

Rock Drill OEMs and Test Methods

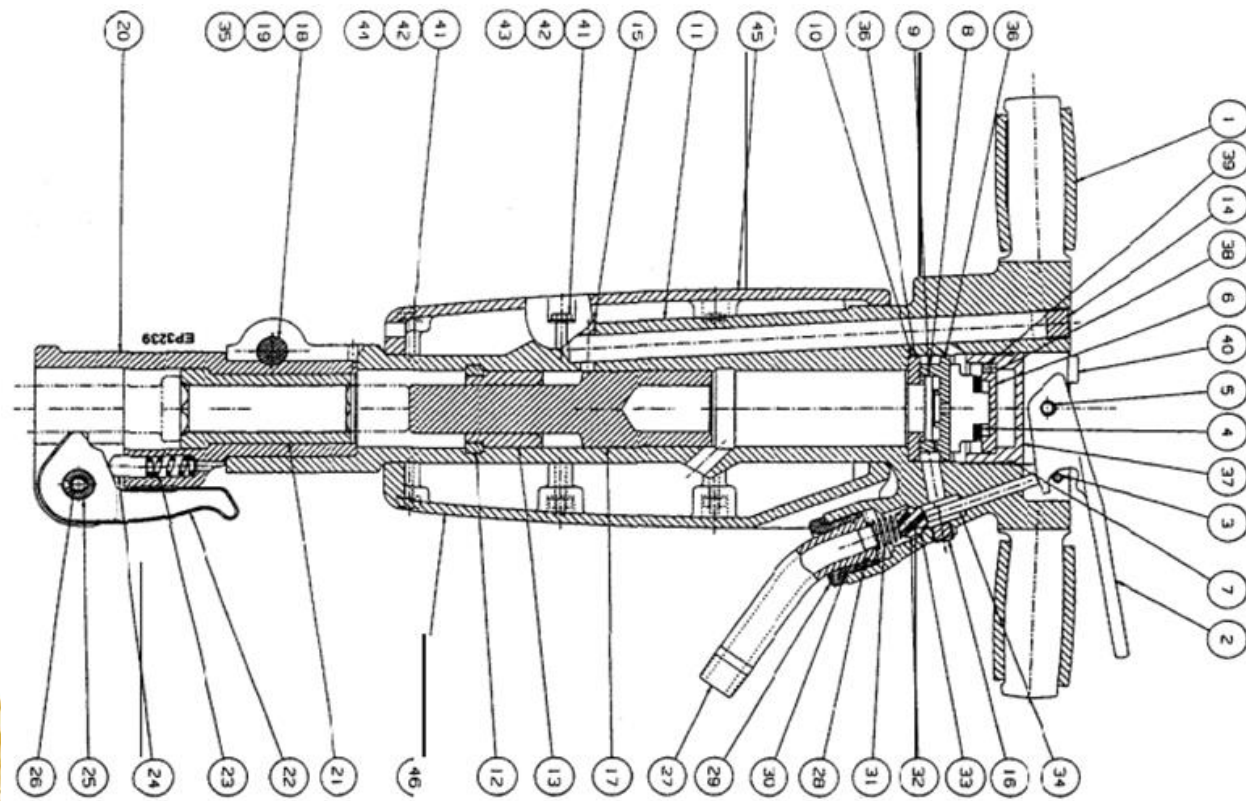
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- I-R equipment typically specifies lubricant requirements in product manual

Proper lubrication is the most important single factor responsible for the service life of a pneumatic jackhammer. A jackhammer can be seriously damaged during the first few minutes of operation if it is not properly lubricated.

Improper lubrication will prevent proper indexing of the rotation and ultimately reduce the rotation speed. Prolonged usage of the jackhammer without proper lubrication will cause damage to the unit. Always use an air line lubricator with these tools. Install the Lubricator approximately 11.5 ft. (3.5 m) from the tool.



- Three RD grades for everything from handheld air tool to downhole drill
 - Same from 1990's to 2020's
 - Typically listed out in each product manual

Rock Drill Oil Specifications

Characteristic	Test Procedure	Below 20° F (-7° C)	20° to 90° F (-7° to 32° C)	Above 90° F (32° C)
Viscosity:				
SUS at 100° F (38° C)	ASTM-D2161	175 Min.	450 Min.	750 Min.
SUS at 210° F (99° C)	ASTM-D2161	46 Min.	65 Min.	85 Min.
cST at 104° F (40° C)	ASTM-D445	37 Min.	105 Min.	160 Min.
cST at 212° F (100° C)	ASTM-D445	6 Min.	11 Min.	16 Min.
Pour Point, ° F (° C) Max.	ASTM-D97	-10° F (-23° C)	-10° F (-23° C)	0° F (-18° C)
Flash Point, ° F (° C) Min.	ASTM-D92	370° F (188° C)	400° F (204° C)	450° F (232° C)
Viscosity Index, Min.	ASTM-D2270	90	90	90
Steam Emulsion No. Min.	ASTM-1935-65	1200	1200	1200
Consistency	---	Stringy	Stringy	Stringy
Falex Load Test lbs. (kg) [Min.]	ASTM-D2670	2000 lbs. (907 kg)	2000 lbs. (907 kg)	2000 lbs. (907 kg)
Timken E. P. Test lbs. (kg) [Min.]	ASTM-D2782	30 lbs. (14 kg)	30 lbs. (14 kg)	30 lbs. (14 kg)

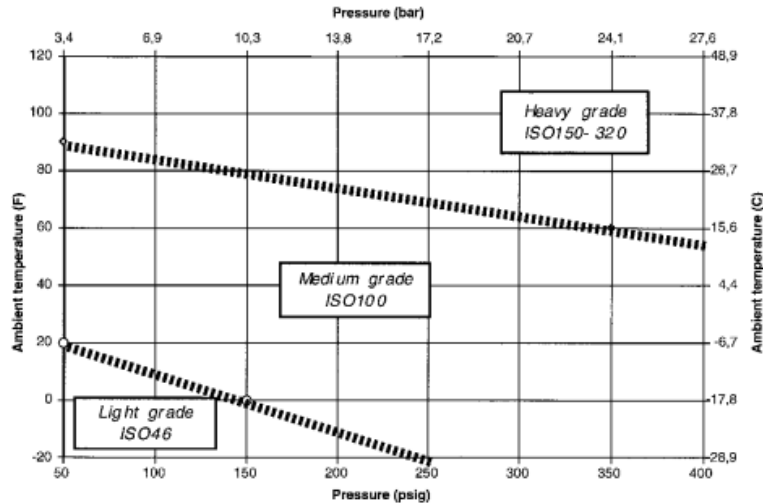
Lubrication (not provided with the tool)

- SAE 20 light oil recommended for temperatures below 20 degrees Fahrenheit.
- SAE 30 medium oil recommended for temperatures between 20 and 90 degrees Fahrenheit.
- SAE 50 heavy oil recommended for temperatures above 90 degrees Fahrenheit.

EN-2

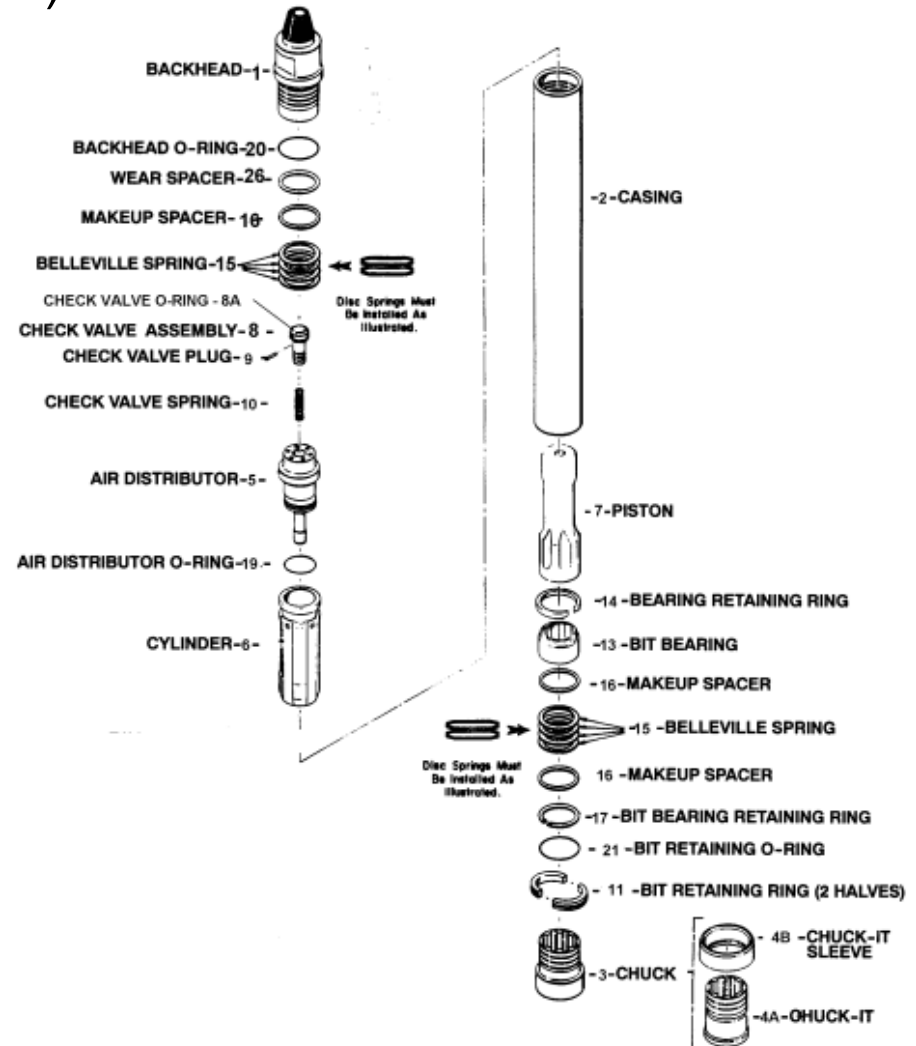
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- 2003: I-R Downhole Drill (DHD Classic)
 - Uses same oils as a jackhammer



Supertac Rock Drill Oil Part Numbers

Grade	1 Gallon (3.8 Liter)	5 Gallon (18.9 Liter)	55 Gallon (208 Liter)
Light	52334174	52333192	52333200
Medium	52334182	52333218	52333226
Heavy	52334190	52333234	52333242



DHD SF6 - EXPLODED VIEW

- Merged with Ingersoll-Rand in 2020
- “Gardner-Denver Ground Bearing Test”
 - No details available
 - 300,000 psi film strength test
 - Advertised by two ILMAs for rock drill
 - “300,000 psi” claim commonly used for MoS₂ or solid EP



- BTE Mid-Western
 - Smaller rock drill OEM
 - S83 jackleg line acquired from Gardner-Denver in mid 1980's



Viscosity for Air Temperatures	ISO Viscosity Grade	Minimum Flash Point	Pour Point	Pin Wear Test Film Strength (PSI)	Steam Emulsion Number
Below 20F (7C)	32	360F (182C)	-55F (-48C)	300,000	1,200+
20F to 40F (-7C to 4C)	68	405F (207C)	-30F (-34C)	300,000	1,200+
40F to 80F (4C to 27C)	100	420F (216C)	-10F (-23C)	300,000	1,200+
80F to 110F (27C to 43C)	150	445F (229C)	-5F (-21C)	300,000	1,200+
Above 110F (43C)	220	470F (243C)	5F (-15C)	300,000	1,200+

- Swedish firm, bought Gardner-Denver's downhole drilling line in mid 2000's
- Biobased ISO 32 / 46 / 68 rock drill oils

TECHNICAL DATA COMPARISON					
	BioBlend RDP 100	Mobil Almo 527	Shell Torcula 100	Chevron Aries 100	Atlas Copco Rock Drill Oil
ISO grade	100	not listed	100	100	46
Viscosity @ 40°C	100,0	112,9	100,0	95,0	46,0
Viscosity @ 100°C	19,3	11,4	11,6	10,9	8,9
Viscosity index	>220	91	104	98	>214
Pour point °C	-35	-30	-33	-31	-35
Flash point °C	>315	204	263	230	>279
Timken OK load	>27 kg	not listed	23 kg	30 kg	35 kg
Falex E.P.	3500	not listed	not listed	3200	>10 000
Biodegradability	>90%	Environmentally persistent	Environmentally persistent	Environmentally persistent	>99%

- Ingersoll-Rand:
 - Light: SAE 20, typically a little heavier than ISO 32
 - Medium: SAE 30, typically ISO 100
 - Heavy: SAE 50, typically a little heavier than ISO 150
- ISO 46 – all season
- ISO 68 – #20
- ISO 100 – #30
- ISO 150 – #40
- ISO 220 – #50



- Chevron Aries rock drill oils
 - Tacky, emulsifying, ashless

	32	46	100	150	220	320
<i>Product Number</i>	273254	273265	273266	273272	273268	273267
<i>SDS/MSDS Number</i>						
<i>USA</i>	26143	23516	23516	23516	23516	23516
<i>Colombia</i>	—	—	33458	—	—	—
API Gravity	25.2	32.2	31.5	29.8	28.8	26.7
Viscosity, Kinematic						
cSt at 40°C	32	46	100	150	220	320
cSt at 100°C	5.3	6.7	11.3	15.0	19.2	24.4
Viscosity, Saybolt						
SUS at 100°F	162	236	524	790	1163	1696
SUS at 210°F	43	48	66	81	98	118
Viscosity Index	95	98	98	99	98	97
Flash Point, °C(°F)	140(284)	210(410)	230(446)	260(500)	260(500)	260(500)
Pour Point, °C(°F)	-42(-44)	-33(-27)	-30(-22)	-30(-22)	-24(-11)	-18(0)
Timken OK Load, lb	-	60	65	65	70	75
Falex EP Fail Load, lb	-	3200	3200	3200	3200	3200
Steam Emulsion Number	>1200	>1200	>1200	>1200	>1200	>1200

- Mobil Almo rock drill oils
 - Emulsifying, no mention of tack or ashless

Property	ALMO 524	ALMO 525	ALMO 527	ALMO 529	ALMO 530	ALMO 532
Grade	ISO 32	ISO 46			ISO 220	ISO 320
Density @ 15.6 C, kg/l, ASTM D4052	0.88	0.883	0.899	0.893	0.898	0.902
Flash Point, Cleveland Open Cup, °C, ASTM D92	170	188	220	220	220	232
Kinematic Viscosity @ 100 C, mm ² /s, ASTM D445	5.5	7.3	11.5	16.5	19.7	24.9
Kinematic Viscosity @ 40 C, mm ² /s, ASTM D445	32	46	100	172	220	320
Pour Point, °C, ASTM D97	-51	-30	-27	-24	-24	-21
Viscosity Index, ASTM D2270	108	105	100	102	100	99

**I-R
Medium**

**I-R
Heavy**

- Oil sample emulsified with low pressure steam and allowed to separate
 - Obsolete now, still specified in some turbine, cylinder, and rock drill oils
 - Replaced by ASTM D1401, a more dynamic test which includes stirring

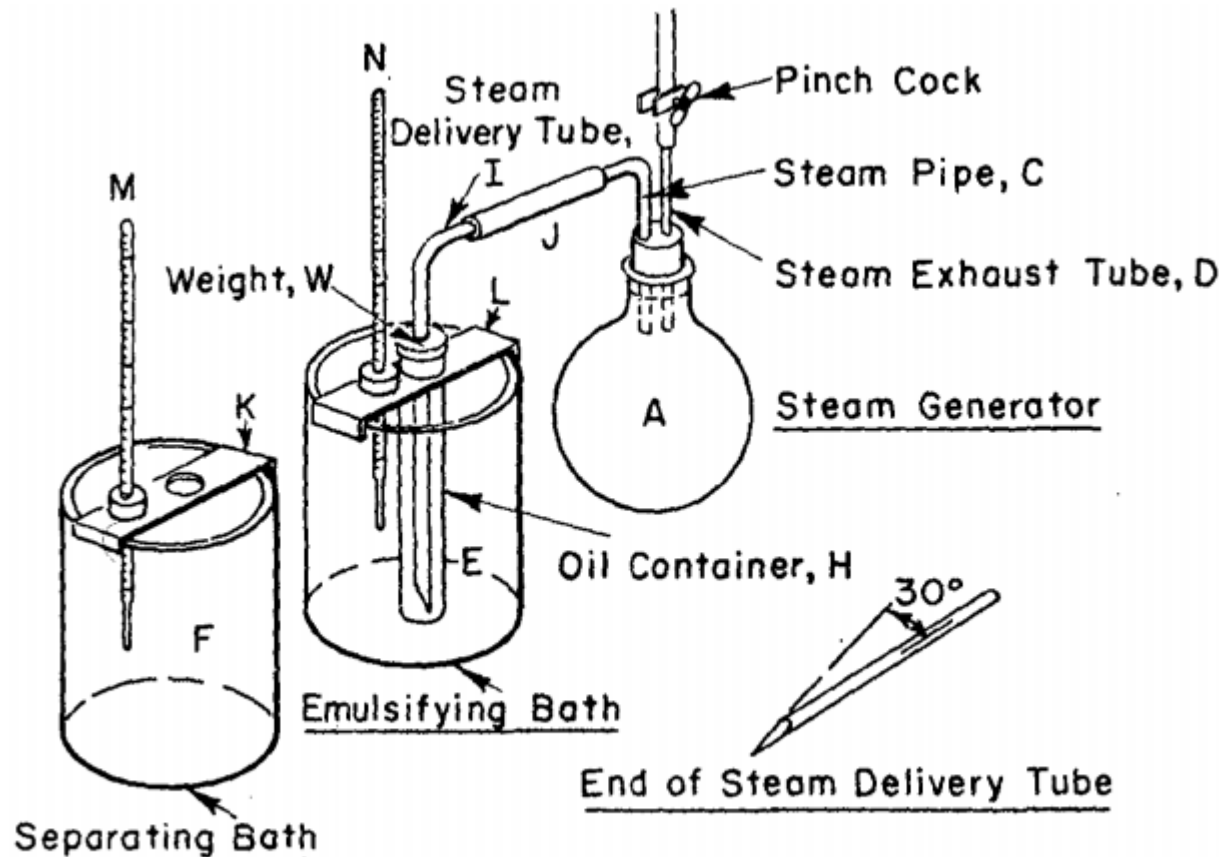
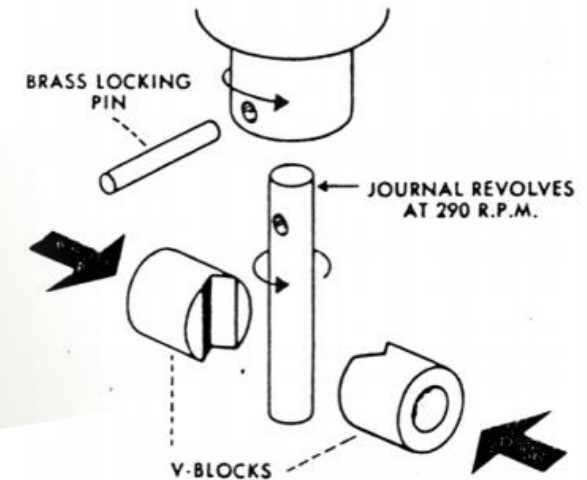
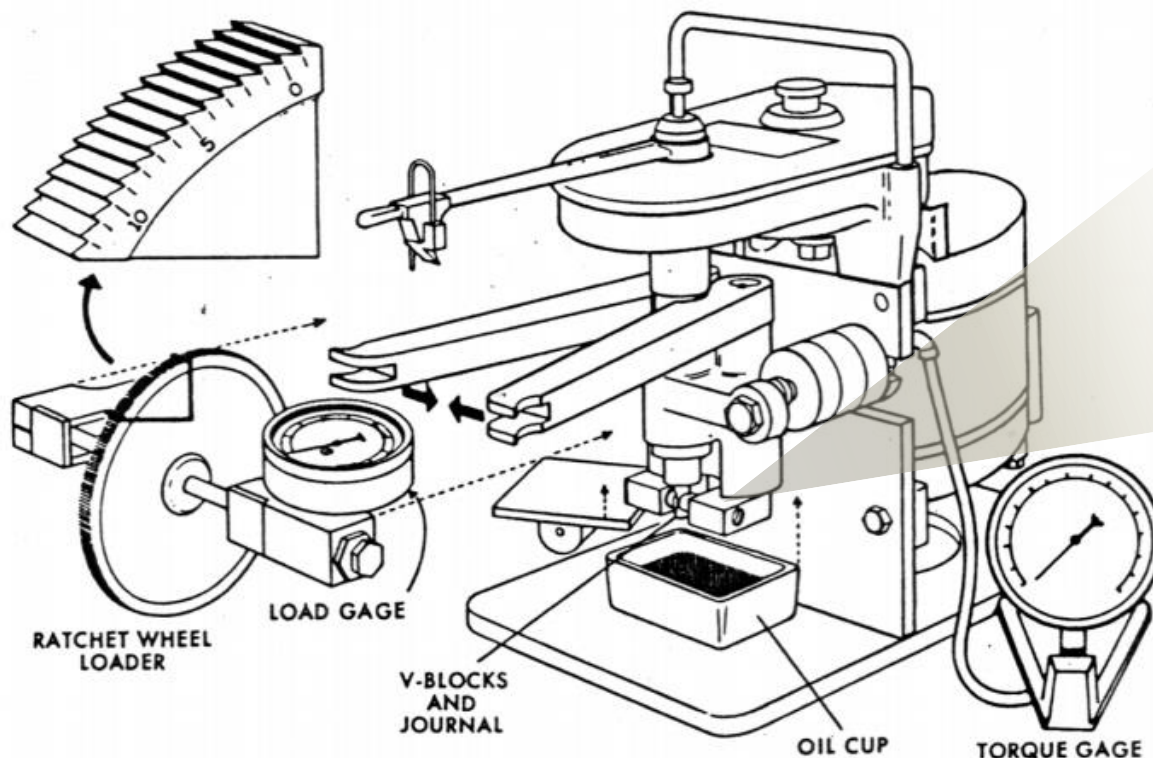


FIG. 1.—Apparatus for Steam Emulsion Test.

- Older rock drill specifications (I-R) specify a failure load for ASTM D2670
 - But D2670 is a wear method
 - Reports mm wear or number of teeth the loading ratchet advances
 - ASTM D3233 (Falex Pin & Vee EP) reports load
 - I-R may refer to using the D2670 equipment for EP (= D3233)



- Test method for measuring the EP properties of a lubricant
 - Steel cup spinning on steel block at 800 rpm
 - Load increased until film breakthrough and scoring occurs
- OK load reported as last load which did not produce scoring
- Requires a gallon of sample

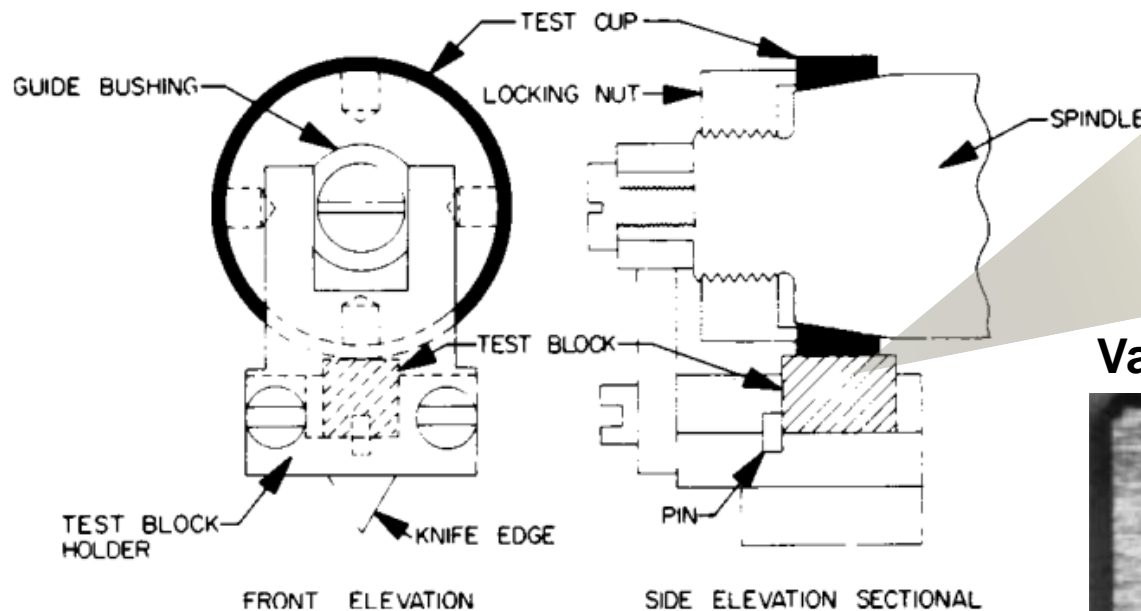
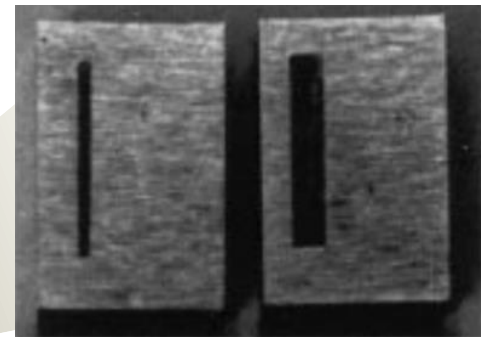
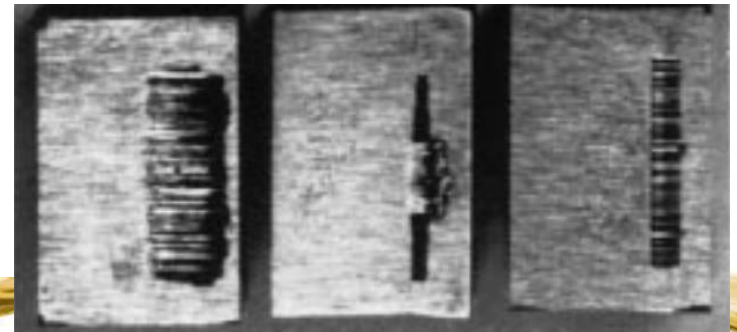


FIG. 3 Assembly of Tester Showing Test Pieces

Low and Moderate Wear



Various Types of Scoring (Fail)



- Typically include additional, more modern test methods:
 - ASTM D1401 – water separability
 - Allows detailed comparison between emulsifying and demulsifying
 - ASTM D2783 – 4-ball extreme pressure
 - Popular method for benchmarking EP protection
 - ASTM D5182 – FZG scuffing load capacity
 - Measures scoring on low speed high torque gear set
 - 12 stages
 - Other basic tests like D892 foam, D130 copper corrosion, D665 rust



- 1:1 water and lube stirred at 1500 rpm in graduated cylinder for 5 minutes
 - Volume in mL of oil / water / emulsion measured over time
- Every 100 seconds of D1935 ~ 10 min of D1401 (for a small sample set)
 - 1200 second Steam Emulsion No. = 40/40/0 (120) *roughly*

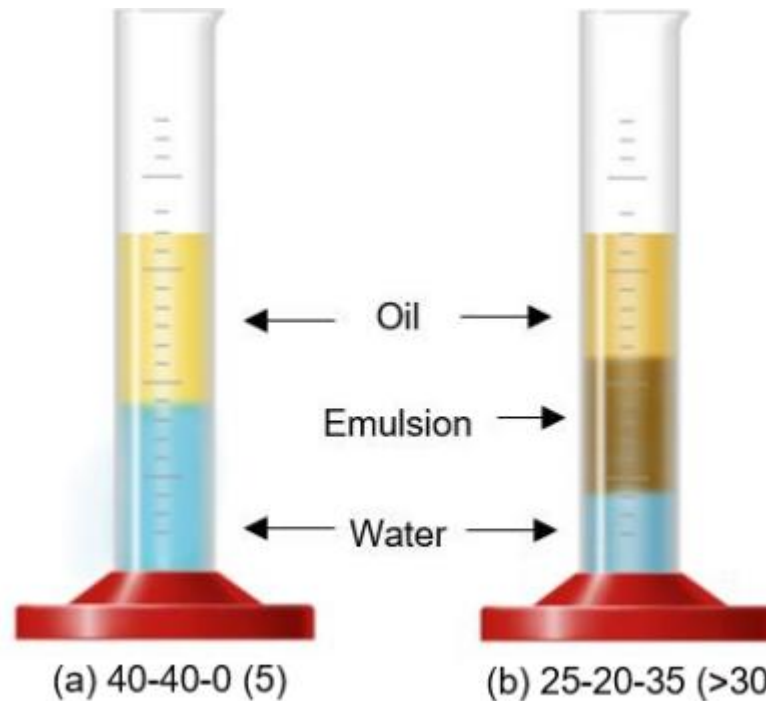
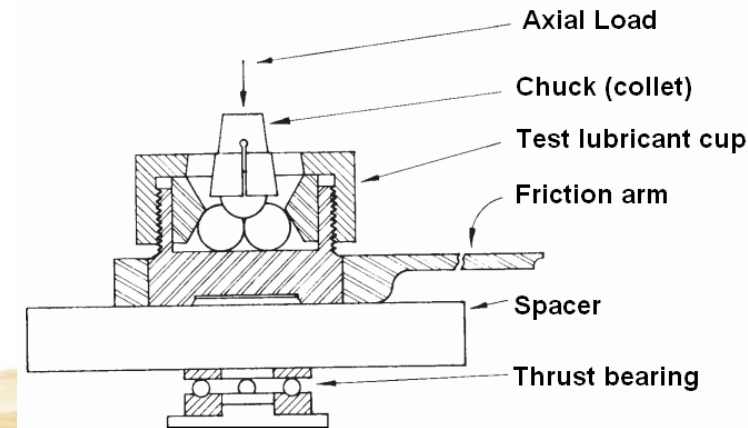


Figure 3 : Example Demulsibility Test Measurements.

- 4-ball test geometry that loads three stationary balls with one rotating ball
 - 1760 rpm for 10 seconds then scar dia. of bottom balls are measured
 - Load increased in stages, new balls used each time
- “Weld load” or “weld point”
 - Load in kg at which the four balls seize or have excess scar (>4mm dia.)
 - Reported as the load at which weld/failure occurs
 - Unlike Timken OK which is reported as the load before failure
- Last non-seizure load (LNSL)
 - Transition between AW and EP behavior
 - Scar size increases rapidly after LNSL
 - Fluid film broken, metal-on-metal



- Load wear index (LWI)
 - Essentially: average of load / scar size for last ten loads before weld
 - Requires several correction factors and some involved math
 - Indirect way of comparing EP lubricants, hard to interpret
- Limiting pressure of seizure (LPOS)
 - Converts load and scar from last non-seizure load into an effective pressure (in N/m^2) under which the film strength fails
 - Good data point for comparing samples with same weld load
 - Used to informally classify level of EP protection (GL-4 vs. GL-5, etc.)



- Low speed high torque gear set is misaligned and loaded until excess wear
 - 12 stages, 15 minutes each
 - Second test for stages >12
- Very common in industrial gear oils (12-14 stage) and high end HF (10 stg.)
 - ASTM D5182, DIN 51534, CEC L-07

