I. L. 1840
(Filing No. 25-000)

Westinghouse

Industrial and Oil Well Pumping Speed Reducers

INSTRUCTIONS FOR CORRECT LUBRICATION AND MAINTENANCE

LUBRICATION

The areas of contact on gear teeth are relatively small and the pressures produced in transmitting the loads are relatively large. It is, therefore, essential to provide a film of lubricant of sufficient strength to withstand the localized pressure during the period of contact. The peripheral speed of the gears governs the period of tooth contact and determines the time during which the film must withstand the pressures. When speeds are high, the time is very short and the loads are usually light, a comparatively light bodied lubricating oil can be used. When speeds are low and the loads heavy, the contact time is considerably longer and a heavier bodied oil should be used. However, the exacting requirements of gear unit lubrication under normal loads demand high grade oils.

Room temperatures or the temperatures of atmosphere surrounding the gear drive also have considerable bearing on the grade of oil that should be used. Mineral oils invariably show a higher viscosity as the temperature is lowered, and in the majority of instances, a heavy grade of oil possesses a higher pour point than a lighter one refined from the same stock of the same brand unless a special treatment has been used to lower the pour. Therefore, a gear drive operating in a surrounding temperature of Zero to plus 70 degrees Fahrenheit should ordinarily be lubricated with an oil of lower viscosity than the same unit operating in a surrounding temperature of from 70 to 120 degrees.

Westinghouse-Nuttall gear drives are designed with as near fool-proof lubrication systems as possible, wherein the gears and bearings are lubricated with the same oil. It is, therefore, obvious that if an oil of high viscosity and a high pour test is used in a gear drive which is subjected to low operating temperatures, the oil will not readily flow and may result in bearing failures. There is included as part of this leaflet a list of a number of reliable refiners and their oils which are recommended for use in Westinghouse-Nuttall Units for different classes of service and under different operating temperatures. Any reliable refiner's oils of equal grade and viscosity may be used.

We recommend that the unit be filled at the time of its installation with the recommended grade of oil. For normal operation it is advisable to drain and filter the oil in the gear unit and refill to the specified oil level after one month's initial service, after which changing the oil once every six months will ordinarily be sufficient. Small quantities of oil may be added from time to time to maintain the proper level. However, this is very infrequently required. In no case should the oil level be higher than specified by the oil level nameplate. The oil level should be checked only when the unit is not running.

The maximum temperature (temperature of oil inside the unit) at which a standard gearmotor or gear unit should be operated is 180 degrees Fahrenheit. For operating temperatures below Zero degrees or higher than 180 degrees Fahrenheit, consult our engineers.

RECOMMENDED LUBRICANTS FOR ALL GEARED SPEED REDUCERS, GEARMOTORS OR SPEED INCREASING UNITS

Lubricating oils for use in Westinghouse-Nuttall gear drives should be of a **high grade,** high quality, well-refined Petroleum oil, filtered and within the recommended viscosity as noted below for duty and temperature.

Viscosity Range S.U.V. Seconds		
Lubricant Number	At 100°F.	At 210°F.
1*	490–700	.....
2	700–1000	.....
3	.....	75–105
4*	.....	105–125
5	.....	125–150
6	.....	150–180

For Operating Room Temperature of			
Service Duty	0° to 70° F. Use Lubricant No.	70° to 120° F. Use Lubricant No.	120° to 180° F. Use Lubricant No.
Light	1	1	2
Medium	1	2	3
Heavy	4*	5	6

* Pour test 0°F. Max.

The following are trade names of oils (Refiners names listed in alphabetical order) complying with above specifications but any reliable refiners oils of equal grade and viscosity may be used:

Refiner	Lubricant Number					
	1	2	3	4	5	6
The American Oil Co. Baltimore, Md.	Amoco Motor Oil Medium SAE-30	Amoco Motor Oil Heavy SAE-40	Amoco Motor Oil Ex. Heavy SAE-50	Amoco Motor Oil XX Heavy SAE-60	Amoco Motor Oil Ultra Heavy SAE-70	American Gear Oil #1504
Associated Oil Co. San Francisco, Cal.	Cycol SAE-30	Aoco Penn 50	Cycol C & T 50	Vedol 60	Cycol C & T 70	Cycol S. G. Gear Oil
Atlantic Refin. Co. Pittsburgh, Pa.	No. 1234	No. 1235	No. 1212	No. 1168	No. 1149	No 1104

RECOMMENDED LUBRICANTS FOR ALL GEARED SPEED REDUCERS, GEARMOTORS OR SPEED INCREASING UNITS—Continued

Refiner	LUBRICANT NUMBER					
	1	2	3	4	5	6
Gulf Refining Co. Pittsburgh, Pa.	Gulf Paramount Oil D	Gulf Parvis Oil A	Gulf Parvis Oil B	Gulfcrown Oil C	Gulf I. C. Oil B	Gulf I. C. Oil C
E. F. Houghton & Co. Philadelphia, Pa.	Vital Medium Motor Oil	Vital Med. Heavy Motor Oil	Vital Heavy Motor Oil	Vital Extra Heavy Motor Oil	Special VIM Cylinder Oil	#800 Vim Cylinder Oil
Humble Oil & Refining Co. Houston, Texas	Humble 997 Motor Oil (SAE-30)	Humble 997 Motor Oil (SAE-40)	Humble 997 Motor Oil (SAE-50)	Humble 997 Motor Oil (SAE-60)	Humble 997 Motor Oil (SAE-70)	F.F.F. Cylinder Oil
Imperial Oil Ltd. of Canada	Imperial Marvelube Thirty	Imperial Marvelube Forty	Imperial Marvelube Fifty	Imperial Sturbinol-F.	Imperial Capitol Cylinder Oil	Imperial 20th Century Mineral Cylinder Oil
Keystone Lubricating Co. Philadelphia, Pa.	SR-3	SR-2	SR-2	(a) SR-1	SR-1	# 73-W
Marathon Oil Co. Tulsa, Oklahoma	No. 406	No. 410	No. 412	No. 426	No. 434	No. 438
The National Refining Co. Cleveland, Ohio	Medium Heavy Enarco Motor Oil SAE-30	Heavy Enarco Motor Oil SAE-40	Dual-Heavy Enarco Motor Oil SAE-50	(c) Extra Heavy Enarco Motor Oil SAE-60	XX Heavy Enarco Motor Oil SAE-70	Enarco #600 Gear Oil
Phillips Petroleum Co. Bartlesville, Okla.	Condor Heavy	Condor X- Heavy	Condor X- Heavy	(c) Condor XX-Heavy	66 Tractor X- Heavy	66 Tractor Sup. Heavy
The Pure Oil Co. Chicago, Illinois	Klondyke Heavy	Puritan Spec. Heavy	No. 394	No. 377	Puritan Super Heavy	C-Mineral
Richfield Oil Co. Los Angeles, Cal.	Richfield Elevator Gear Oil 30	Rioco Elevator Gear Oil 40	Rioco Elevator Gear Oil 50	Rioco Elevator Gear Oil 60	Richlube Elevator Gear Oil 70	Richfield Elevator Gear Oil Extra Heavy
ShellEastern Pet. Prod ucts, Inc. New York, N. Y.	Shell Turbine Oil H-190	Shell Diesel Eng. Oil #5	Shell Diesel Eng. Oil #6	(d) Shell Hi-Duty Oil 60	Shell Hi-Duty Oil 70	Cylinder Oil D-10
Shell Petroleum Corp. St. Louis, Mo.	Shell Hi-Duty Oil 30 (d)	Shell High Duty Oil 40	Shell Hi-Duty Oil 50	Shell Hi-Duty Oil 60 (d)	Shell Hi-Duty Oil 70	Shell Cylinder Oil D-10
Shell Oil Co. San Francisco, Cal.	Shell Turbine Oil H-190	Shell Diesel Eng. Oil #5	Shell Diesel Eng. Oil #6	(d) Shell Hi-Duty Oil 60	Shell Hi-Duty 70	Shell B Cylinder Oil
Sinclair Ref. Co. New York, N. Y.	Opaline Oil Medium Heavy	Rubilene Oil Heavy	Rubilene Oil Extra Heavy	Opaline Oil Aircraft	Rubilene Ultra Heavy	Mineral Valve Oil Dark
Socony Vacuum Oil Co. New York, N. Y. Magnolia Pet. Co. Dallas, Texas Gen. Pet. Corp. Los Angeles, Cal.	(a) Gg. DTE Oil Extra Heavy	Gg. DTE Oil—BB	Gg. DTE Oil—BB	(a) Gg. DTE Oil—AA	Gg. Super Cylinder Oil 600-W Mineral	Gg. Super Cylinder Oil 600-W Mineral
Standard Oil Co. of California San Francisco, Cal.	Calol Turbine Oil Ex. Heavy (c)	Calol Diesel Eng. Oil Heavy	Calol Low Pressure Cyl. Oil	Calol Cylinder Oil (b)	Calol Cylinder Oil	Calol High Pressure Cylinder Oil
Standard Oil Co. 910 S. Michigan Ave. Chicago, Ill.	Superla Gear Oil #3	Superla Gear Oil #2	Superla Gear Oil #2	(d) Superla Gear Oil #1	Superla Gear Oil #0	Polarine Transmission Oil #160 Summer

September, 1936

Supplement to Instruction Leaflets IL-1840 and IL-2057

Addition to table of Recommended lubricants for all geared speed reducers, gearmotors or speed increasing units.

The following are additional trade names of oils (Refiners names listed in alphabetical order) complying with above specifications but **any** reliable refiners' oils of equal grade and viscosity may be used.

Refiner	LUBRICANT NUMBER					
	1	2	3	4	5	6
Cities Service Oil Co. (Del.) Cities Service Ref. Co. Louisiana Oil Ref.	Cities Service Pacemaker #5 (c)	Cities Service Pacemaker #6	Cities Service Pacemaker #7	Cities Service Pacemaker #8 (c)	Cities Service Pacemaker #9	Cities Service Pacemaker #10
Cities Service Oil Co. (Pa.)	Cities Service Penn- (d) Pacemaker #6	Cities Service Penn- Pacemaker #7	Cities Service Penn- Pacemaker #7	Cities Service Penn- (d) Pacemaker #8	Cities Service Penn- Pacemaker #9	Cities Service Penn- Pacemaker #10
Continental Oil Co. Ponca City, Okla.	Dectol Heavy (c)	Dectol HH	Dectol Special Heavy	Dectol X Heavy (c)	Dectol XX Heavy	Transmission Oil SAE 160
Pennzoil Co. Oil City, Pa.	Pennzoil Motor Oil Medium SAE 30	Pennzoil Motor Oil Heavy SAE 50	Pennzoil Motor Oil Ex. Heavy SAE 60	Pennzoil Motor Oil Ex. Heavy SAE 60 (c)	Pennzoil Motor Oil Ex. Ex. Heavy SAE 70 L	Pennzoil Motor Oil Ex. Ex. Ex. Heavy SAE 70 H
Skelly Oil Co. El Dorado, Kansas	Tagolene SAE 30	Tagolene SAE 50	Tagolene SAE 50	Tagolene SAE 60 (c)	Tagolene SAE 70	Tagolene SAE 70 Plus

(c) Not recommended for operating temperatures below 10° F.
(d) Not recommended for operating temperatures below 15° F.

INSTALLATION

The continuous efficient operation of a speed reducing or speed increasing unit depends mainly upon five factors:

1. The alignment of the unit with driving and driven equipment.
2. Method of mounting and type of foundation.
3. Type of load and loading conditions.
4. Lubrication.
5. Maintenance.

It is obvious that correct alignment and mounting are necessary to prevent undue stresses on the shafts and bearings, and restricted action of flexible couplings. Frequently the cause of failure of bearings, shaft breakage, broken bases, overheating and noisy operation of equipment is that insufficient consideration was given the alignment and mounting. Therefore, these items should be periodically checked in every maintenance schedule.

The type of load and method of loading is very important in gear unit maintenance because the unit selected for a given service is intended to be operated at close to its rated horsepower capacity for greatest efficiency. Although allowance for a certain amount of overload was made when the unit was designed for the anticipated load conditions, they are frequently severely overloaded after installation due to excessive fluctuations in load, and wear in various parts of the entire installation.

To obtain the best result and bring the maintenance expense down to a minimum, the Speed Reducer should be mounted on a **solid** foundation and properly aligned with the driven equipment.

Where the Unit is supported on structural foundations, it is recommended that the supporting base plate thickness be not less than the diameter of the holding down bolts and that sufficient rigidness be provided in the structural members to prevent sway or flexing.

In the majority of installations the high speed shaft of industrial speed reducers is directly coupled to the prime mover, while the low speed shaft may be directly coupled to the driven shaft or connected by chain, belt, or pinion mounted on the reducer shaft. Outboard bearings may sometimes be necessary for giving proper support to the low speed shaft when this shaft is subjected to unusually heavy loads, as would be in the case when pulleys, sprockets or pinions of small diameters or wide faces are used. When chain or pinion drive is used, it is recommended that the gear unit be doweled to the foundation.

In the majority of installations, the high speed shaft of oil well pumping speed reducers is belted to the prime mover by either a flat belt, V type or cog belt. The minimum pulley size for this type of connection should not be of smaller diameter than specified for unit selected. It is generally advisable to select as large a pulley diameter as possible as this will provide a larger arc of belt contact and, consequently, increase the life of the belt and reduce the cost of belt maintenance.

The low speed shaft is generally connected to the driven equipment by either a counterbalanced crank or plain crank or both as is the case when one well is pumped the conventional way and one or more wells pumped by back crank arrangement. The power required when using counterbalanced crank for conventional pumping and back crank for off-side pumping from the same unit should never exceed the allowable rating for single crank pumping and the wells should be balanced to obtain an equal power distribution on the up-and-down stroke.

For general convenience, the projecting shaft of Speed Reducers are made of standard length. This length is often greater than the required width of sprocket, pinion, etc., used, but this should not be considered as an invitation to mount the sprocket or pinion at the extreme end of the shaft. Mount them as close to the bearing as possible, as an inch or two of unnecessary overhang may greatly increase the bending stress on the shaft leading to eventual fatigue failure.

The first procedure after a unit has been properly installed is to fill the case with oil to the proper oil level indicated with the recommended grade of lubricant for the particular class of service. The unit should be allowed to run with a relatively light load for approximately one-half hour, or until the oil has had a chance to collect in the reservoirs at the bearings, and then re-check the oil level. This check, however, should not be made until the unit has been stopped for approximately ten minutes. This is essential in order to let the oil settle at an even level in the two separate reservoirs. (The main reservoir and the settling chamber at the high speed end are connected by relatively small holes which necessitates a time interval before a correct indication of the oil level is obtained.) As the oil required to fill the bearing reservoirs has lowered the oil level in the case, it may be found necessary to add a small amount of oil to bring the oil level to its indicated position.

If the above procedure is not convenient, the oil may be directed into the bearing reservoirs at the same time as the oil is poured into the case. By either method, as an extra precaution, the oil level should be re-checked after a few hours of running time.

The oil level indicated applies to the particular ratio furnished with the Unit when shipped from the factory. Therefore, if it is desired at a later date to change the gear ratio, the oil level for this new ratio must be changed. The correct oil level should be such that the smallest gear (not pinion) is dipping in the oil approximately the full depth of the tooth.

Each gear unit is provided with a breather, generally located at the top of the gear case in the hand hole cover. This breather is provided for the specific purpose of reducing the pressure inside the gear case to that of the surrounding atmosphere; therefore, it is important to check this breather at regular intervals to make sure that the breather holes are not clogged up with dust and dirt. If the gear unit is located in a dusty location, the breather should be packed with steel wool to prevent the dust from entering the interior and mix with the oil. The steel wool in these breathers should be cleaned in kerosene or gasoline at frequent intervals.

Change of Gear Ratio

At times it may be desirable to change the output speed. This can generally be done within a certain range by changing the mating gear and pinion either on the high speed or low speed gear set, or both, depending on the output speed required and the type of unit.

INSTALLATION—Continued

Gears and pinions are generally cut on their shafts in order to insure smooth running. Therefore, we recommend that if a gear and pinion are located on the same shaft, as is generally the case on the intermediate shaft of a double reduction unit, the gear and pinion be furnished as an assembly and not separately. To install the new gears, the top half of the gear case must be removed, which is readily done by simply removing all bolts at the flange of the gear case and all bolts holding the bearing end caps to the gear case, also loosen the dowel pins used for locating the upper and lower half gear case.

The top half gear case may then be lifted. The gears are then exposed and can readily be taken out and replaced.

Particular attention should be given to the adjustment of the shaft end float.

The space between the bearing and the pilot fit of the end cap should be held to a minimum. The clearance at this point should be approximately .002 to .004 inches. This can readily be adjusted by proper shimming. All adjustments should be made with the bearing end caps secured tightly against the lower half gear case bearing hubs.

Before the upper half gear case and the end caps are reassembled, all machined surfaces should be thoroughly cleaned and free from oily substances. A thin coat of a good grade of oil resisting cement, such as Westinghouse #672, should be painted on the surface at the split of the case and the machined surfaces of the end caps and the mating surfaces of the gear case. The surfaces should be bolted together before the cement has dried. Particular care should be taken that no cement gets into the bearings.

OIL CAPACITY FOR SH, DH AND OIL WELL PUMPING UNITS

Approximate No. of Gallons Required

Type SH Speed Reducers

Unit No.	Approx. Amount of Oil for Resp. Ratio Range		
SH-6	5-Pints for Ratios 9.5 to 2.82 Incl.		
SH-8	3-Qt's. for Ratios 9.5 to 2.82 Incl.		
SH-9	5-Pints for Ratios 9.5 to 5.3	7-Pints for Ratios 4.73 to 2.82	
SH-10	1-Gal. for Ratios 9.5 to 5.3	1½ Gal's. for Ratios 4.73 to 2.82	
SH-12	1¾ Gal's. for Ratios 9.5 to 4.73	2½ Gal's. for Ratios 4.25 to 2.82	
SH-14	2½ Gal's. for Ratios 9.5 to 4.73	3¾ Gal's. for Ratios 4.25 to 2.82	
SH-16	3 Gal's. for 9.5 to 6.88	3¾ Gal's. for 6.4 to 4.25	5¼ Gal's. for 3.84 to 2.82
SH-18	3½ Gal's. for 9.5 to 5.94	5¼ Gal's. for 5.3 to 3.84	7 Gal's. for 3.2 to 2.82
SH-21	6¼ Gal's. for 9.5 to 5.94	9 Gal's. for 5.3 to 3.84	11½ Gal's. for 3.2 to 2.82
SH-25	11½ Gal's. for 9.5 to 5.94	15 Gal's. for 5.3 to 3.84	19½ Gal's. for 3.2 to 2.82
SH-32	18 Gal's. for 9.5 to 5.94	26 Gal's. for 5.3 to 3.84	34 Gal's. for 3.2 to 2.82
SH-36	26 Gal's. for 9.5 to 5.94	39 Gal's. for 5.3 to 3.84	51 Gal's. for 3.2 to 2.82

Type DH Speed Reducers

Unit No.	Approx. Amount of Oil for Resp. Ratio Range		
DH-6	7-Pints for Ratios 70.5 to 22.0 Incl.	1-Gal. for Ratios 21.0 to 11.96 Incl.	
DH-7	1¼ Gal's. for 70.5 to 27.8 Incl.	1½ Gal's. for 21.0 to 16.0 Incl.	1¾ Gal's. for 13.2 to 11.7 Incl.
DH-9	2¼ Gal's. for 70.5 to 27.8 Incl.	2½ Gal's. for 24.7 to 16.0 Incl.	2¾ Gal's. for 13.15 to 11.69 Incl.
DH-10	3¾ Gal's. for 70.5 to 27.8 Incl.	4 Gal's. for 24.7 to 16.0 Incl.	4½ Gal's. for 13.5 to 11.7 Incl.
DH-12	6½ Gal's. for 70.5 to 27.8 Incl.	7¼ Gal's. for 24.7 to 11.5 Incl.	
DH-14	10 Gal's. for 70.5 to 27.8 Incl.	11 Gal's. for 24.7 to 16.0 Incl.	12 Gal's. for 13.35 to 11.65 Incl.
DH-16	14¾ Gal's. for 70.5 to 27.8 Incl.	16¼ Gal's. for 24.7 to 16.0 Incl.	17½ Gal's. for 13.15 to 11.5 Incl.
DH-18	20½ Gal's. for 70.5 to 27.8 Incl.	22½ Gal's. for 24.7 to 16.0 Incl.	24½ Gal's. for 13.4 to 11.7 Incl.
DH-20	28 Gal's. for 70.5 to 27.8 Incl.	31 Gal's. for 24.7 to 16.0 Incl.	35 Gal's. for 13.5 to 11.7 Incl.
DH-24	47 Gal's. for 70.5 to 27.8 Incl.	52 Gal's. for 24.7 to 16.0 Incl.	58 Gal's. for 13.25 to 11.5 Incl.
DH-28	80 Gal's. for 70.5 to 27.8 Incl.	90 Gal's. for 24.7 to 16.0 Incl.	99 Gal's. for 13.5 to 11.6 Incl.
DH-36	163 Gal's. for 70.5 to 27.8 Incl.	178 Gal's. for 24.7 to 16.0 Incl.	190 Gal's. for 13.15 to 11.5 Incl.

Oil Well Pumping Units

Unit No.	Approx. No. of Gals. Req'd.
ODH-110	6
ODH-110-B	5½
ODH-18	17
TC-20	14
OP-15-B	14
OP-20	10
OP-20-B	22½
OP-20-H	22½
OP-20-HB	15
OP-27	15
OP-27-H	24
OP-27-HB	24
OP-35-A	31
OP-35-AB	31

Note: Capacities listed above are approximate. Be sure to fill gear unit with oil to level indicated by the oil level nameplate.

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Pittsburgh, Pa.

Printed in U. S. A. (Rep. 2-37)