2008 MOV USERS' GROUP MEETING

COMMERCIAL GRADE DEDICATION AND IN-SERVICE MOV LONG LIFE GREASE TESTING

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Background

FOR SAFETY RELATED APPLICATIONS STATIONS CAN PURCHASE GREASE FROM THE MOV OEM OR FROM OTHER SOURCES INCLUDING LUBE AND MOV DISTRIBUTORS AND/OR REPAIR SHOPS. IN ALL CASES SOME FORM OF VERIFICATION OF THE SHIPMENT IS A GOOD IDEA.

THIS PRESENTATION WILL COVER WHAT TESTS ARE COMMON AND SOME ISSUES, INCLUDING LIMITS.

Background Cont'd

IN-SERVICE TESTING IS SIMILAR BUT THE INTENT IS NOT TO CONFIRM THAT THE GREASE IS WHAT WAS ORDERED BUT WHETHER IT IS FIT FOR CONTINUED SERVICE.

A COMBINATION OF VISUAL AND TACTILE TESTING IS USED BY MANY STATIONS, WHILE A FEW OTHERS ADD SPECIFIC LAB TESTS. THESE WILL BE REVIEWED DISCUSSING THE PROS AND CONS.

Testing

THE MANUFACTURES' CERTIFICATE OF ANALYSIS (COA) FOR EACH BATCH INCLUDES THE FOLLOWING TESTS;

- APPEARANCE
- COLOR
- PENETRATION
- DROPPING POINT
- TIMKEN

MOV Long Life Pail

NLGI Grease Grades

GRADE	PENETRATION
000	445-475
00	400-430
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

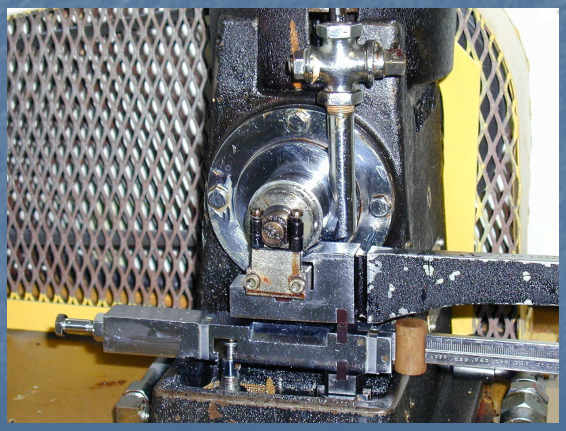
Penetration ASTM D217

Grease Worker

Dropping Point
ASTM D566

Dropping Point
ASTM D2265

Timken ASTM D2509



EPRI Grease Tests

- WORKED PENETRATION: ¼ AND ½ SCALE
- WEIGHT LOSS AFTER AGING
- DROPPING POINT (ASTM D2265)
- INFRARED (FTIR)
- DIFFERENTIAL SCANNING CALORIMETRY (HPDSC)
- RHEOMETER STUDIES – YIELD STRESS
- PIN-ON–DISC (POD), FRICTION & WEAR STUDIES

Acceptance (COA) - Grade 0

APPEARANCE	SMOOTH
COLOR	TAN
PENETRATION, MM/10	355 TO 385
DROPPING POINT, °F (°C)	≥525 (274)
TIMKEN, LB (KG)	≥46 (21)

'Typical' - Grade 0

APPEARANCE	SMOOTH
COLOR	TAN
PENETRATION, MM/10	370
DROPPING POINT, °F (°C)	572 (300)
TIMKEN, LB (KG)	55 (25)

Reject - Grade 0

APPEARANCE	LUMPY
COLOR	BROWN OR BLACK
PENETRATION	OUTSIDE RANGE
DROPPING POINT, °F (°C)	<450 (<232)
TIMKEN, LB (KG)	<25 (<11)

Manufacturing Limits Penetration

	ACCEPTANCE	TYPICAL	REJECT
GRADE 0	355-385	370	<355 or >385
GRADE 1	310-340	325	<310 or >340
GRADE 2	265-295	280	<265 or >295

Penetration Precision

- ASTM D217 reproducibility is ± 20 units.
- ASTM D1403 ¼ and ½-scale reproducibility correspond to ±50 and ±25 units respectively.

Reject 3rd Party Penetration

	¼ Scale	½ Scale	Full Scale
	ASTM D1403	ASTM D1403	ASTM D217
GRADE 0	<305 or >435	<330 or >410	<335 or >405
GRADE 1	<260 or >390	<285 or >365	<290 or >360
GRADE 2	<215 or >345	<240 or >320	<245 or >315

Dropping Point

- ASTM D2265 PRECISION STATEMENTS VALID 19 OUT OF 20 TIMES FOR MEASURED DROPPING POINTS RANGING FROM 277- 316°C;

  A) REPEATABILITY (SAME OPERATOR, SAME SAMPLE) WITHIN 7°C

  B) REPRODUCIBILITY (DIFFERENT LABS, SAME SAMPLE) WITHIN 12°C.

  CONSEQUENTLY, A HIGH AND LOW CAN BE DIFFERENT BY 24°C (43°F).

Typical Acceptance Tests

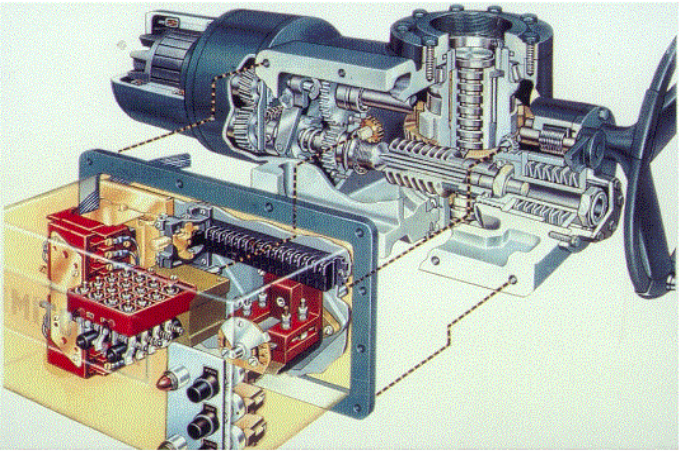
- COLOR
- APPEARANCE
- PENETRATION

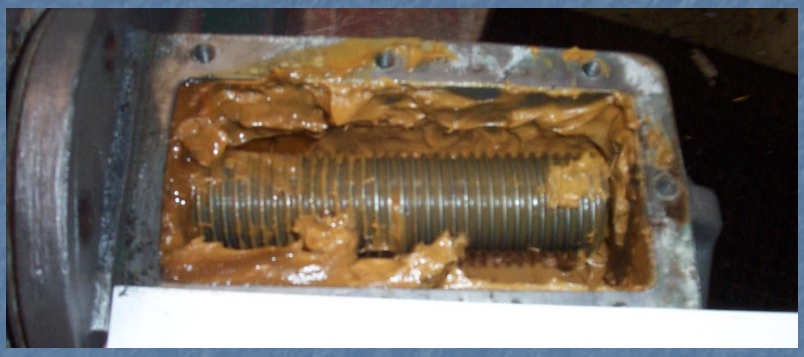
- DROPPING POINT
- FTIR
- METALS

Acceptance Limits

- MUST BE CHOSEN TO TAKE INTO ACCOUNT TEST PRECISION.
- SHOULD ALSO TAKE INTO ACCOUNT RESULTS FROM THAT PARTICULAR TEST SITE, EQUIPMENT AND OPERATOR.
- THE INTENT BEING NOT TO PROOF TEST THE PRODUCT BUT TO DETERMINE IF WHAT WAS ORDERED WAS RECEIVED.

In-service Assessments






SMB-4


04/03/2005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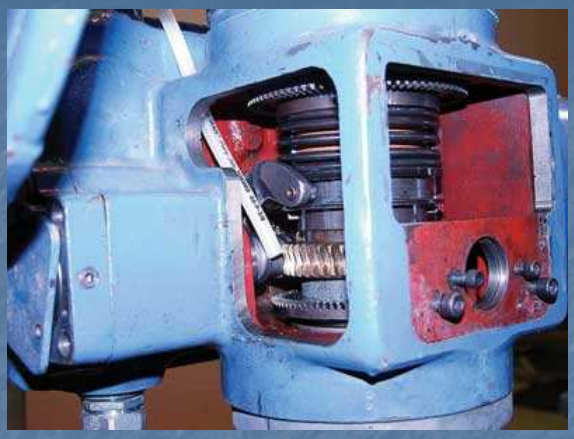
Test Sample Sizes

APPEARANCE	SMALL
FTIR	TRACE
RULER	0.2 ML
HPDSC	1 or 2 G
RHEOMETRY	SMALL
DROPPING POINT	5 G
TACTILE STIFFNESS	SMALL
BLOTTER TEST	SMALL
BASE NUMBER	20 G
EVAPORATION LOSS	25 ML
PIN-ON–DISC (POD)	28 G
PENETRATION: ¼&½ SCALE	15/40 G
OIL SEPARATION	100 G
FOUR BALL WEAR	200 G
DELETERIOUS PARTICLES	200 ML
PENETRATION: FULL SCALE	400 G



SHOWING GREASE SAMPLING WITH A TUBE

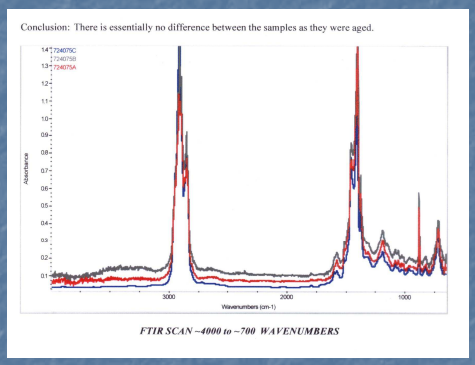
REF: B. BOLT AND C. BROWN

Candidate In-service Tests On Small Samples

- COLOR*
- TACTILE CONSISTENCY TESTING*
- BLOTTER CHROMATOGRAPHY
- RULER
- YIELD STRESS*

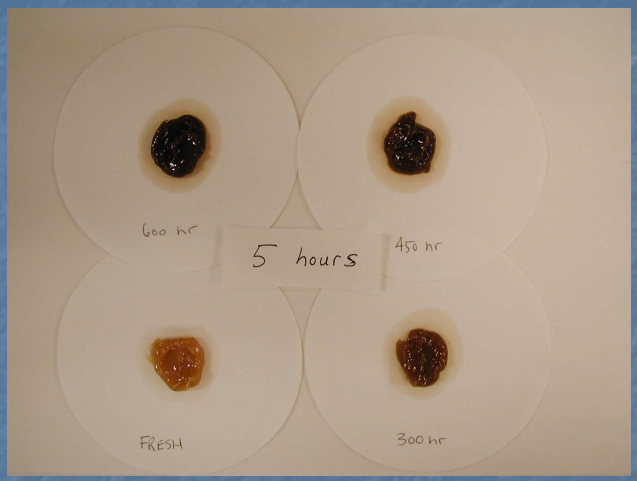
- TOTAL BASE NUMBER
- WEAR METALS

Tests - FTIR



SHOWING NO OBVIOUS
DEGRADATION AFTER AGING AT UP 600 HOURS (302°F)

Tests- Blotter



FRESH AND THREE AGED (302°F) SAMPLES
(LEFT FOR 5 HOURS AT ROOM TEMPERATURE)

Estimated Service Lives

TEMPERATURE		LIFE	
°F	°C	HOURS	YEARS
302	150	600*	0.07
284	140	1200	0.14
266	130	2400	0.27
248	120	4800	0.55
230	110	9600	1.1
212	100	19200	2.2
194	90	38400	4.4
176	80	76800	8.8
158	70	153600	17.5
140	60	307200	35
122	50	614400	70
104	40	1228800	140

*** PREVIOUS GREASE WAS DEAD AT <300 HOURS**

Aged MOV Extra

66 HOURS AT 350°F (177°C)

Aged MOV Extra

66 HOURS AT 350°F (177°C) - STIRRED

MOV Long Life Grade 0

66 HOURS AT 350°F (177°C)

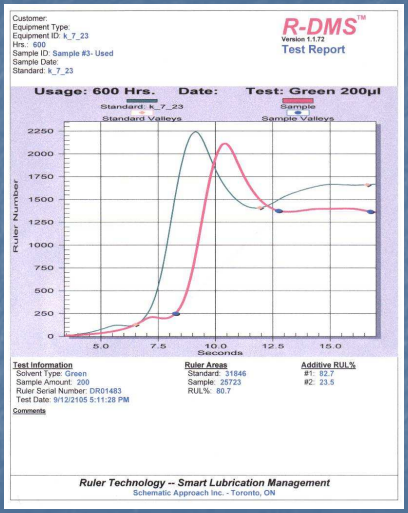
STILL GREASE-LIKE

Previous Calcium Complex

66 HOURS AT 177°C (350°F)

HARD

Tests - Ruler



600 HOURS AGING RESULT

R/S RHEOMETER

Visual And Tactile Assessments

- THE COLOR AND APPEARANCE OF A GREASE IS A VERY HELPFUL FIRST STEP BUT IS SHOULD BE SUPPORTED WITH OTHER TESTS AND BOTH A KNOWLEDGE OF THAT SPECIFIC GREASE AND THE APPLICATION.
- THE CONSISTENCY (FEEL) OF A GREASE CAN ALSO BE VERY HELPFUL.

Assessments

Rating	0-1
Color	Light Tan or any of the following up to but not including dark black.
Texture	Soft buttery texture. Runny, semi-fluid to touch. Still has texture of fresh grease.
Actions	None

Note: Excessive amount of brass or other wear or foreign material at any time is likely cause for immediate action.

Assessments

Rating	2
Color	Carmel to Dark Tan
Texture	Stiffer but returns to like new condition upon stirring or rubbing between fingers. Possibly oil separation or cracking. No tunneling around gears.
Actions	Consider re-grease at next scheduled inspection interval.

Assessments

Rating	3
Color	Chocolate Brown
Texture	Tacky to touch but becomes soft and slippery when pressed and rubbed between fingers. Some loss of oils has occurred. Do a blotter test. No contamination is evident. Lubrication properties still acceptable. Some tunneling at around gears.
Actions	Re-grease and consider scheduling an overhaul at next scheduled inspection interval if soon enough.

Assessments

Rating	4
Color	Dark Brown
Texture	Grease is sticky and does not return to a soft and supple condition when pressed and rubbed between the fingers unless extreme effort is used. Oil separation has occurred and hardened grease globules may be present. Cavitation around gearing is evident. Some contamination is appearing (wear particles, dirt, etc.). Grease may start to smell burnt. Lubrication at a minimal acceptability.
Actions	Notify Supervision. Consider immediate grease replacement or schedule an overhaul at an imminent maintenance window. Do not go another RO.

Assessments

Rating	5
Color	Black
Texture	Grease is dry and lumpy. Virtually no oil remains. Contains wear particles and dirt. Grease will smell burnt. Extreme cavitation around gears is evident. No lubrication qualities remain.
Actions	Notify Supervision. Consider immediate replacement.

Conclusions

1. THERE ARE MANY SIMPLE AND COST EFFECTIVE TESTS THAT CAN BE RUN TO ENSURE THAT THE GREASE SPECIFIED IS WHAT WAS ORDERED.
2. IT IS VERY IMPORTANT THAT THE RESULTS BE INTERPRETED TAKING INTO ACCOUNT THE TEST, THE TEST PRECISION AND THE LAB USED.

Conclusions

3. REJECT LIMITS SHOULD BE APPROPRIATE.

4. IT IS EXPECTED THAT THE USE OF A SUITABLY QUALIFIED 3RD PARTY LAB COULD SIMPLIFY THE PROCESS SO THAT MORE TESTING IS NOT REQUIRED.

Conclusions

5. IN-SERVICE GREASE ASSESSMENTS SHOULD BE COMPLIMENTED WITH LAB TESTING TO ENSURE THAT THE CRITERIA IS APPROPRIATE FOR THE APPLICATION.

6. AN INDUSTRY WIDE COOPERATIVE EFFORT ON IN-SERVICE ASSESSMENTS COULD BE VERY HELPFUL.

Documentation

- EPRI 'COMPARATIVE ANALYSIS OF NEBULA AND MOV LONG LIFE FOR LIMITORQUE MAIN GEARBOX APPLICATIONS, RPT #1003483, DECEMBER 02
- POSITION PAPER, EQUIVALENT REPLACEMENT EVALUATION FOR MOV GEARBOX LUBRICANT, E. CAVEY, MUG FILE 02G-J01, MAY 02
- MOV STEM LUBRICANT AGING RESEARCH, K. DEWALL & J. WATKINS, INEEL/EXT – 02-00975, SEP 02. ALSO MUG FILE 03J-P21, HANDOUTS JAN 03
- RATE OF LOADING, F. BENSINGER (FLOWSERVE), MUG FILE 03J-P07, HANDOUTS JAN 03
- MOV LONG LIFE MUG PRESENTATIONS
  - ALL-IN-ONE, AN UPDATE ON MOV LONG LIFE, MUG FILE 03J-P04
  - MOV LONG LIFE LIMITSWITCH APPLICATIONS, MUG FILE 04J-P07 & P11
  - MOV LONG LIFE CONDITION MONITORING, 05
  - MOV LONG LIFE CONDITION MONITORING UPDATE, 06
  - MOV GREASE WEAR TESTING, K. BROWN ET AL, 07

THANK YOU