TELEPHONE 312-844-4000 · TELEX 720-424

DMB

PRATT

HENRY PRATT COMPANY

creative engineering for fluid systems

401 SOUTH HIGHLAND AVENUE · AURORA, ILLINOIS 60507

March 8, 1984

Nuclear Regulatory Commission
Region 3 Office
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Attention: Mr. James G. Keppler, Director
Office of Inspection and Enforcement

Subject: G.H. Bettis 10CFR Part 21 Report No. CAR #0023
ADVISORY NOTIFICATION

Dear Mr. Keppler:

This letter is a follow-up to our notification to you on February 20, 1984.

Henry Pratt Company has reviewed G.H. Bettis and Pratt records and identified potentially affected actuators.

Potentially affected nuclear valve/actuators as originally supplied by Pratt for use in domestic nuclear plants were furnished to Florida Power and Light - St. Lucie #2 and TVA - Stride (Hartsville and Phipps Bend).

Attached please find copies of letters of notification to these utilities identifying such valve/actuators. Also enclosed is a revised copy of CAR #0023 dated February 13, 1984.

Very truly yours,

A. K. Wilson
Vice President
Manager of Engineering

AKW/np
Enclosures
CC: H. C. Schwenk
G. A. Kurkjian
W. A. Amundsen
B. R. Cummins
R. Kane, G.H. Bettis
T. J. Petermann
C. A. Chandley, TVA
W. F. Malek, FPL (c/o Ebasco)

50-389
50-518
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TELEPHONE 312-844-4000 TELEX 720-121

PRATT

HENRY PRATT COMPANY

401 SOUTH HIGHLAND AVENUE · AURORA, ILLINOIS 60507

March 8, 1984

Florida Power & Light
c/o Ebasco Services, Inc..Agent
1111 So. Federal Highway
Stuart, FL 33494

Attention: Mr. Walter F. Malek
Supervising Mechanical Engineer

Subject: St. Lucie #2

Dear Mr. Malek:

Attached please find G.H. Bettis 10CFR21 Report No. CAR#0023 Advisory Notification dated 2/13/84. This report advised that actuator stroking time may be lengthened to beyond 15 seconds by the swelling action of ethylene propylene seals when used with hydrocarbon based lubricants (Mobilgrease 28).

Review of Pratt/Bettis records indicates that the below listed actuators furnished with Pratt valves may be affected.

Pratt Job No.	Qty.	Bettis Model	Valve Tag No.
D-0096-10	2	N721C-SR40-as-M3	1-FCV-25-20&21
D-0096-11	1	N721C-SR40-12-M3	1-FCV-25-26
D-0095-4	4	T310-SR-5	1-HCV-14-1,2,6&7

Please evaluate the safety impact of this information as related to your application of these valve/actuator assemblies.

Instructions for corrective action are included on Page 2 of the G.H. Bettis 10CFR21 Report No. CAR#0023 dated February 13, 1984.

Very truly yours,

Bruce R. Cummins

B. R. Cummins
Quality Assurance Manager

BRC/np
Enclosure
CC: A. K. Wilson
R. D. Nelson
U.S.N.R.C. Region III, Glen Ellyn, IL
T. J. Petermann
R. Kane - G.H. Bettis

TELEPHONE 312-844-4000 TELEX 720-121

PRATT

HENRY PRATT COMPANY

401 SOUTH HIGHLAND AVENUE · AURORA, ILLINOIS 60507

March 8, 1984

Mr. C. A. Chandley
Chief Mechanical Engineering Branch
Tennessee Valley Authority
W7C126
400 West Summit Hill Drive
Knoxville, TN 37902

Subject: TVA/Stride (Hartsville & Phipps Bend)

Dear Mr. Chandley:

Attached please find G.H. Bettis 10CFR21 Report No. CAR#0023 Advisory Notification dated 2/13/84. This report advised that actuator stroking time may be lengthened to beyond 15 seconds by the swelling action of ethylene propylene seals when used with hydrocarbon based lubricants (Mobilgrease 28).

Review of Pratt/Bettis records indicates that the below listed actuators furnished with Pratt valves may be affected.

Pratt Job No.	Qty.	Bettis Model	Valve Tag No.
D-0151-1	2	N732C-SR-100-12	P38-FF001A&B
D-0151-3	8	N732C-SR-100-12	X73-FF006A&B
			X73-FF008A&B
			X73-FF010A&B
			X73-FF007A&B
D-0154-1	2	NT-310B-SR4-12	P38-FF001A&B
	8	NT-310B-SR4-12	X-73FF006A&B
			X73-FF008A&B
			X73-FF010A&B
			X73-FF007A&B
D-0154-4	2	N722C-SR80-12	T41-FF030A&B
D-0154-5	2	N722C-SR80-12	T41-FF044&045
D-0154-6	2	NCB725-SR80-12	P38-FF003A&B
D-0154-8	2	NCB725-SR80-12	X73-FF007A&B
D-0155-1	2	NCB725-SR80-12	X63-FF00?A&B
D-0155-15	2	NCB725-SR80-12	X63-FF00?A&B
D-0157-1	2	NT310B-SR4-12	P38-FF001A&B
D-0157-3	8	NT310B-SR4-12	X73-FF006A&B
			X73-FF008A&B
			X73-FF010A&B
			X73-FF007A&B
D-0157-4	2	N722C-SR80-12	T41-FF030A&B
D-0157-5	2	N722C-SR80-12	T41-FF044&045
D-0157-6	2	NCB725-SR80-12	X73-FF003A&B
D-0157-8	2	NCB725-SR100-12	X73-FF007A&B

PRATT

Tennessee Valley Authority
Mr. C. A. Chandley
March 8, 1984

Please evaluate the safety impact of this information as related to your application of these valve/actuator assemblies.

Instructions for corrective action are included on Page 2 of the G.H. Bettis 10CFR21 Report No. CAR#0023 dated February 13, 1984.

It is our understanding that some of these valve/actuator assemblies have been transferred to other Nuclear plants. Unless notified by you in writing to the contrary, we will assume that you will notify these Nuclear plants and we would appreciate receiving a copy of such notifications.

If we may be of further service, do not hesitate to contact us.

Very truly yours,

Bruce R. Cummins

B. R. Cummins
Quality Assurance Manager

BRC/np
Enclosure
CC: A. K. Wilson
R. D. Nelson
T. J. Petermann
R. Kane - G.H. Bettis
U.S.N.R.C. Region III, Glen Ellyn, IL

D-0158-1	2	NCB725-SR80-12	X63-FF009A&B
D-0158-15	2	NCB725-SR80-12	X63-FF007A&B
D-0164-1	2	NCB725-SR80-12	X63-FF009A&B
D-0164-15	2	NCB725-SR80-12	X63-FF007A&B
D-0163-1	2	NT310B-SR4-12	P38-FF001A&B
D-0163-3	8	NT310B-SR4-12	X73-FF006A&B
			X73-FF008A&B
			X73-FF010A&B
			X73-FF007A&B
D-0163-6	2	NCB725-SR80-12	P38-FF003A&B
D-0163-8	2	NCB725-SR80-12	X73-FF007A&B
D-0150-7	2	NCB520-SR100-12	X63-FF007A&B
D-0151-6	2	NCB725-SR80-12	P38-FF003A&B
D-0151-8	2	NCB725-SR100-12	X73-FF007A&B
D-0152-1	2	NCB725-SR80-12	X63-FF009A&B
D-0152-15	2	NCB725-SR80-12	X63-FF007A&B
D-0159-7	2	NCB520-SR100-12	X63-FF007A&B
D-0160-1	2	NT310B-SR4-12	P38-FF001A&B
D-0160-3	8	NT310B-SR4-12	X73-FF006A&B
			X73-FF008A&B
			X73-FF010A&B
			X73-FF007A&B
D-0160-6	2	NCB725-SR80-12	P38-FF003A&B
D-0151-4	2	N722C-SR80-12	T41-FF030A&B
D-0151-5	2	N722C-SR80-12	T41-FF044&045
D-0161-1	2	NCB725-SR80-12	X63-FF009A&B
D-0161-15	2	NCB725-SR80-12	X63-FF007A&B
D-0160-8	2	NCB725-SR100-12	X73-FF007A&B
D-0163-4	2	N722C-SR80-12	T41-FF030A&B
D-0163-5	2	N722C-SR80-12	T41-FF044&045
D-0167-1	2	NCB725-SR80-12	X63-FF009A&B
D-0167-15	2	NCB725-SR80-12	X63-FF007A&B
D-0166-1	2	NT310B-SR4-12	P38-FF001A&B
D-0166-3	8	NT310B-SR4-12	X73-FF006A&B
			X73-FF008A&B
			X73-FF010A&B
			X73-FF007A&B
D-0166-6	2	NCB725-SR80-12	P38-FF003A&B
D-0166-8	2	NCB725-SR100-12	X73-FF007A&B
D-0160-4	2	N722C-SR80-12	T41-FF030A&B
D-0160-5	2	N722C-SR80-12	T41-FF044&045
D-0165-7	2	NCB520-SR100-12	X63-FF007A&B
D-0166-4	2	N722C-SR80-12	T41-FF030A&B
D-0166-5	2	N722C-SR80-12	T41-FF044&045
D-0160-9	2	NCB522-SR80-12	X73-FF009A&B
D-0151-9	2	NCB525-SR80-12	X73-FF009A&B
D-0154-9	2	NCB525-SR80-12	X73-FF009A&B
D-0157-9	2	NCB525-SR80-12	X73-FF009A&B
D-0163-9	2	NCB525-SR80-12	X73-FF009A&B
D-0166-9	2	NCB525-SR80-12	X73-FF009A&B

A Galveston-Houston Company

18703 GH Circle
P.O. Box 508
Waller, TX 77484
Telex 76 2713
(713) 463-5100

Q: AKW

February 20, 1984

Henry Pratt Company
401 S. Highland Avenue
Aurora, IL 60507

Attention: Mr. Bruce Cumming

Dear Mr. Cumming:

Enclosed is a copy of the previous response to the 10CFR-21 report filed by GH-Bettis on November 18, 1983. The only differences between this copy and the previously sent copies are:

1.) The original date of distribution is now included on the Abstract page.

2.) The Summary page at part 1 reflects the NT310-SR4 & 5, NT312-SR5 instead of T310-SR4 & 5, T312-SR5.

3.) Each of the pages have been properly numbered.

We greatly apologize for the above mentioned oversights and hope this will rectify the problem.

Also note, the response sent to the U.S. Nuclear Regulatory Commission, for the above mentioned 10CFR-21 report, is identical to the response sent to you, including all updates and revisions.

If we may be of any further assistance, please do not hesitate to contact us.

Sincerely,

GH-BETTIS

Richard T. Upton

Richard T. Upton
Manager, Research and Development Engineering

RTU/jw
enc:
cc: W. N. Bitterman
R. R. Kane
A. T. Locascio
S. Davis
N. D. Quam

10CFR21 REPORT NO. CAR#0023

ADVISORY NOTIFICATION

FEBRUARY 13, 1984

February 13, 1984

ABSTRACT

Actuator stroking times can be lengthened to beyond 15 seconds by the swelling action of ethylene propylene seals when used with hydrocarbon based lubricants.

IEEE 382-1977 section 6.3, in-house testing and technical literature supplied by other organizations was used as a basis for the upgrade to Molykote 44 silicone lubricant from the synthetic hydrocarbon Mobilgrease 28 lubricant.

Periodically exercising of installed units can be used as a guide for determining when maintenance is required.

Henceforth, Molykote 44 will be used in the construction of all new 'N' series actuators.

Summary

GH-Bettis issued a 10CFR-21 report on November 18, 1983. This report was based on GH-Bettis laboratory testing of a series of nuclear qualified actuators. The results of these tests indicated that there existed a potential degradation of actuator stroking times related to elapsed time from original manufacture. The reason for this potential degradation of actuator performance was traced to the specific combination of seals and grease used in original manufacture. The Ethylene Propolene seals absorbed hydrocarbons from the grease causing them to swell. Seal swell increased the time required to initialize stroke. Both the seal material and grease were identical to those tested in GH-Bettis qualification report 37274 which has been submitted to and approved by all GH-Bettis nuclear customers. Engineering analysis and laboratory testing have yielded the following conclusions:

1. The GH-Bettis actuators identified as having the potential of stroking speeds greater than 15 seconds are NCB Series, N52X, N72X, N73X series and the NT310-SR4 & 5, NT312-SR5. The 15 second stroking time was selected as representative of customer specifications submitted for safety related pneumatic valve actuators.

2. The remainder of the NT series GH-Bettis actuators did not suffer degradation in stroking times beyond normal operating limits.

3. Stroking of actuators at frequent intervals appears to inhibit stroking time degradation. Therefore, "exercising" actuators at a minimum of 15 day intervals while monitoring initial stroking times will provide positive indication of actuator performance. This procedure has long been recommended by GH-Bettis as a reliable method to minimize the effects of seal "set". Seal "set" or flattening at the contact surface can cause jerky operation and/or leakage.

4. Any installed actuator that fails to stroke within the time limit as originally specified must be serviced immediately with new seals and Dow Corning Molykote 44 lubricant.

   Actuators that are presently in storage must be serviced with new seals and Dow Corning Molykote 44 lubricant prior to placing into service.

5. Henceforth all GH-Bettis qualified actuators will be manufactured using Dow Corning Molykote 44 silicone grease.

Appendix A

Engineering analysis, laboratory testing and consultation with many suppliers research departments have yielded a great deal of information about seals and lubricants. The application of this information to actuators indicates that each design is effected differently. Results indicate that the NCB Series, the N52X, N72X, N73X series and the NT310-SR4 and SR5, NT312-SR5 actuators potentially can degrade to stroking times greater than 15 seconds. This projection is based on worse case analysis. The remainder of the NT series actuators are not projected to degrade in stroking time.

To explain: the actuator seals (ethylene propylene) swell when in contact with the Mobil 28 grease currently used in the manufacture of 'N' series actuators. Seal swell increases seal loading causing greater time required to initialize motion. This problem is a function of seal contact area as it relates to the force available from the actuator piston or spring. As a result the larger the actuator the smaller the effect. In addition the magnitude of stroking time degradation is related to the elapsed time between actuator cycles. The longer the actuator remains stationary the more "set" the seals take. The "set" characteristic causes the seal to form an intimate contact with the sealing surfaces further increasing the time required to initialize stroke. Once the actuator begins to stroke, the seals begin to recover their original shape, thus freeing the unit up. Stroking the actuator three or more complete cycles using pressurize gas will cause the seals to recover sufficiently to reduce stroking time to a minimum. No seal degradation has been traced to periodic actuator stroking, quite the opposite has been experienced. Frequent stroking tends to extend seal life resulting in longer actuator cycle life.

Units should be stroked or exercised at intervals of no more than 15 days. Observation of initial stroke time will provide accurate interpretation of actuator condition and may be used to determine when maintenance is required. Units that are in storage will also benefit from this procedure which has long been recommended by GH-Bettis. This procedure is applicable to all GH-Bettis actuators and has been published under the title "Operating, Storage and Maintenance Instructions for Bettis Rotary Valve Actuators" (3).

(3) Refer to attached data sheets.

Appendix B

GH-Bettis laboratory test results and vendor supplied industry accepted specifications for lubrication have yielded the following:

Molykote 44[1] grease has no tendency to swell ethylene propylene seals. Therefore, this grease would not contribute to stroking time degradation.

Molykote 44 grease has proven to be equal to or better than the Mobile 28[2] grease in resisting wear in metal to metal contact. Tests were conducted for 5000 full cycles at ambient temperature and 300°F. Molykote remained intact in the piston cylinder area reducing seal wear.

Actuators currently supplied by GH-Bettis incorporate Mobile 28 synthetic hydrocarbon based lubricant which causes Ethylene Propylene seals to swell. Therefore, GH-Bettis has followed IEEE382(1975) section 6.3 which allows the substitution of materials of construction, when test results and analysis can be presented to justify the material upgrade.

Henceforth all GH-Bettis qualified actuators will be manufactured using Dow Corning, Molykote 44, medium grade grease. This grease is being specified as a product improvement and has by GH-Bettis analysis and test proved it is equal to, or better than, the Mobile 28 grease currently used.

Submitted by:

Anthony T. Locascio
Quality Assurance Manager

Robert R. Kane
Director of Engineering & Research

(1), (2), Refer to attached data sheets.

Exhibits

1. Dow Corning, Molykote 44 Data Sheet

2. Mobile 28 Data Sheet

3. Operating, Storage and Maintenance Instructions for GH-Bettis Rotary Valve Actuators.

[redacted]

January 30, 1984

Mr. Richard Upton
R. H. Bettis
P.O. Box 508
Waller, TX 77484

Dear Mr. Upton:

Attached is the information you requested on the radiation resistance of Molykote® 44 Grease.

If you need further information, please contact me.

Regards,

DOW CORNING CORPORATION

Michael Kasperski

Michael G. Kasperski
Technical Service and Development
517/496-5349

/bet 1-20

attachment

RADIATION

The units of radiation dose might best be summarized together with certain equivalences derived from empirical experiment.

rep = Roentgen equivalent physical
= Absorption of 83.8 ergs/gram of energy
= 1.7×10^9 slow neutrons/cm^2 (pile radiation)
= 1.7×10^9 nvt (pile radiation)
= 0.838 rad

The unit refers exclusively to neutrons and is an integrated value made up of the number of neutrons per cubic centimeter times their velocity and times the time. The equivalence shown between rep and slow neutrons or nvt applies only to pile radiation wherein this ratio was determined.

Small doses of radiation tend to thin greases by destroying some of the bodying action of the filler. Micro penetrometer measurements showed the following relative increases after 2.5×10^8 rep.

Grease	Increase in Penetrometer
DC 41	4 fold
DC 44	3 fold

lgher doses in the range of 4.7×10^9 rep would undoubtedly nk these greases to crumbly gels.

Penetration After Various Radiation Doses -

	Dose Megarads	Penetration Unworked	Penetration Worked 60
DC 41	0	266	295
	50	340	324
DC 44, light	0	312	329
	50	325	331
DC 44, Medium	0	256	255
	10	275	266
	20	274	291
	30	289	295
	40	287	306
	50	295	310
	60	305	324
	70	322	324
	80	312	340
	100	351	372
	120	346	385
	140	344	425
	180	344	422
DC 44, Heavy	0	214	221
	50	242	264

As shown in the following graph, radiation of silicone greases adversely affects the physical properties.

With respect to radiation of Dow Corning greases the following conclusions can be derived.

1. At low radiation doses the soap thickener degrades so that the grease becomes soft or soapy.

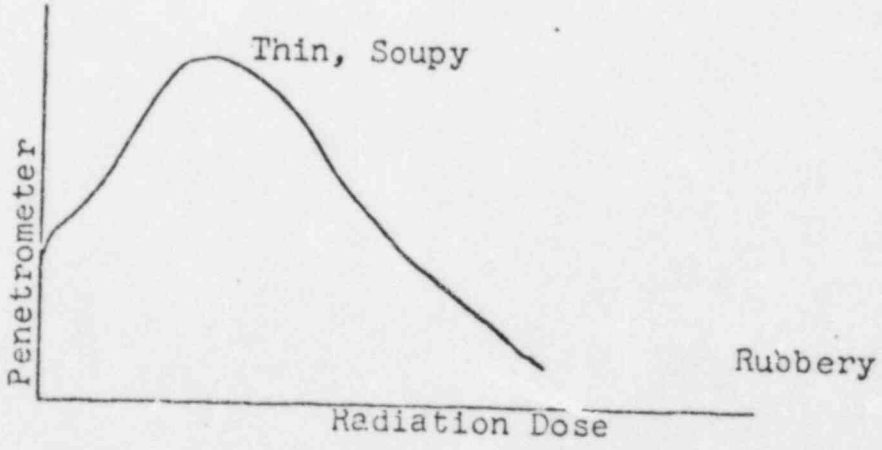
2. As graphically shown, the radiation dose required to start gelation has been reached at 130 megarads for the worked sample and 180 megarads for the unworked. The leveling of the curve indicates this fact.

3. Above 130 megarads DC 44 behaves as a high viscosity fluid after working.

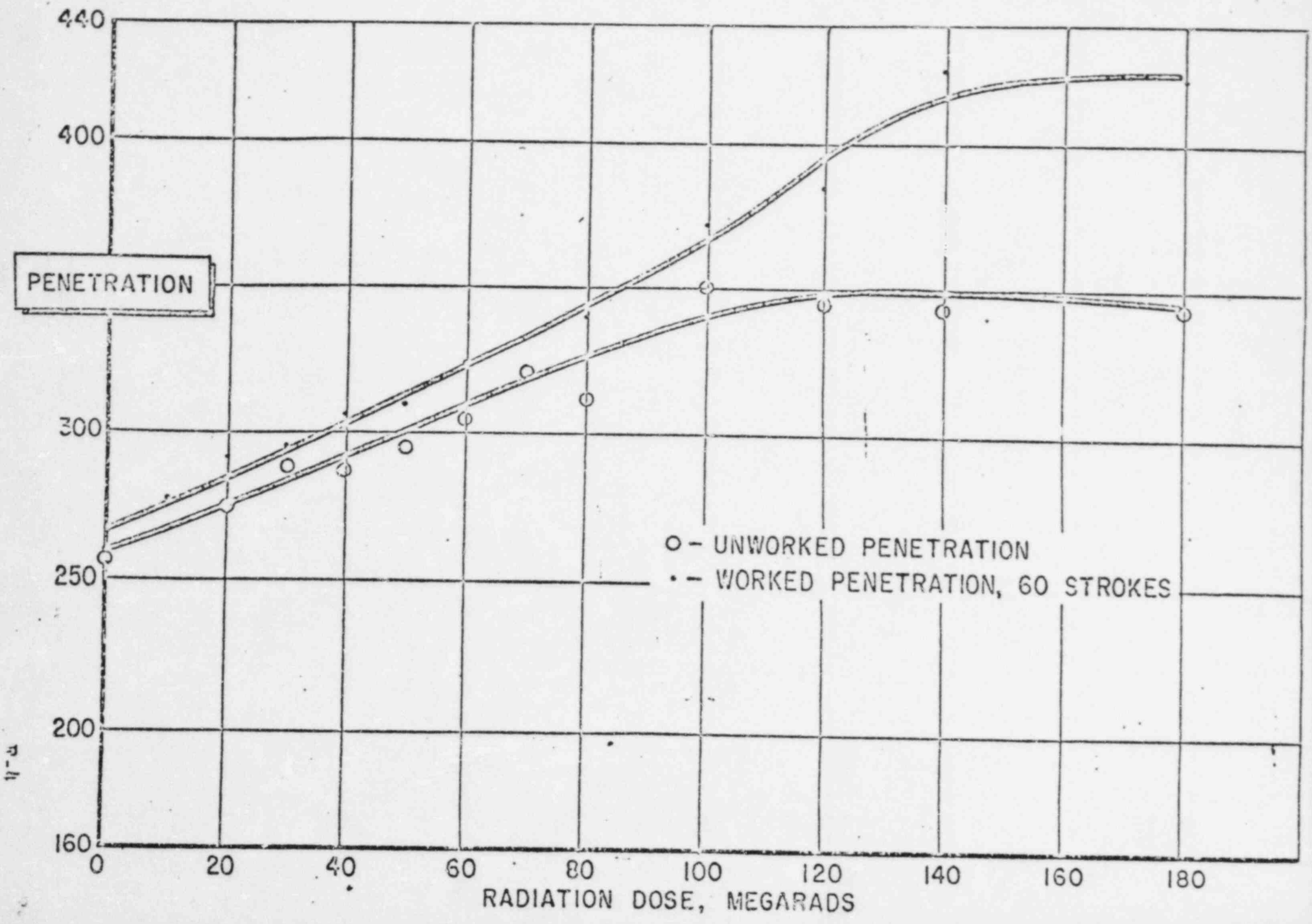
4. Of the available silicone greases, DC 44 has the best radiation resistance. The light grade appears to be the least affected by small radiation doses with heavy next and medium the most severely affected.

5. Organic greases in general have greater radiation resistance than silicone greases.

Silicone greases behave in this manner when irradiated -



EFFECT OF RADIATION ON DC 44, MEDIUM



TYPICAL PROPERTIES OF MOLKYKOTE 33, 41 AND 44 GREASES

These values are not intended for use in preparing specifications

	Molykote 33 grease		*Molykote 41 grease*	*Molykote 44 grease*	
	Light	*Medium*		*Light*	*Medium*
Color	Pink/Gray[1]	Pink/Gray[1]	Black	Amber	Amber
Thickener	Lithium soap	Lithium soap	Carbon black	Lithium soap	Lithium soap
Penetration,[2] worked 60 strokes	300	260	280	300	260
Bleed, after 24 hrs at 300 F (149 C),[3] percent	3.5	2.0	5.0[4]	4	2.5
Evaporation, after 24 hrs at 300 F (149 C),[3] percent	2.0	2.0	3.0[4]	1.5	1.0
Dropping Point, degrees	410 F (210 C)	410 F (210 C)	None	400 F (204 C)	400 F (204 C)
Dirt Count[5]	Pass	Pass	N/A	Pass	Pass
Temperature Range, degrees	-100 to 400 F (-73 to 204 C)	-100 to 400 F (-73 to 204 C)	0 to 550 F (-17 to 288 C)	-40 to 400 F (-40 to 204 C)	-40 to 400 F (-40 to 204 C)
Specific Gravity at 77 F (25 C)	0.97	0.97	1.14	1.05	1.05
Bomb Oxidation,[6] pressure drop after 500 hrs at 210 F (99 C), psi	2.0	2.0	—	2.0	2.0
Water Washout Resistance,[7] loss percent	0.5	0.5	0.5	0.5	0.5
Thermal Conductivity:					
cal/sec/cm²/°C/cm	0.00028	0.00028	—	0.00028	0.00028
BTU/hr/ft²/°F/in	8.13	8.13	—	8.13	8.13
Specific Heat:					
cal/gm/°C	0.379	0.379	0.368	0.368	0.368
BTU/lb/°F	0.379	0.379	0.368	0.368	0.368
High Temperature Bearing Performance, hrs at 10,000 rpms, 6-lb radial load, 204 bearing at 400 F (204 C), Weibull B_{50}	—	320	Not Recm'd	—	800
Max. DN Value (Bore Size in mm x rpm)	150,000-200,000	150,000-200,000	75,000	150,000-200,000	150,000-200,000

[1] The dye in Molykote 33 changes color on standing; this color change does not affect the serviceability of the grease

[2] ASTM D 217

[3] Determined with equipment described in MIL-S-8660B

[4] Determined using 392 F (200 C)

[5] MIL-I-15719A and Amendment 1

[6] ASTM D 942

[7] MIL-I-15719A

Specification Writers: Please contact Dow Corning Corporation, Midland, Michigan, before writing specifications on these products.

Information about Molykote® Silicone Greases

DOW CORNING

MOLYKOTE® 33, 41 AND 44 GREASES

Type,	
Molykote 33 and 44 greases	Silicone oil thickened with lithium soap
Molykote 41 grease	Silicone oil thickened with carbon black
Physical Form	Greases
Special Properties	Resistant to oxidation, moisture and corrosive atmospheres; good shear stability; wide service temperature range
Primary Uses	Lubricants for antifriction bearings and plastic and rubber parts

DESCRIPTION

Molykote® 33, 41 and 44 greases are silicone lubricating oils with thickeners added. Molykote 33 and 44 greases are thickened with a special lithium soap; Molykote 41 grease is thickened with carbon black.

Designed primarily for use on ball bearings operating under light to moderate loads, these greases will not thin out excessively or gum up. They are resistant to oxidation, moisture and corrosive atmospheres. They are also inert, have good shear stability, and are serviceable over a wide temperature range — Molykote 33 grease from -100 to 400 F (-73 to 204 C); Molykote 41 grease from 0 to 550 F (-18 to 288 C); Molykote 44 grease from -40 to 400 F (-40 to 204 C).

Molykote 33 and 44 greases are available in two consistencies — light and medium. Molykote 41 grease is available in a light consistency, NLGL #2. Molykote 44 grease is also available in a special consistency designed to meet MIL-I-15719A.

USES

All three Molykote greases are used to lubricate ball and roller bearings operating under light to moderate loads and at low speeds. Typical applications include:

Molykote 33 grease

- Freezer cart casters and cold room conveyor equipment
- Electric clock motors
- Maximum-demand meters, power-factor meters, watt-hour meters
- Windshield wiper motor gears
- Photographic, optical and surveying equipment
- Oscillographs, geophysical, and light, low-torque instruments

Molykote 41 grease

- Antifriction bearings of high-temperature equipment
- Oven conveyor bearings
- Wheel bearings of coke oven carts
- Pumps handling molten salts
- Governor linkage of steam turbines
- Anti-seize for bolts and studs
- Knife-type electric power disconnect switches
- Ball and socket connections of power insulators

Molykote 44 grease

- Kiln preheater fans, oven fans, radiator cooling fans
- Textile slashers and driers
- Conveyor systems

Molykote 33, 41, and 44 greases do not soften or affect most plastics and are used to lubricate plastic gears, bearings and cams, as well as metal and rubber parts. Because of their low torque requirements, these greases are especially effective in equipment that must start in extreme cold.

Oxidation Resistance

Molykote 33, 41, and 44 greases are recommended for use in units that must remain operable when subjected not only to low and high operating temperatures, but also to severe weathering and oxidation.

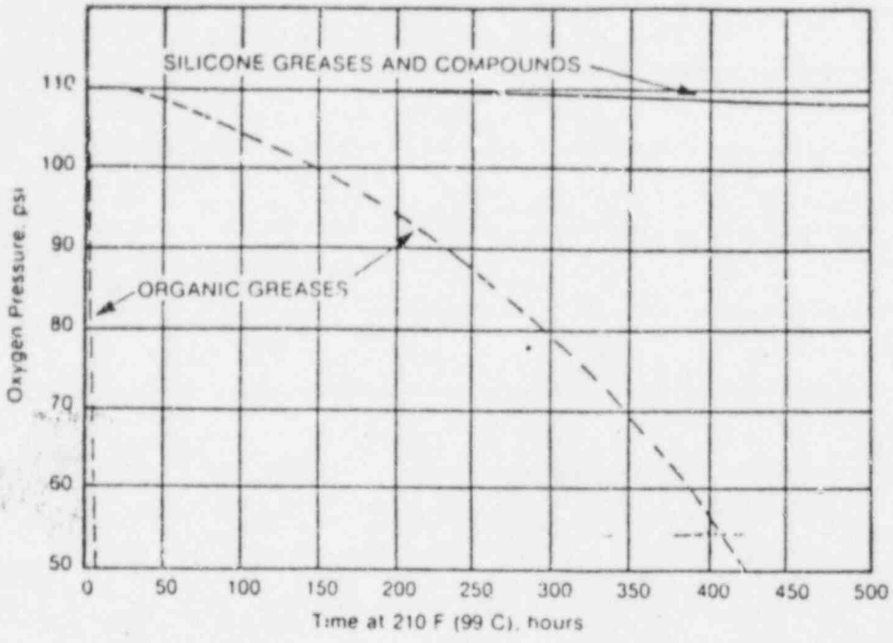
The results of a comparison between silicone and organic greases are shown in Figure 1. In these tests, after 500 hours of exposure to oxygen under a pressure of 110 psi and a temperature of 210 F (99 C), in the presence of a brass catalyst, silicone greases cause a pressure drop of only 1.5 psi.

HOW TO USE

General

Conventional grease application methods — brushing, grease gun or automatic applicators — are suitable for use with Molykote 33, 41, and 44 greases. Laboratory tests and field reports indicate that "heavy duty" guns available from such manufacturers as Lincoln-St Louis are preferred.

FIGURE I: OXIDATION RESISTANCE OF SILICONE GREASES



NOTE: Extra care should be taken at all times to prevent dirt from contaminating the lubricant. These greases should be packed with a clean metal or ebonite spatula. They should not be applied to surfaces that are to be painted. Molykote 41 grease should not be used with highly loaded ferrous metal bearing combinations, especially where sliding friction is encountered.

CAUTION

Temporary discomfort may be produced from eye contact with Molykote 33, 41 and 44 greases.

SHIPPING LIMITATIONS

None

STORAGE AND SHELF LIFE

When stored at or below 90 F (32C), Molykote 33, 41 and 44 greases have a shelf life of 18 months from date of shipment.

Mobilgrease 28

Mobilgrease 28, a nonsoap, synthesized hydrocarbon fluid type grease formulated to lubricate bearings and other mechanisms operating at high speeds and extremes of low and high temperatures. Technological developments in industry are frequently slowed by the inability of existing lubricants to function satisfactorily at the temperatures, speeds or loads that are encountered in many special applications. Many of these problems became critical first in the aviation industry where weight and speed are major factors in design. Some years ago, performance demands of some components, such as aircraft wheel bearing assemblies, exceeded the capability of the existing specialty greases and a cooperative study between Mobil and the Military was undertaken to find an improved solution to the problem. As a result of this study, Mobilgrease 28, an all synthetic product, was developed. In aircraft applications Mobilgrease 28 has been outstanding and its use in industrial applications offers a solution to many difficult grease lubrication problems where design or operating factors impose temperature, speed, or load conditions that exceed the performance capabilities of the best conventional greases.

PRODUCT DESCRIPTION

Mobilgrease 28, a completely synthetic lubricant, is manufactured from a synthesized hydrocarbon fluid and a nonsoap thickener. It has extreme pressure characteristics and excellent resistance to water washing, as well as being effective over an extremely wide range of operating temperatures. Mobilgrease 28, a synthetic grease, is dark red in color, has a smooth buttery structure and a consistency between an NLGI No. 1 and No. 2 grease.

The chemical similiarity of the synthesized hydrocarbon fluid of Mobilgrease 28 to petroleum products obviates several problems that have been of concern with other synthetic greases. Seal materials that are satisfactory with petroleum products are also satisfactory with Mobilgrease 28. In addition, slight contamination of Mobilgrease 28 with a previously used petroleum type grease, while it should be avoided if practicable, should not cause compatibility probelms that might result in excessive softening or hardening.

Mobilgrease 28 meets the requirements of U.S. Military Specification MIL-G-81322 C Grease, General-Purpose, Aircraft. The specification describes a grease intended for use over the temperature range from -65F (-54C) to 350F (177C) for such applications as aircraft landing wheel assemblies, control systems and actuators, screwjacks, servo mechanisms, sealed-bearing motors, oscillating bearings and helicopter rotor bearings. The specification requires that the grease perform satisfactorily for extended periods in high speed bearings operating at 350F (177C), offer low starting and running torque at -65F (-54C), and provide good extreme-pressure and friction-reducing characteristics. Mobilgrease 28 exceeds the requirements of the specification in all respects.

Mobilgrease 28, a synthetic grease, also meets the requirements of U.S. Military Specification DOD-G-24508A (Navy). It can be designated U.S. Military Symbol WTR and NATO Symbol G-395.

During the development of Mobilgrease 28, extensive laboratory and full scale tests were conducted. One of the most significant was in F 4 C Phantom Jet brake and wheel assemblies in simulated rejected takeoffs. During the test, brake disc stack temperatures exceeded 2000F (1095C), and bearing temperatures exceeded 580F (304C). In spite of these temperatures and the accompanying heavy loads, bearings lubricated with Mobilgrease 28 performed satisfactorily, and both the bearings and grease were judged capable of further service.

U.S. Military Specification DOD-G-24508A(Navy) describes a lubricant for shipboard auxiliary machinery. Mobilgrease 28 synthetic grease provides grease bearing performance sufficient to eliminate bearing relubrication between ship overhauls.

Other tests indicated that Mobilgrease 28 offers unique ability to prevent friction oxidation (so-called fretting) and lubricate antifriction bearings under conditions of high loads, speeds and temperatures. It has also shown superior ability to lubricate heavily loaded sliding mechanisms such as wing flap screwjacks.

In summary, Mobilgrease 28 offers outstanding performance over wide temperature ranges, with excellent retention and resistance to high temperature degradation. In addition, it resists water washing, provides superior load carrying ability, reduces frictional drag, and prevents excessive wear.

APPLICATION

Mobilgrease 28, synthetic grease is recommended for the lubrication of plain and antifriction bearings at low to high speeds, and splines, screws, worm gears, and other mechanisms where high friction reduction, low wear, and low lubricant friction losses are required. It provides minimum resistance to starting at extreme low temperatures (down to -65F, -54C) as well as low running torque.

Mobilgrease 28 is recommended for use in landing wheel assemblies, control systems and actuators, screwjacks, servo devices, sealed-bearing motors, oscillating bearings and helicopter rotor bearings on military and civil aircraft and on naval shipboard auxiliary machinery. It should be used wherever a grease meeting U.S. Military Specification MIL-G-81322 C or DOD-G-24508A(Navy) is specified. It can also be used where the older, superseded specifications MIL-G-81322 (WP), MIL-G-7711A, MIL-G-3545B, and MIL-G-25760A may be called for, and will provide superior performance in all respects to products qualified under these older specifications.

Mobilgrease 28 is recommended for industrial grease lubrication applications including sealed or repackable ball and roller bearings, wherever extreme temperature conditions, high speeds or water washing resistance are factors. Typical applications where it has offered advantages are conveyor

Mobilgrease 28

bearings, small alternator bearings operating at temperatures near 350F (177C), high speed miniature ball bearings, and bearing situations where oscillatory motion, vibration and fretting create problems.

Mobilgrease 28 is capable of retaining its consistency under high temperature and shear conditions over extended periods of operation. Therefore, it opens opportunities for the design of high output equipment. Mobil's representative will be glad to assist in the exploration of new uses for this product.

TYPICAL CHARACTERISTICS

Physical and chemical characteristics of Mobilgrease 28 are shown in the tabulation that follows. Those values not shown as maximums or minimums are typical characteristics which may vary slightly. In addition, pertinent test properties are given to exhibit performance characteristics of the grease.

HANDLING PRECAUTIONS

No special precautions are required when handling Mobilgrease 28, however prolonged repeated skin contact should be avoided. Good personal hygiene should be practiced. Remove and launder wetted clothing before reuse. Skin contacted with the product should be washed with soap and warm water. On rare occasions, hypersensitive individuals may develop skin allergies. If this occurs, remove from further exposure and seek advice of a physician.

ADVANTAGES

- Improved friction reduction
- Low wear rates
- Low lubricant drag
- Wide temperature range
- High thermal stability
- Compatibility with mineral oil base greases
- Extreme pressure characteristics
- High resistance to water washing

Characteristic	Mobilgrease 28	MIL-G-81322C Requirements
Thickener Type	Nonsoap	—
Fluid Type	Synthetic Hydrocarbon	—
Color	Dark Red	—
Structure	Smooth, Buttery	—
Penetration at 77F (25C) Worked 60 X Worked 100,000 X	 285 310	 265-320 350 max
Dropping Point, F (C) (ASTM D566, IP132	500 + (260 +)	450 (232)
Rust Test (ASTM D1743)	Pass	Pass
Load Wear Index, ASTM D2596, kg	40	30 min
Corrosion to Copper 24 hr at 212F (100C)	 None	 Nil
Water Resistance (ASTM D1264) % Washout at 100F (38C)	 1	 20 max
Wear-40 kg, 1 hr, 1200 rpm at 167F (75C) Steel-On-Steel (ASTM D2266) Scar diam., mm	 0.50	 1.30 max
Evaporation (ASTM D972) 22 hrs at 350F (177C), % Loss	 10	 12 max
Oil Separation 30 hrs at 350F (177C), %	 5	 10 max
Low Temp. Torque (ASTM D1478) -65F (-54C) Starting/Running, g-cm	 6400/750	 10,000/1000
Rubber Swell, ASTM D471 L Type Synthetic 1 wk @ 158F (70C)	 6%	 15% max

OPERATING, STORAGE & MAINTENANCE INSTRUCTIONS FOR BETTIS ROTARY VALVE ACTUATORS

Bettis actuators are extremely rugged, compact and designed for use with a wide range of valve sizes and types, to be used with a wide range of pressures, temperatures and environments.

Storage

For applications where the actuator is not put into immediate service (or is used in intermediate services), it is recommended that the actuator be cycled by air or nitrogen pressure at least three (3) times per month. This keeps seals and packings flexible and insures that the valve is free. When it is not possible to cycle with air or nitrogen and a manual override is available, it is recommended that the pressure inlets be unplugged so the actuator can be cycled manually. Indoor storage, if available, is recommended for all actuators. Care should be taken to plug the cylinder ports, control valve ports and body ports to keep out foreign particles and moisture. Also, actuators should not be stored in an atmosphere harmful to resilient seals.

Installation

Place the actuator and valve in the same position (both open or both closed) and remove any existing manual gearing from valve. At this point, check the valve and actuator mounting surfaces, stem adapter and valve stem for proper orientation and possible discrepancies. If the valve is equipped with a lubricator fitting, remove this fitting and install the lubricator extension nipple furnished with the actuator. Reinstall the lubricator fitting in the extension nipple. Install the stem adapter bushing, if furnished loose, over valve stem, position set screw in place and install actuator over bushing. The actuator is usually mounted parallel to the run of the pipe. Tighten all bolts and nuts evenly, taking care to center the actuator on the valve stem. It is a good idea to cycle the actuator while the mounting bolts are somewhat loose as this will allow the unit to center itself.

Since there are many valve and actuator combinations, it is not practical to include detailed instructions for each type. Mountings are designed to be as simple as possible to keep guess work out of installation. Actuators are shipped from the factory with the travel stops adjusted for approximately ninety degree (90°) rotation. Generally it is necessary to make slight stop adjustments once the actuator is installed on the valve. Refer to the valve manufacturer's recommendations for specific requirements. When the valve has internal stops, the actuator should be adjusted at the same points. The actual "stopping" should be done by the actuator. If the valve does not have internal stops, adjust the actuator to the full open position. Using this as a reference point, rotate the valve closed and adjust to the valve manufacturer's specifications for total rotation.

Start-up

When actuator is first put into service, slight leakage past the piston seals and/or rod packings may be detected. This is due to the seals and packings having been held in one position tending to cause them to take a "set". In such cases, the actuator should be operated through several cycles thereby energizing the seals and packings, resulting in a wearing-in condition.

The speed of operation will be determined by a number of factors including: (1) the distance from the pressure source; (2) supply line size; (3) supply line pressure; (4) control valve orifice size; (5) the torque requirements of the valve; (6) the size of the actuator, etc. Due to the interaction of these variables it is difficult to specify a "normal" operating time. Fast operating times may be obtained by using one or more of the following: (1) larger supply lines; (2) larger control valve; (3) higher supply pressure and/or (4) quick exhaust valves. Slower operating times may be obtained by using flow control valves to meter the exhaust. Incoming supply should not be metered or exhaust flow metered excessively, since this may cause erratic operation.

Maintenance

Once installed and properly adjusted *(SEE STORAGE, INSTALLATION AND START-UP INSTRUCTIONS)* the Bettis actuator is ready for operation. Due to the rugged design of the actuator and lubricants used at assembly time, routine maintenance is generally unnecessary.

For actuators normally used in pneumatic systems, all bearing surfaces are generally coated with a teflon dry-film lubricant and corrosion inhibitor. Actuators used primarily in hydraulic systems, the bearing surfaces are

generally coated with a Teflon dry-film lubricant and corrosion inhibitor, except for piston rods and tie bars which are electroless nickel coated. All threaded fasteners, bearing surfaces, tracks, rollers, pins, yoke bores, gaskets and seals are coated with petroleum grease. These lubricants increase the insurance of long service life, low maintenance and trouble-free operation.

Good instrument practices are also recommended. Clean, dry air, gas or hydraulic fluid is essential for long service life and satisfactory operation. If instrument air or hydraulic fluid of this quality is not available, it is recommended that an in-line filter be provided to prevent foreign particles from entering the cylinders of the actuator. It should be noted that new air lines often have scale and other debris in them. This debris can damage control valves, solenoids, seals, etc.

Operation

Normal operation is accomplished by applying pressure to the appropriate pressure inlet(s) of a double acting or spring return cylinder by means of a proper control valve. Bettis actuators are sized to produce the required valve torque at the supply pressure designated by the customer.

All Bettis actuators feature a totally enclosed body cavity that provides protection for all moving parts and eliminates the chance of injury to operating personnel. This enclosure may also be used as an optional oil bath, if and where required. Under most normal circumstances Bettis pneumatic actuators do not require additional lubricants but it should be remembered that most control valves and solenoids (with the exception of positioners) perform better on lubricated air. For this reason, an air line lubricator may be installed. Care should be taken to use only lubricants compatible with the seals in the actuator and control valves.

For manual operation of Bettis actuators, the supply pressure must be vented or equalized on both sides of the power piston (with some provision for handling the slight difference in displacement of opposing sides of the cylinder piston).

(1) If the type of manual operator is an internal manual, move the lever in a clockwise direction (upward and horizontal when unit is top mounted) until mechanism is engaged. With this done, the handwheel then operates actuator and valve.

(2) If the type of manual operation is a hydraulic override, rotate the handwheel in the appropriate direction to operate actuator and valve.

(3) If the type of manual operation is a hydraulic override on a spring return actuator, fully close block/by-pass valve and operate hand pump in order to override actuator spring and operate actuator and valve.

(4) If the type of manual is a jackscrew, simply turn appropriate jackscrew to operate actuator and valve.

Spare parts

Replacement parts may be ordered for all Bettis actuators. Published parts list drawings include recommended spare parts. It should be remembered that these spare parts are of resilient material and have a limited shelf life. Other parts are generally not required as spares.

When ordering replacement parts, it is important to include the complete actuator model number and serial number along with the part numbers required. More detailed information concerning your particular application may be obtained by writing GH-Bettis, P.O. Box 14689, Houston, Texas U.S.A. 77021, Telephone: 713/748-1143, Telex: 76-2713

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