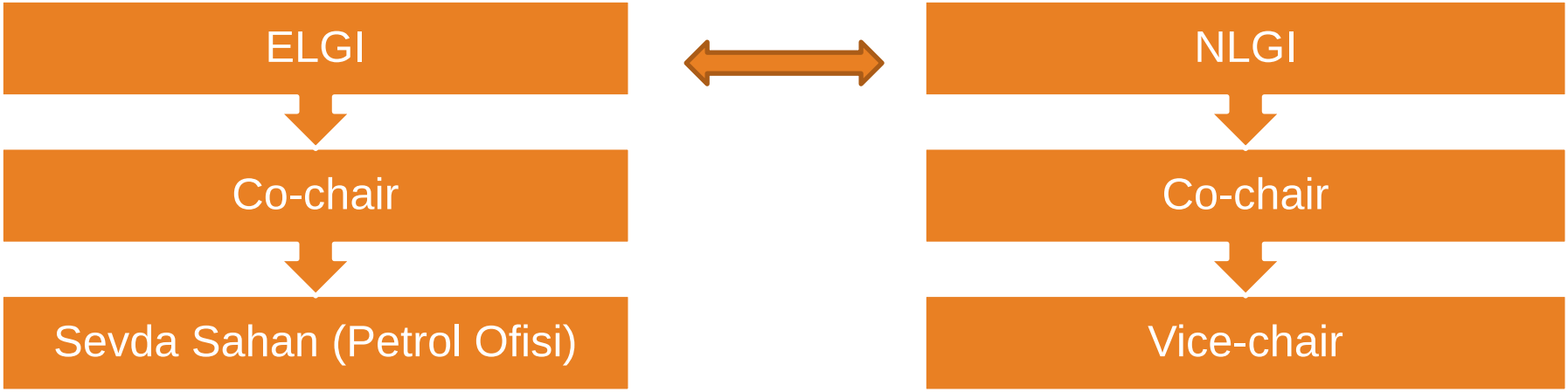
- 2 year tenure in each position with advancement through positions
  - Vice-chair moves to chair, new vice-chair elected
  - Must spend 2 years in vice-chair position unless chair opens due to resignation
  - New volunteer for any open position (not filled by advancement) need to be voted in
- If no volunteers, then position remains open
  - If volunteer identified during 2 year tenure, then vote held and, if agreed, 2 year tenure starts again from that meeting
  - If no vice chair, current chair needs to be re-elected every two years

Proposed structure of Joint WGs



- If the WG is a Joint WG and the current chair cannot attend both ELGI and NLGI meetings, (and the vice-chair position is not filled or likewise cannot fill in for the chair):
  - Two co-chairs may be identified and, pending a successful vote, split duties between the meetings.
  - If vice-chair position is vacant, the chair will be responsible for those duties as well (agenda/minutes).
  - The co-chair positions would have a two year tenure before being put back up for re-election. every two years.
-

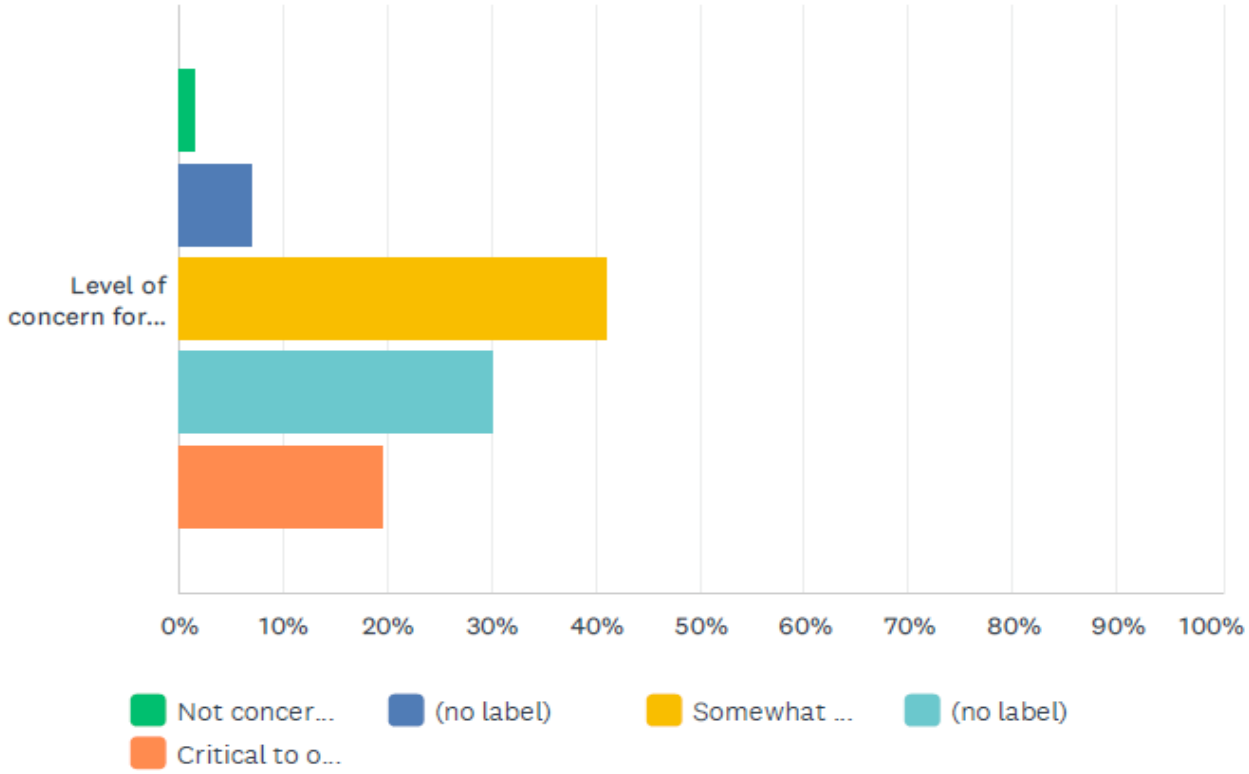
Proposed structure of Joint WGs



- If the WG is a Joint WG and the current chair cannot attend both ELGI and NLGI meetings, (and the vice-chair position is not filled or likewise cannot fill in for the chair):
  - Two co-chairs may be identified and, pending a successful vote, split duties between the meetings.
  - If vice-chair position is vacant, the chair will be responsible for those duties as well (agenda/minutes).
  - The co-chair positions would have a two year tenure before being put back up for re-election. every two years.
-

Q2 How concerned is your company about any aspect of evaluating particles in grease?

Answered: 56 Skipped: 0



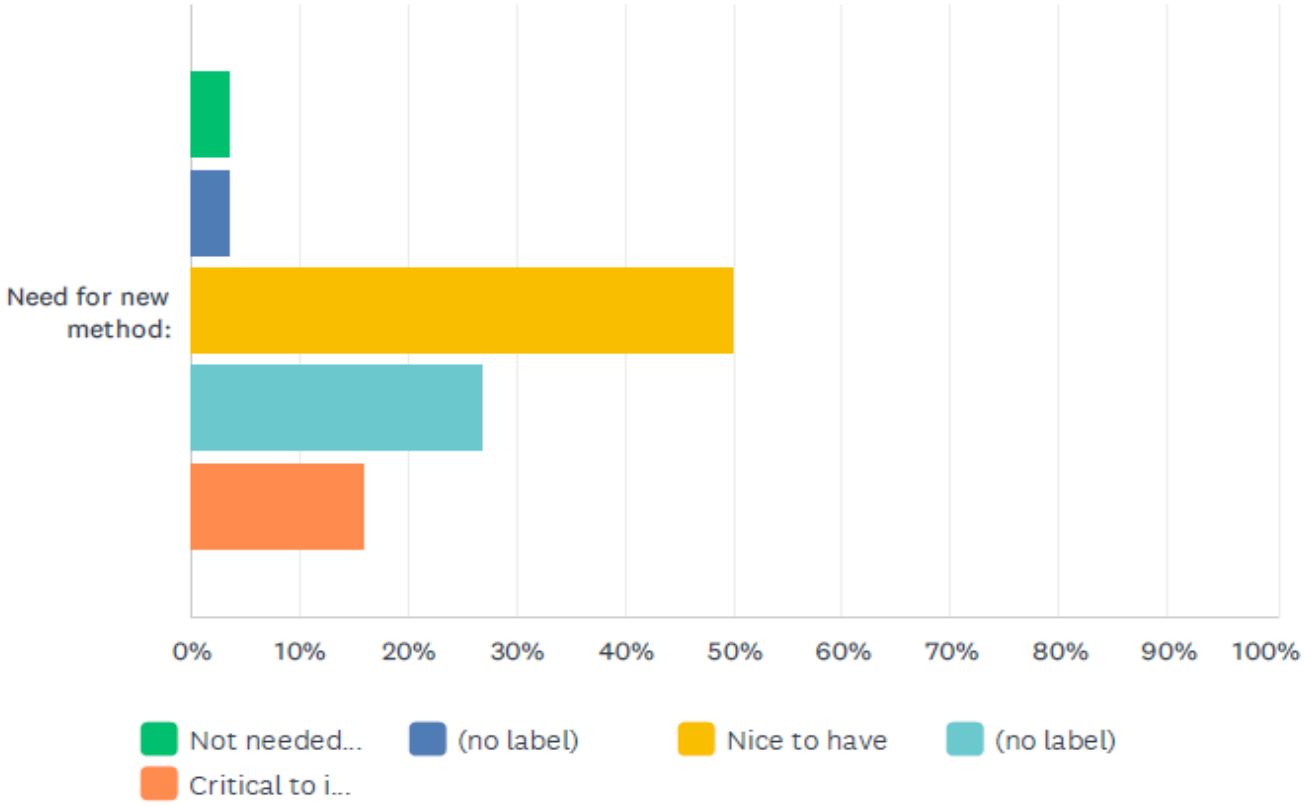
	NOT CONCERNED AT ALL	(NO LABEL)	SOMEWHAT CONCERNED	(NO LABEL)	CRITICAL TO OUR BUSINESS	TOTAL	WEIGHTED AVERAGE
Level of concern for your company:	1.79% 1	7.14% 4	41.07% 23	30.36% 17	19.64% 11	56	3.59

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Q3 How much need do you believe there is for a new method to evaluate particles in grease?

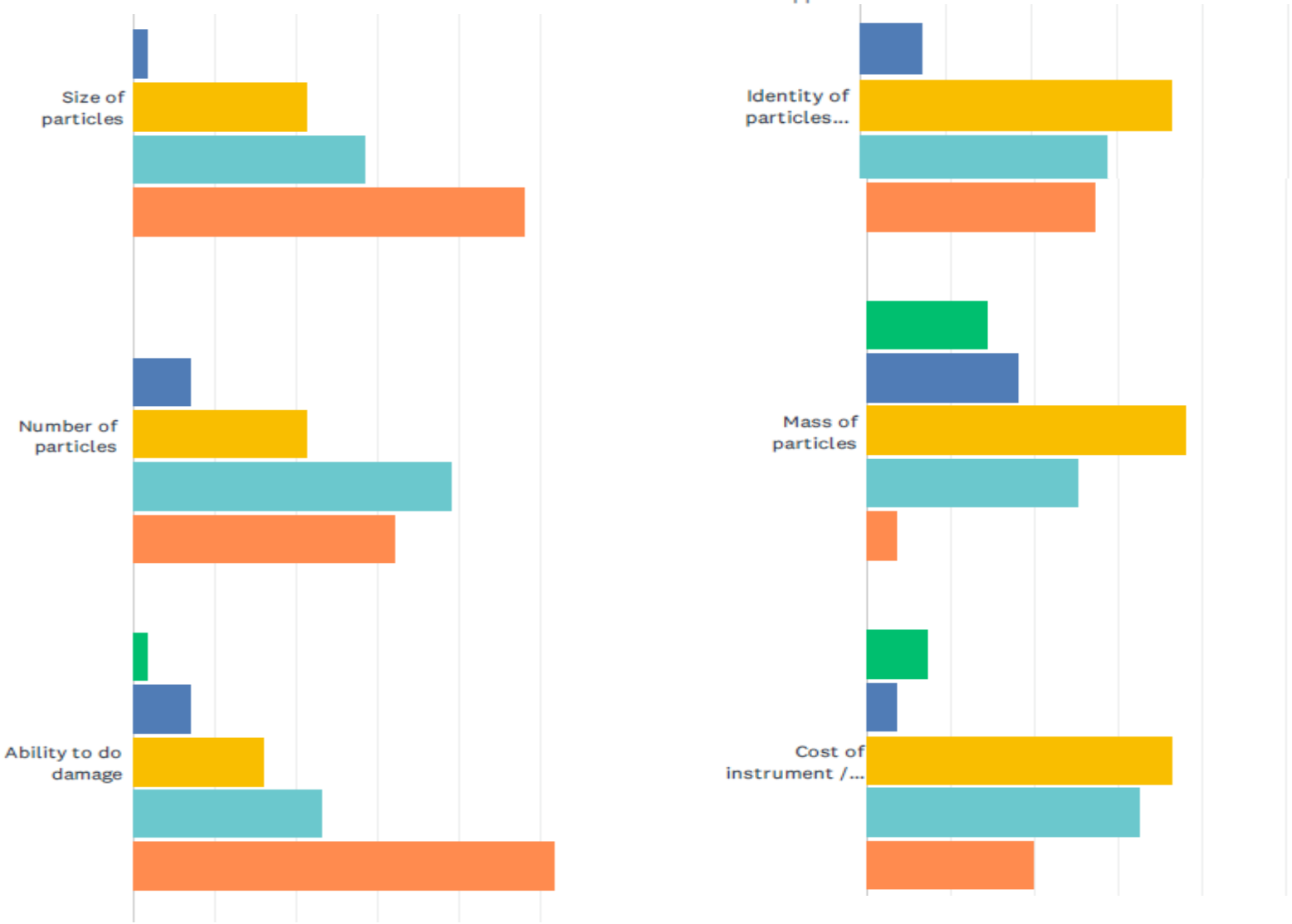
Answered: 56 Skipped: 0



	NOT NEEDED AT ALL	(NO LABEL)	NICE TO HAVE	(NO LABEL)	CRITICAL TO INDUSTRY	TOTAL	WEIGHTED AVERAGE
Need for new method:	3.57% 2	3.57% 2	50.00% 28	26.79% 15	16.07% 9	56	3.48

Q5 What is the importance of each aspect listed below:

Answered: 56 Skipped: 0

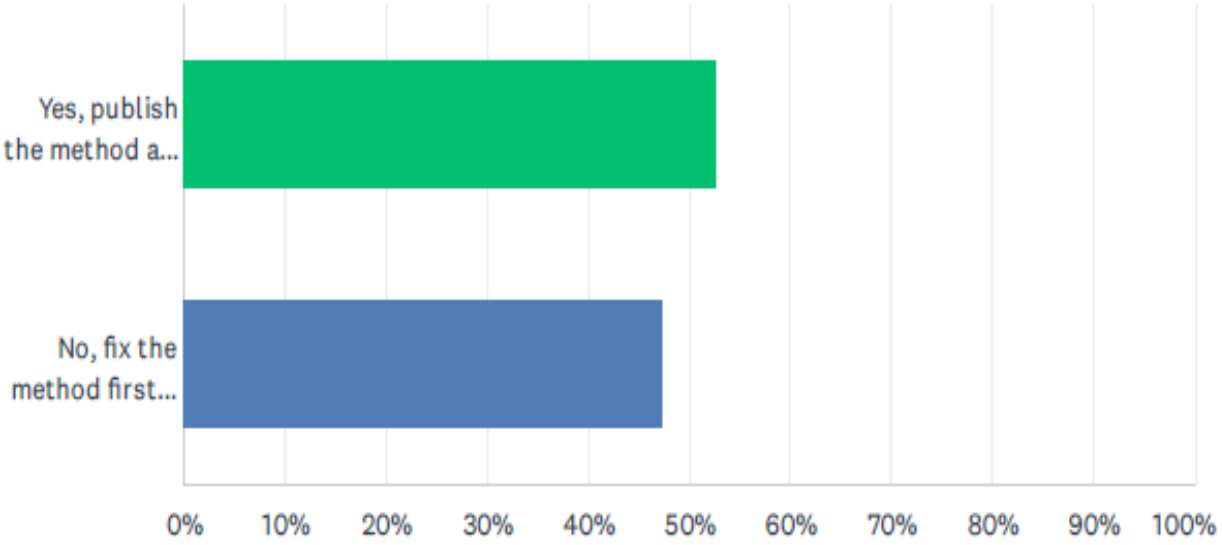


INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Q6 Would you be in favor of a new method being introduced with less than desirable reproducibility?

Answered: 55 Skipped: 1



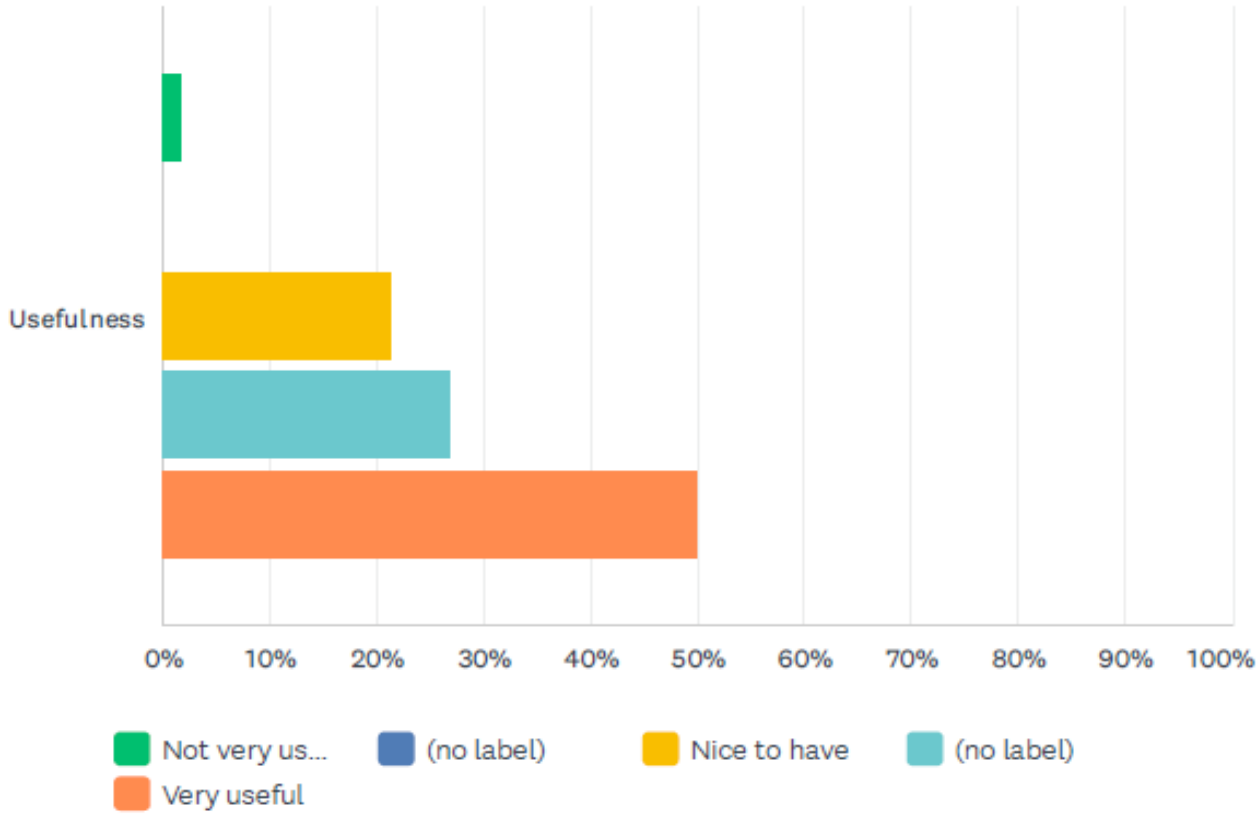
ANSWER CHOICES	RESPONSES	
Yes, publish the method and then continue to work on reproducibility	52.73%	29
No, fix the method first and then publish it	47.27%	26
TOTAL		55

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Q7 How useful would a white paper be that outlines different techniques currently available for the evaluation of particles in grease?

Answered: 56 Skipped: 0



	NOT VERY USEFUL	(NO LABEL)	NICE TO HAVE	(NO LABEL)	VERY USEFUL	TOTAL	WEIGHTED AVERAGE
Usefulness	1.79% 1	0.00% 0	21.43% 12	26.79% 15	50.00% 28	56	4.23

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

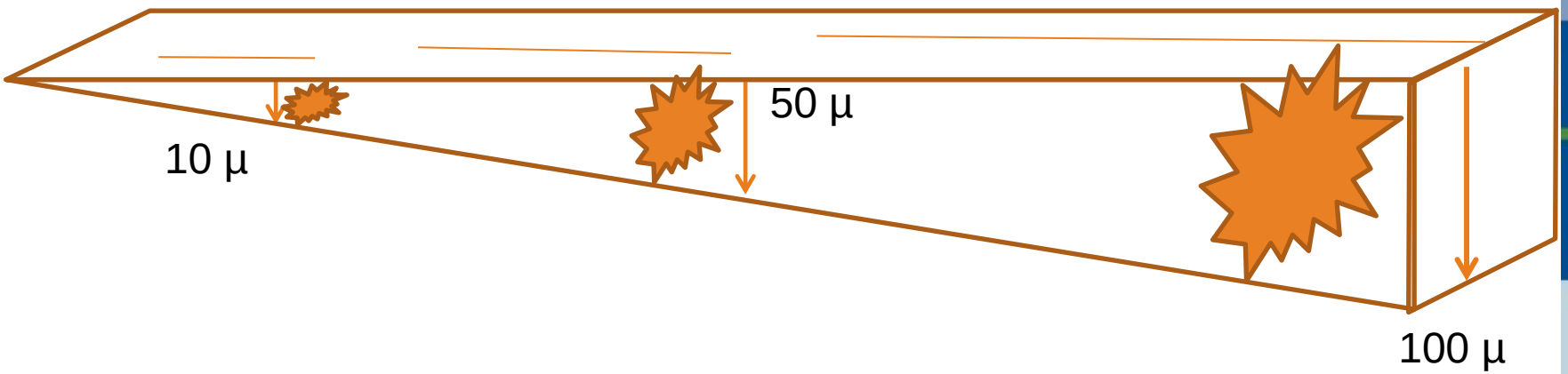
Current methodology

- **Focus on Hegman gauge to provide:**
  - Number & size of particles
  - Quickly
  - Inexpensively
  - Focus for QC, troubleshooting field applications
- **ASTM D1404 already in place and provides**
  - Number and ability to do damage
- **Previous discussions of group have led to focus efforts on these two methods as complimentary techniques**
- **There are many other techniques currently available that:**
  - Provide more detail on particles
  - Less economical
  - More complicated/greater amounts of grease

White Paper?

- **Proposed white paper**
  - Overview of other methods of evaluating particles in grease
  - Resource for the grease industry
  - Task force:
    - Chris Pether (Afton)
    - Anuj Mistry (Fuchs NA)
    - Faizan Rabbani (SKF)
    - Melissa Quinn (BP)
    - Andreas Dodos (Eldons)
    - Others?

Hegman Gauge



- Particles leave tracks behind in the grease until they can roll under the straight edge of the gauge
- Due to differing widths of the troughs, need to normalize results to width of trough or volume of grease

Hegman gauge – need same size

- **Standardizing on one Hegman gauge**
  - Gage No. 6254
    - 1 x 6.25 inches, 0 to 100 microns, 2 tracks
    - Other models okay as long as dimensions are identical
  - A-1 Scraper
    - 1/4 x 1-1/2 x 3-3/4"
    - Two edges with .015" radius making line contact. For 1-1/2" through 3-1/2" gages.
- **One source:**
  - BYK-Gardner GmbH • Lausitzer Strasse 8 • 82538 Geretsried • Germany • Tel +49 8171 3493-0 • Fax +49 8171 3493-140
- **Second source**:
  - Precision Gauge and Tool Company
    - 375 Gargrave Rd. Dayton, Ohio 45449 (937) 866-9666
    - http://www.pgtgage.com

Recent round robin efforts - overview

- **Round robin**
  - 22 participants
  - 11 samples (blind duplicates) – 22 runs each lab
  - 27 sets of data
- **Repeatability (r) good, but reproducibility (R) varied and in some cases quite large**
- **Suggested alternate measuring method to improve R**
- **Mini round robin started in April by limited number of labs to test concept**
- **Would need full round robin to generate r & R for formal method if we proceed further**

Grease samples

Sample code	Thickener	Solids	Oil	NLGI Grade	Color
B/P	Calcium sulfonate		Mineral	3	Amber
J/N	Polyurea		Mineral	2	Black
I/T	Lithium-12		Mineral	0	Red
G/Q	LiCx	3% MoS2	Mineral	2	Black
A/O	Al-Cx			2	White
H/K	Lithium		Mineral	1	Tan
F/L	Lithium/calcium		Mineral	2	Amber
E/R	CaSO4 Complex		Mineral	2	Green
C/D	LiCx	moly	Synthetic	2	Grey
M/S	LiCx	polymers		1.5	Green

Range of colors: amber, black, red, white, green

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Participants – thank you!

1	Mike Lennon	Afton Chemical	Have sples & some data
2	Dr. Pokhriyal	Indian Oil	
3	Olav Hoeger	Shell	
4	Jeff Bohn	Axel Americas	
5	Matthew Campbell	ExxonMobil	
6	Virginie Chanfray	Condat	
7	Teresa Makuvek	FedChem	Have sples & willing to help
8	C. Sementa/A. Meladino	Monson	
9	Sara Roche	Castrol (Naperville)	
10	Matthew Gregory	Fuchs (Australasia)	
11	Dylan Kletzing/Rich W.	MRG Labs	Have sples; need Hegman
12	Franck Bardin	Total France	
13	Roland Ardai	Axel Christiernsson	Have sples & willing to help
14	George Dodos	Eldons	
15	S. Mitterer/C. Rohbogner	Oelcheck	
16	Ruslan Aziev	Intesmo	
17	Dirk Drees	Falex	
18	Anoop Kumar	Chevron	
19	Joe Huntley	Hydrotex	
20	Matt Bailey	Summit	Have sples & willing to help
21	Kuldeep Mistry	Timken	
22	Sonia Stramare	Blaser Swisslube	Not enough sple left; can help but need more

Ratings guide

- Letter grades assigned to each size range based on # of scratches in that region

RATING TABLE

Assign rating based on the number of particles in each size range:

From	To	Rating
0	9	**A**
10	19	**B**
20	or more	**C**

- Expanded number of size ranges
- Using “+/-” to “average” ratings

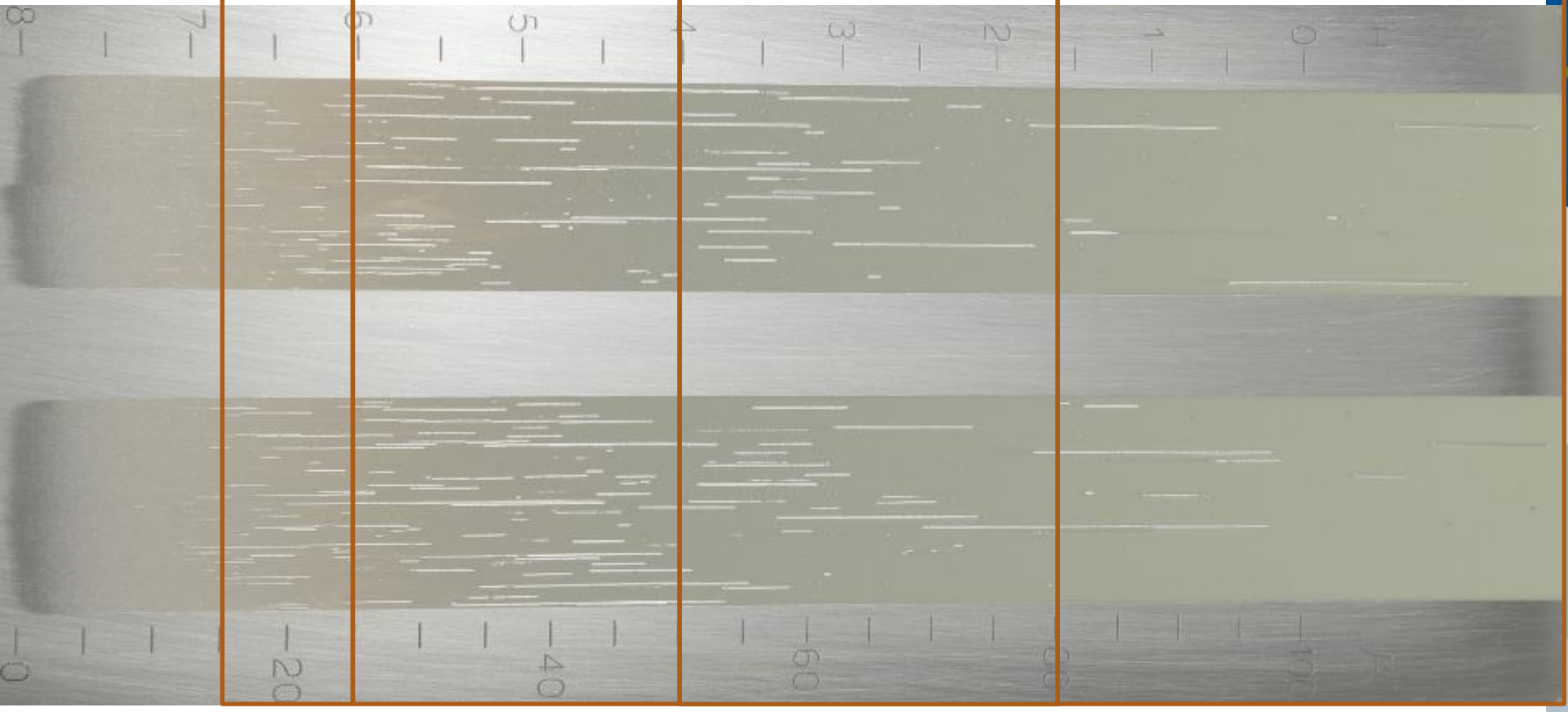
A			B			C
A/A/A	A/A/B	A/B/B	B/B/B	B/B/C	B/C/C	C/C/C
A	A-	B+	B	B-	C+	C

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

#2/#16

B	C	C	A
15	30	20	6
C	C	C	A
20	23	22	9
15-25 µ	25-50 µ	50-80 µ	>80 µ

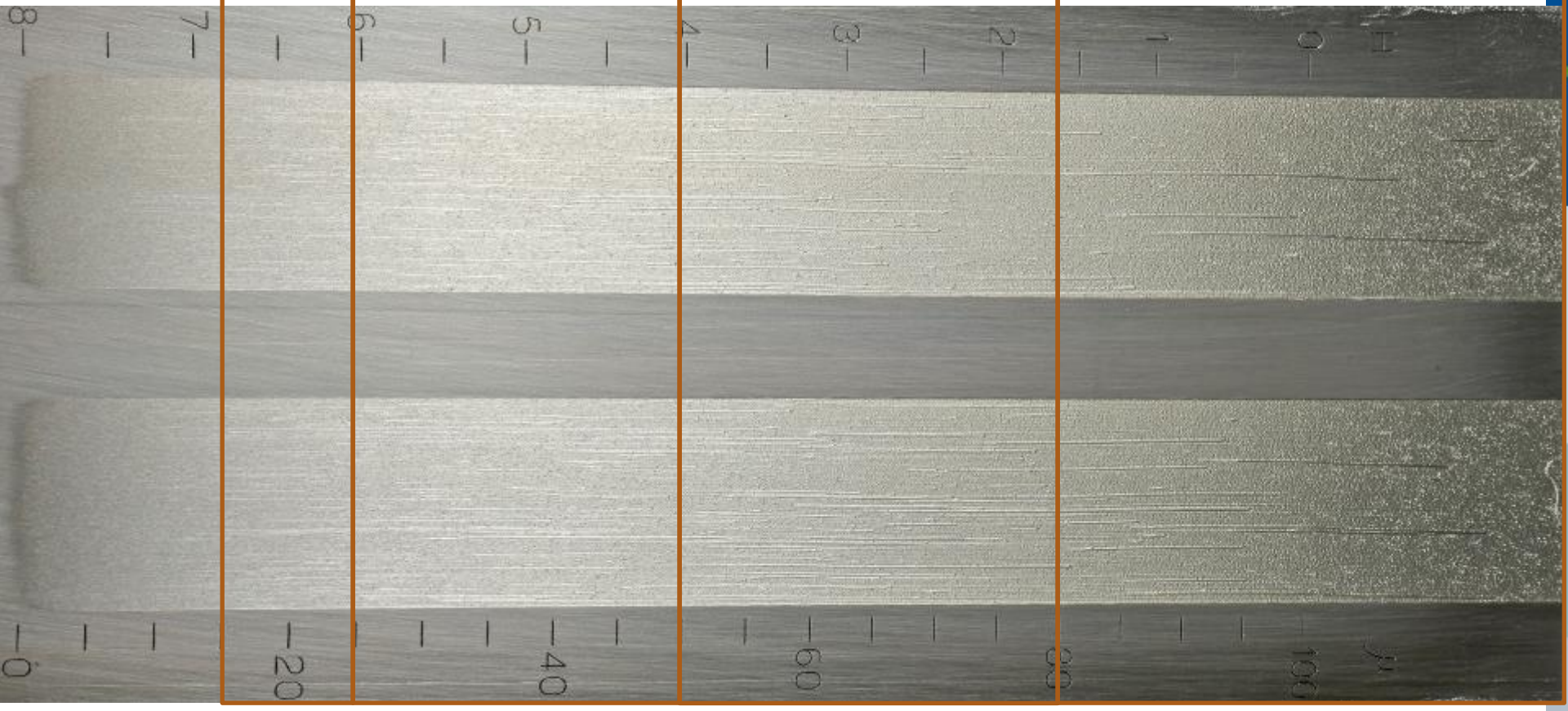


INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

#4/#12

B	B	C	A
15	18	26	9
C	B	C	B
22	13	24	14
15-25 µ	25-50 µ	50-80 µ	>80 µ



Results

- Repeatability on 11 duplicate “blind” samples
- Very good repeatability within lab

Count	%	Cum %	Ave	
644	62.2	62.2	26.0	Same
193	18.6	80.8	7.4	Within 1
91	8.8	89.6	3.2	Within 2
67	6.5	96.0	2.0	
24	2.3	98.4	0.7	
10	1.0	99.3	0.4	
7	0.7	100.0	0.1	
1036				

Results

- Reproducibility is not as good on some samples

	A	A-	B+	B	B-	C+	C
A/O	26	8	5	7	0	0	4
	12	8	6	7	8	3	6
	18	6	5	12	3	3	3
	38	6	3	2	1	0	0
C/D	12	2	2	15	4	4	11
	3	2	4	7	2	5	27
	4	4	4	4	4	3	27
	13	2	1	8	3	4	19
G/Q	7	3	6	10	5	5	14
	3	6	1	6	3	3	28
	7	4	7	10	4	8	10
	20	3	4	10	7	0	6
J/N	5	5	3	10	5	7	15
	2	3	2	7	6	3	27
	6	6	3	6	8	9	12
	15	4	4	10	10	2	5

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Results

- **Seems to show biggest problems are based on colors**
  - Black and grey greases have lowest skew and kurtosis values
  - Amber and green all are good
  - White and red are borderline

Sample	Thickener	Solids	Oil	Grade	Color	Ave Skew	Ave Kurtosis	"Bad" areas	Ave Std Dev
G/Q	LiCx	3% MoS2	Mineral	2	Black	0.6	1.0	3/3	2.1
J/N	Polyurea		Mineral	2	Black	0.6	1.7	3/3	2.1
C/D	LiCx	moly	Synthetic	2	Grey	1.2	2.2	2/2	2.4
A/O	Al-Cx			2	White	1.4	4.1	0/1	1.7
I/T	Lithium-12		Mineral	0	Red	1.5	4.1	1/1	1.6
E/R	CaSO4 Cx		Mineral	2	Green	1.8	5.7	0/0	1.6
B/P	CaSO4		Mineral	3	Amber	1.9	6.1	0/0	1.3
F/L	Li/Ca		Mineral	2	Amber	1.9	6.3	0/0	0.9
M/S	LiCx	polymers		1.5	Green	2.0	7.0	0/0	0.2
H/K	Lithium		Mineral	1	Tan	2.0	7.0	0/0	0

"Bad" area is skew <1.0 or kurtosis <3

Rating options

- **Use current method/system for most greases**
  - Seems to be good for many greases
    - Amber & green especially
  - Identify exceptions and improve method for them
    - Black & grey seem very difficult
    - Red/white are borderline

Rating options

- Look at pictures of greases with various levels of scratches and assign a “grade” by placing it between two pictures
  - Similar to EMCOR rating guide in ASTM

TABLE 1 Corrosion Classifications

NOTE—Under certain circumstances a pair of parallel bands may be observed, the color of which changes with viewing angle; do not confuse these bands with corrosion which appears black when viewed from all angles.

Rating	Designation	Description
0	no corrosion	no corrosion
1	trace	no more than three spots of corrosion, none of which has a diameter larger than 1 mm
2	light	small areas of corrosion covering up to 1 % of the surface
3	moderate	areas of corrosion covering between 1 and 5 % of the surface
4	heavy	areas of corrosion covering between 5 and 10 % of the surface
5	severe	areas of corrosion covering more than 10 % of the surface

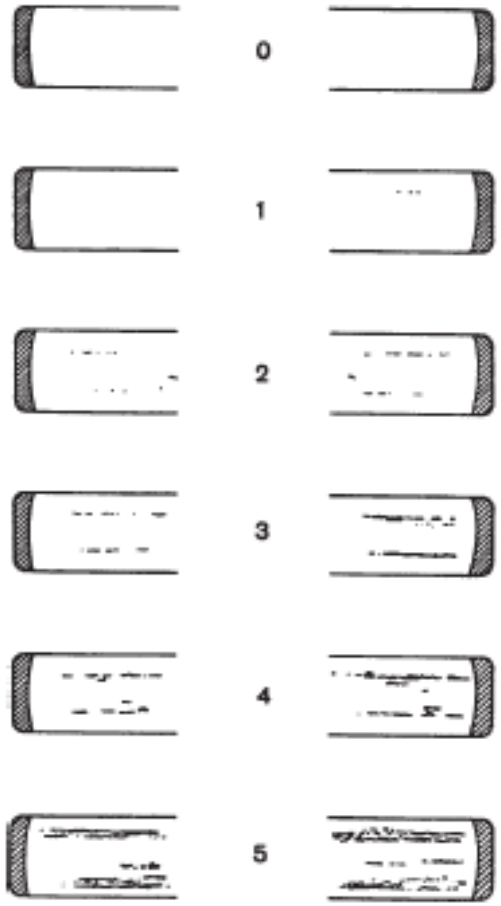


FIG. 2 Various Ratings Illustrating Degree of Corrosion

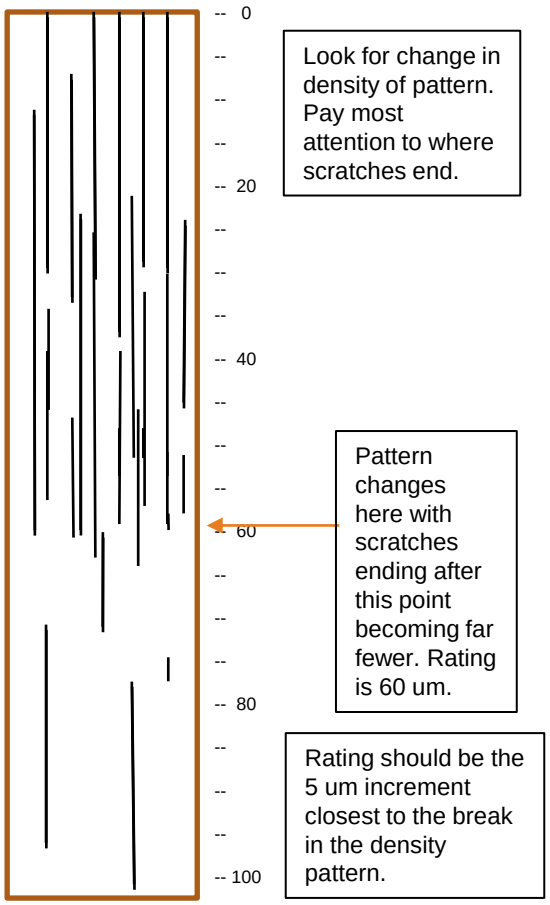
INDUSTRIAL GREASE

Rating options

- **Look at “break” in density of scratches**
  - Where does it go from “a lot” to “a little”? (Used in paint industry)
  - Single number (micron reading) for each grease
  - Maybe add count or rating for large particles above breakpoint

Rating guide - examples

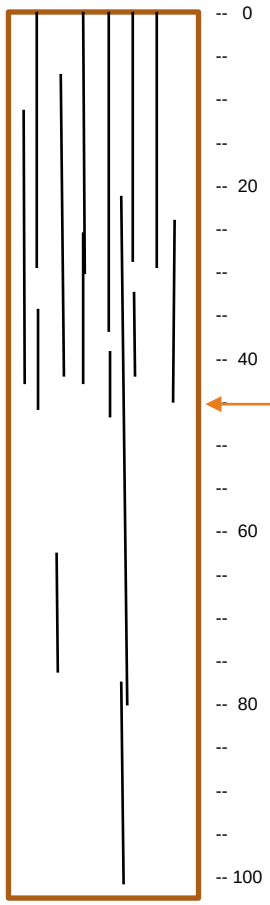
These diagrams represent typical gage patterns to illustrate common types of patterns seen in evaluating particle size distributions in grease samples. The intent is to give guidance to the operator in evaluating and assigning a rating.



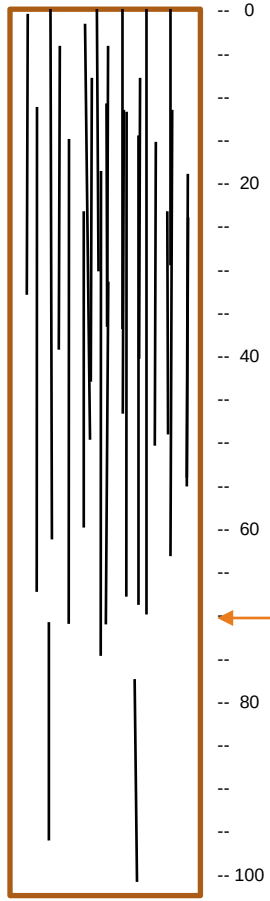
Look for change in density of pattern. Pay most attention to where scratches end.

Pattern changes here with scratches ending after this point becoming far fewer. Rating is 60 um.

Rating should be the 5 um increment closest to the break in the density pattern.



Pattern changes here with scratches ending after this point becoming far fewer. Rating is 45 um.



Pattern changes here with scratches ending after this point becoming far fewer. Rating is 70 um.

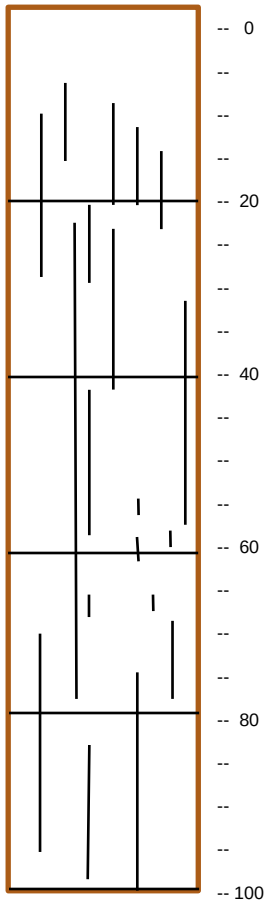
INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Rating options – current focus

- **Count density of scratches at discrete points**
  - Example – count number of scratches every 20 microns
  - Give better feel for range of particles; more info than breakpoint
  - Perhaps better reproducibility

Rating guide - examples



20 micron indicator - has 4 scratches that cross the 20 micron line.

40 micron indicator - has 3 scratches that cross the 40 micron line.

60 micron indicator - has 2 scratches that cross the 60 micron line.

80 micron indicator - has 2 scratches that cross the 80 micron line.

100 micron indicator - has 1 scratch that crosses the 100 micron line extending past end of the gage

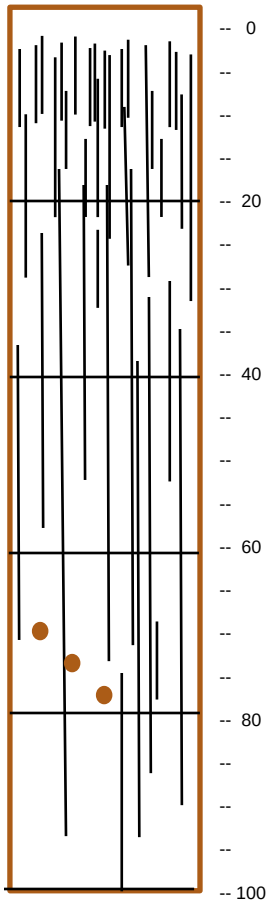
These diagrams represent typical gage patterns to illustrate common types of patterns seen in evaluating particle size distributions in grease samples. The intent is to give guidance to the operator in evaluating and assigning a rating.

Letter ratings are based on number of scratches

From	To	Rating
0	9	A
10	19	B
20	or more	C

Ratings are assigned based on the number of particles that cross the different size indicators:

Size range (microns)
20
40
60
80
100



20 micron indicator - has 14 scratches that cross the 20 micron line.

40 micron indicator - has 10 scratches that cross the 40 micron line.

60 micron indicator - has 7 scratches that cross the 60 micron line.

80 micron indicator - has 5 scratches that cross the 80 micron line.

100 micron indicator - has 1 scratch that crosses the 100 micron line extending past end of the gage

Size range (microns)	1st run
20	**A**
40	**A**
60	**A**
80	**A**
100	**A**

Note that short line segments are not counted within a size range unless they cross the indicator line.
Dots, bubbles or other blemishes without both length and depth are not counted at all.

Size range (microns)	1st run
20	**B**
40	**B**
60	**A**
80	**A**
100	**A**

Afton CHEMICAL Passion for Solutions

Ratings grid – see Excel sheet (attached separately)

Sample Code		RATINGS GRID:			
GR-274-					
	Size range (microns)	1st run	2nd run	3rd run	Observations/comments
A	20				
	40				
	60				
	80				
	100				
C	20				
	40				
	60				
	80				
	100				
G	20				
	40				
	60				
	80				
	100				
J	20				
	40				
	60				
	80				
	100				

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Rating options – current focus

- **Count density of scratches at discrete points**
  - Example – count number of scratches every 20 microns
  - Give better feel for range of particles; more info than breakpoint
  - Perhaps better reproducibility
- **Rerun 4 samples using new evaluation of scratches**
  - Same technique for “pulling” samples on Hegman
  - See following for description of technique and examples
  - Fill in attached spreadsheet with data and return to Joe
- **4 samples:**
  - GR-274-A
  - GR-274-C
  - GR-274-G
  - GR-274-J

Method set up/sampling – New round robin

- **Only change is to evaluation of scratches**
- **Hegman Gauge:**
  - Enter the particulars of your Hegman gage (model #, trough size, depth, width, etc.). Your gage should be at least conforming to the agreed upon dimensions – 1” width x 6.25” long with a trough depth going from 0 to 100 microns.
- **Cleaning:**
  - Prior to each run, clean any residual grease off the gage with a rag or paper towel.
  - Using a lint-free material, wipe with an appropriate solvent to thoroughly clean and prepare the surface for the next determination.
- **Sampling:**
  - Use metal spatula to obtain a sample from the container (wood or other materials that are likely to contribute particles should not be used for sampling).

Procedure

- **Sample draw:**
  - Start with a small dollop of grease at the shallow end (0 micron) of the trough. Hold the metal scraper at an 80 to 90 degree angle (slightly angled to the deeper end) and draw the grease along the trough smoothly and evenly. If any gaps are visible or grease coverage is not smooth, use a little more grease and redo.
    - Note: Grease may be pulled toward operator or pushed away but always start at the shallow end and tilt the scraper slightly toward the deep end
  - The entire draw should take 2 to 5 seconds and be done entirely without stopping or hesitation which could cause blemishes on the grease surface.
- **Evaluation:**
  - Starting at the shallow end, evaluate the scratches visible in the surface of the grease. Note the number of scratches that **cross the imaginary line at each of the indicated size markers on the gage** (20, 40, 60, 80 and 100 micron).
  - Fill in the ratings grid with the observed number of scratches for each size marker. I will convert to letter grades in the final report.

Procedure

- **Evaluation (cont):**
  - No magnification or special lighting should be used during the evaluation, but analysts are encouraged to use different viewing angles to determine “true” scratches.
  - Complete 3 runs for each sample
  - If possible, include the actual count of scratches as indicated on the RATING GRID. *(This is helpful for analysis of the data in the round robin but will not be necessary as part of the standard method.)*
  - See attached examples for descriptive explanations that may clarify ratings (Rating Guide – Examples)

Evaluation discussion

- **Observations/Comments:**
  - Make note of questions, observations regarding the method and any clarifications that might be helpful for the final method.
  - While the method, as written, will ultimately require only an A, B or C rating (based on the number of particles present), it would be helpful for the round robin and method development if the raters could provide an approximate number of the actual particles present especially if the rating is an A or a B.
  - If labs have more than one technician who might run this method in the future, it would be great to have more than one data set from that lab. If a second set of data is acquired, please use the same format as above with a clear indication that different technicians have done the evaluation.

Rating guide

- **In general, scratches have both length and depth**
  - An indistinct line which does not appear to extend to the bottom of the trough in the grease is not counted as a scratch
    - Could be softer, smaller thickener particle or other artifact
  - The scratch needs to have some finite length
    - An apparent particle beneath the surface of the grease is not counted as a scratch
    - Bubbles or blemishes in the grease are not scratches

Grease samples

Sample code	Thickener	Solids	Oil	NLGI Grade	Color
B/P	Calcium sulfonate		Mineral	3	Amber
J/N	Polyurea		Mineral	2	Black
I/T	Lithium-12		Mineral	0	Red
G/Q	LiCx	3% MoS2	Mineral	2	Black
A/O	Al-Cx			2	White
H/K	Lithium		Mineral	1	Tan
F/L	Lithium/calcium		Mineral	2	Amber
E/R	CaSO4 Complex		Mineral	2	Green
C/D	LiCx	moly	Synthetic	2	Grey
M/S	LiCx	polymers		1.5	Green

Range of colors: amber, black, red, white, green

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Participants – thank you!

1	Mike Lennon	Afton Chemical	Have sples & some data
2	Dr. Pokhriyal	Indian Oil	
3	Olav Hoeger	Shell	
4	Jeff Bohn	Axel Americas	
5	Matthew Campbell	ExxonMobil	
6	Virginie Chanfray	Condat	
7	Teresa Makuvek	FedChem	Have sples & willing to help
8	C. Sementa/A. Meladino	Monson	
9	Sara Roche	Castrol (Naperville)	
10	Matthew Gregory	Fuchs (Australasia)	
11	Dylan Kletzing/Rich W.	MRG Labs	Have sples; need Hegman
12	Franck Bardin	Total France	
13	Roland Ardai	Axel Christiernsson	Have sples & willing to help
14	George Dodos	Eldons	
15	S. Mitterer/C. Rohbogner	Oelcheck	
16	Ruslan Aziev	Intesmo	
17	Dirk Drees	Falex	
18	Anoop Kumar	Chevron	
19	Joe Huntley	Hydrotex	
20	Matt Bailey	Summit	Have sples & willing to help
21	Kuldeep Mistry	Timken	
22	Sonia Stramare	Blaser Swisslube	Not enough sple left; can help but need more

Early results with new method

		Axel	Axel	Axel	Summit	Summit	Summit	Afton	Afton	Afton	edChem	edChem	edChem
	Size range (microns)	1st run	2nd run	3rd run	1st run	2nd run	3rd run	1st run	2nd run	3rd run	1st run	2nd run	3rd run
A	20	A	A	A	A	A	A	A	B	B	B	A	A
	40	A	A	A	A	A	A	A	A	A	A	A	A
	60	A	A	A	A	A	A	A	A	A	A	A	A
	80	A	A	A	A	A	A	A	A	A	A	A	A
	100	A	A	A	A	A	A	A	A	A	A	A	A
C	20	A	A	A	A	A	A	B	A	B	B	B	B
	40	A	B	B	A	A	B	B	B	A	B	B	B
	60	B	B	B	C	A	B	B	A	A	B	B	B
	80	B	B	B	C	B	B	B	A	B	B	B	B
	100	B	B	B	B	A	B	B	A	A	A	A	B
G	20	A	A	A	B	A	A	B	A	B	C	B	C
	40	A	A	B	B	B	A	B	A	B	B	C	B
	60	B	A	A	C	B	B	A	A	A	B	B	B
	80	A	A	A	B	A	B	A	A	A	A	B	B
	100	A	A	A	B	A	B	A	A	A	B	B	B
J	20	C	B	C	A	A	A	B	C	C	C	C	B
	40	A	B	A	A	A	A	B	B	B	A	B	B
	60	A	A	A	A	A	A	B	A	B	A	A	A
	80	B	A	B	A	A	A	B	A	A	A	A	A
	100	A	A	B	A	A	A	A	A	A	A	A	A

	Axel	Summi	Afton	edCher	Axel	Summi	Afton	edCher
	Average/Final rating				Average/Final			
A	A	A	B+	A-	1	1	3	2
	A	A	A	A	1	1	1	1
	A	A	A	A	1	1	1	1
	A	A	A	A	1	1	1	1
	A	A	A	A	1	1	1	1
C	A	A	B+	B	1	1	3	4
	B+	A-	B+	B	3	2	3	4
	B	B	A-	B	4	4	2	4
	B	B-	B+	B	4	5	3	4
	B	B+	A-	A-	4	3	2	2
G	A	A-	B+	C+	1	2	3	6
	A-	B+	B+	B-	2	3	3	5
	A-	B-	A	B	2	5	1	4
	A	B+	A	B+	1	3	1	3
	A	B+	A	B	1	3	1	4
J	C+	A	C+	C+	6	1	6	6
	A-	A	B	B+	2	1	4	3
	A	A	B+	A	1	1	3	1
	B+	A	A-	A-	3	1	2	2
	A-	A	A	A	2	1	1	1

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Original RR vs new method mini RR

					Size	A	A-	B+	B	B-	C+	C
A/O	**Al-Cx**		**2**	**White**	15 - 25	26	8	5	7	0	0	4
					26 - 50	12	8	6	7	8	3	6
					51 - 80	18	6	5	12	3	3	3
					> 80	38	6	3	2	1	0	0
					20	2	1	1	0	0	0	0
					40	4	0	0	0	0	0	0
					60	4	0	0	0	0	0	0
					80	4	0	0	0	0	0	0
					100	4	0	0	0	0	0	0

					Size	A	A-	B+	B	B-	C+	C
C/D	**LiCx**	**Synthetic**	**2**	**Grey**	15 - 25	12	2	2	15	4	4	11
					26 - 50	3	2	4	7	2	5	27
					51 - 80	4	4	4	4	4	3	27
					> 80	13	2	1	8	3	4	19
					20	2	0	1	1	0	0	0
					40	0	1	2	1	0	0	0
					60	0	1	0	3	0	0	0
					80	0	0	1	2	1	0	0
					100	0	2	1	1	0	0	0

INDUSTRIAL GREASE

Afton CHEMICAL Passion for Solutions

Original RR vs new method mini RR

					Size	A	A-	B+	B	B-	C+	C
G/Q	**LiCx**	**Mineral**	**2**	**Black**	15 - 25	7	3	6	10	5	5	14
					26 - 50	3	6	1	6	3	3	28
					51 - 80	7	4	7	10	4	8	10
					> 80	20	3	4	10	7	0	6
					20	1	1	1	0	0	1	0
					40	0	1	2	0	1	0	0
					60	1	1	0	1	1	0	0
					80	2	0	2	0	0	0	0
					100	2	0	1	1	0	0	0

					Size	A	A-	B+	B	B-	C+	C
J/N	**Polyurea**	**Mineral**	**2**	**Black**	15 - 25	5	5	3	10	5	7	15
					26 - 50	2	3	2	7	6	3	27
					51 - 80	6	6	3	6	8	9	12
					> 80	15	4	4	10	10	2	5
					20	1	0	0	0	0	3	0
					40	1	1	1	1	0	0	0
					60	3	0	1	0	0	0	0
					80	1	2	1	0	0	0	0
					100	3	1	0	0	0	0	0

Additional discussion

- **Forward plan**
  - Continue work with Hegman? If so, how?
  - Other methods deserving effort?
    - Split up? Task forces?
    - Other thoughts?
    - Interest in leading sub-group?
- **Other topics for this WG?**

Final comments

- **The Hegman method is still being discussed as an ASTM standard procedure and will be discussed at the next subcommittee G.**
  - May ask for WG participants to review draft
- **Thanks to everyone for their help in testing & developing this method!**
- **Next meetings:**
  - ASTM D.02 meeting – June 27-28, 2023 (Denver)
  - ELGI Fall WG meetings (Amsterdam)
  - Virtual meetings as necessary or helpful