Chapter 13
Lubricant Specifications and Selection

13-1. Introduction

Proper selection of a lubricant depends on understanding the lubricating regime (i.e., film, mixed, boundary), established conventions of classifications, and an ability to interpret and apply the producer's product data specifications to the equipment. Without this background, it is impossible to make an informed selection or substitution.

13-2. Lubricant Classification

Professional societies and organizations have established classifications for oil and grease. The most widely encountered systems are those of the following organizations:

- SAE (Society of Automotive Engineers)
- API (American Petroleum Institute)
- AGMA (American Gear Manufacturers Association),
- ISO (International Standards Organization)
- NLGI (National Lubricating Grease Institute).

a. Oil classification. Oil is normally classified by viscosity grade, additives, use, or by the producer's brand name. Some oils are classified as nonspecialized industrial oils.

(1) Classification by viscosity grade. Classification according to viscosity is the most prevalent method of describing oils, and the most common classification systems are those of the SAE, AGMA, and ISO. Each organization uses a different kinematic viscosity range numbering system.

(2) Classification by additives.

(a) Oil may be further classified according to the additives included in the oil to enhance its performance properties as follows:

- Inhibited or RO (rust and oxidation inhibited)
- AW (antiwear)
- EP (extreme pressure)
- Compounded
- Residual.

The first three classes are discussed throughout this manual and require no further explanation; they contain the indicated additives. Compounded oil contains from 3 to 10 percent fatty or synthetic fatty oils. It is also called steam cylinder oil. The added fat reduces the coefficient of friction in situations where an extreme amount of sliding friction occurs. A very common application is in worm gear systems. Compounded oil may be composed of either a normal mineral oil or a residual oil, depending on the desired viscosity.

(b) Residual compounds are heavy-grade straight mineral oils or EP oils. These compounds are normally mixed with a diluent to increase ease of application. After application, the diluent evaporates, leaving a heavy adhesive lubricant coating. Residuals are often used for open-gear applications where tackiness is required to increase adhesion. This type of heavy oil should not be confused with grease. Residual oil with lower viscosity is also used in many closed-gear systems. Compounded oil may contain residual oil if the desired viscosity is high.

(3) Classification according to use. This system of classification arises because refining additives and type of petroleum (paraffinic or naphthenic) may be varied to provide desirable qualities for a given application. Some of the more common uses are:

- Compressor oils (air, refrigerant).
- Engine oils (automotive, aircraft, marine, commercial).
- Quench oils (used in metal working).
- Cutting oils (coolants for metal cutting).
- Turbine oils.
- Gear oils.
- Insulating oils (transformers and circuit breakers).
- Way oils.
- Wire rope lubricants.
- Chain lubricants.
- Hydraulic oils.

(4) Nonspecialized industrial oil. This classification includes oils that are not formulated for a specific application and are frequently referred to as “general purpose oil” in the manufacturer’s product literature. These oils are generally divided into two categories: general purpose and EP gear oils.

(a) General purpose oils. General purpose oils contain R&O additives, AW agents, antifoamants, and demulsifiers. They may be used in mechanical applications where a specialized oil is not required. Their ISO viscosity ranges from about 32 to around 460. These oils are often referred to as R&O oils or hydraulic oils although they may contain other additives and are not intended exclusively for hydraulic use.

Some of these oils are more highly refined and provide longer life and better performance than others. These are usually referred to as “turbine oils” or premium grades. Although used in turbines, the name “turbine oil” does not mean their use is restricted to turbines, but refers to the quality of the oil.

(b) EP gear oils. These oils generally have a higher viscosity range, from about ISO grade 68 to around 1500, and may be regarded as general purpose oils with EP additives. Although commonly used in gear systems, these oils can be used in any application where their viscosity range and additives are required. Gear oils should not be confused with SAE gear oils that are specially formulated for automotive applications; automotive oils are not discussed in this manual.

(5) Producer brand names. Oil producers often identify their products by names that may or may not be connected with standard classifications. For example, a name such as Jo-Lube 1525, a product of Jonell Oil, tells nothing of its class. However, Conoco's Dectol R&O Oil 32 indicates that it is an R&O oil with an ISO viscosity of 32. Regardless of how much information may be implied by the brand name, it is insufficient to select a lubricant. A user must refer to the producer’s information brochures to determine the intended use, additives, and specifications.

(6) Oil producer’s product data and specifications

(a) Product data. Oil producers publish product information in brochures, pamphlets, handbooks, or on the product container or packaging. Although the amount of information varies, it generally includes the intended use, the additives (AW, EP, R&O, etc.), oil type (i.e., paraffinic, naphthenic, synthetic, compounded, etc.), and the specifications. Some producers may identify the product by its usage classification such as those noted above, or they may simply note the machinery class where the product can be used. Often, both methods of identification are used. Intended use designations can be misleading. For example, fact sheets for three different oils by the same producer indicate that the oils can be used for electric motors and general purpose applications. However, all three are not suitable for every application of this equipment. One oil contains no oxidation inhibitors and is intended for use where the oil is frequently replaced. The second is an R&O oil with the usual antifoaming and demulsifying agents. AW agents are also included. The third is a turbine oil similar to the second except that the refining method and additive package provide greater protection. One turbine viscosity grade, ISO 32, is treated to resist the effects of hydrogen used as a coolant in generators. Failure to notice these differences when evaluating the data can lead to incorrect application of these lubricants. Producers do not usually list additives. Instead, they indicate characteristics such as good antiwear qualities, good water resistance, or good oxidation resistance. These qualities are not inherent in oil or contained in sufficient quantities to provide the degree of protection necessary. Therefore, the user is safe in assuming that the appropriate agent has been added to obtain the given quality. Product literature also gives the oil type (i.e., paraffinic, naphthenic, residual compounded, or synthetic).

(b) Producer specifications. Producer specifications amount to a certification that the product meets or exceeds listed physical characteristics in terms of specific test values. The magnitude of chemical impurities may also be given. Producers vary somewhat in the amount of information in their specifications. However, kinematic viscosity (centistokes) at 40 and 100 °C (104 and 212 °F), SUS (saybolt viscosity) at 37 and 98 °C (100 and 210 °F), API gravity, pour point, and flash point are generally listed. Other physical and chemical measurements may also be given if they are considered to influence the intended use.

b. Grease classifications.

(1) Characteristics. Grease is classified by penetration number and by type of soap or other thickener. Penetration classifications have been established by NLGI and are given in Chapter 5. ASTM D 217 and D 1403 are the standards for performing penetration tests. A penetration number indicates how easily a grease can be fed to lubricated surfaces (i.e., pumpability) or how well it remains in place. Although no method exists to classify soap thickeners, the producer indicates which soap is in the product. The type of soap thickener indicates probable water resistance and maximum operating temperature and gives some indication of pumpability. Although these are important factors, they are not the only ones of interest. These simple classifications should be regarded as starting requirements to identify a group of appropriate grease types. The final selection must be made on the basis of other information provided in the producer's specifications. Viscosity of the oil included in a grease must also be considered.

(2) Producer’s product data for grease. Producers also provide information and specifications for grease in brochures, pamphlets, handbooks, or on the product container or packaging. Grease specifications normally include soap thickener, penetration, included oil viscosity, and dropping point. The producer may also include ASTM test information on wear, loading, lubrication life, water washout, corrosion, oil separation, and leakage. Grease additives are not usually stated except for solid additives such as molybdenum disulfide or graphite, or that an EP additive is included. If EP or solid additives are used, the producer will often state this emphatically and the product name may indicate the additive.

13-3. Principles of Selection

a. Manufacturer recommendations.

(1) The prime considerations are film thickness and wear. Although film thickness can be calculated, the wear properties associated with different lubricants are more difficult to assess. Lubricants are normally tested by subjecting them to various types of physical stress. However, these tests do not completely indicate how a lubricant will perform in service. Experience has probably played a larger role than any other single criterion. Through a combination of testing and experience, machine manufacturers have learned which classes of lubricants will perform well in their products.

(2) Professional societies have established specifications and classifications for lubricants to be used in a given mechanical application. For example, AGMA has established standard specifications for enclosed and open-gear systems. These specifications have been developed from the experience of the association’s membership for a wide range of applications. Thus, any manufacturer has access to the collective knowledge of many contributors.

(3) It should be noted that the equipment manufacturer's recommendation should not necessarily be considered the best selection. Individual manufacturers may have different opinions based on their experience and equipment design. The concept of “best” lubricant is ambiguous because it is based on opinion. Despite this ambiguity, the manufacturer is probably in the best position to recommend a lubricant. This recommendation should be followed unless the lubricant fails to perform satisfactorily. When poor performance is evident, the manufacturer should be consulted for additional recommendations. This is especially critical if the equipment is still under warranty.

(4) Although some manufacturers may recommend a specific brand name, they can usually provide a list of alternative lubricants that also meet the operating requirements for their equipment. One of the recommended lubricants should be used to avoid compromising the equipment warranty if it is still in effect. Physical qualities (such as viscosity or penetration number), chemical qualities (such as paraffinic or naphthenic oils), and applicable test standards are usually specified.

b. Lubricant producer recommendations.

(1) When manufacturers recommend lubricants for their products in terms of specifications or required qualities rather than particular brand names, the user must identify brands that meet the requirements. Following the suggestions given in this chapter may help the user identify appropriate products. When a user is uncertain, lubricant producers should be consulted to obtain advice on products that comply with the required specifications.

(2) Many lubricant producers employ product engineers to assist users in selecting lubricants and to answer technical questions. Given a manufacturer's product description, operating characteristics, unusual operating requirements, and lubricant specification, product engineers can identify lubricants that meet the manufacturer's specifications. Viscosity should be the equipment manufacturer's recommended grade. If a recommendation seems unreasonable, the user should ask for verification or consult a different lubricant producer for a recommendation. These products will probably vary in quality and cost. The application should dictate lubricant selection. This will help prevent the unnecessary purchase of high-priced premium quality lubricants when they are not required.

c. User selection.

(1) The user should ensure that applicable criteria are met regardless of who makes the lubricant selection. Selection should be in the class recommended by the machinery manufacturer (R&O, EP, AW, etc.) and be in the same base stock category (paraffinic, naphthenic, or synthetic). Furthermore, physical and chemical properties should be equal to or exceed those specified by the manufacturer. Generally, the user should follow the manufacturer's specification. Additional factors to be considered are shown in Tables 13-1, 13-2, and 13-3. Each of these tables uses different criteria that can be beneficial when the user is selecting lubricants.

(2) If the manufacturer's specifications are not available, determine what lubricant is currently in use. If it is performing satisfactorily, continue to use the same brand. If the brand is not available, select a brand with specifications equal to or exceeding the brand previously used. If the lubricant is performing poorly, obtain the recommendation of a product engineer. If the application is critical, get several recommendations.

(3) Generally, the user will make a selection in either of two possible situations:

- Substitute a new brand for one previously in use.

- Select a brand that meets an equipment manufacturer's specifications. This will be accomplished by comparing producer's specifications with those of the manufacturer.

Product selection starts by using a substitution list maintained by most lubricant producers. A substitution list usually shows the products of major producers and the equivalent or competing product by other producers. Substitution lists are useful but they have limitations. They may not be subdivided by classes of lubricants. Furthermore, it is difficult to do more than compare a lubricant of one producer with one given by the publishing producer. For example, consider three producers called A, B, and C. Producer A's substitution list may compare B's products with A's, or C's with A's. However, B and C cannot be compared unless A has a product equivalent to both B and C. A user would need substitution lists from many producers to be able to effectively select more than one option. Many producers claim they do not have a substitution list, or are reluctant to provide one. As noted in Chapter 11, the chart of

Table 13-1
Factors Affecting Lubricant Selection

Element	Type	Size	Material	Operating Temperature	Operating Conditions	Velocity	Remarks
Bearings	Plain, needle roller, ball	Shaft diameter				rev/min	
Chain drives	Links; number and pitch	PCD of all wheels and distance between centers				Chain speed ft/min	
Cocks and valves	Plug, ball, etc.		Fluid being controlled				Depends on properties of the fluid
Compressors	BHP, manufacturer's name			Gas temperature	Max gas pressure	rev/min	
Couplings	Universal or constant velocity					rev/min	
Cylinders		Bore, stroke	Cylinder, piston, rings	Combustion and exhaust gas temperature	Combustion and exhaust gas pressure	Crank speed, rev/min	
Gears	Spur, worm, helical, hyperbolic	BHP, distance between centers			Radiated heat and heat generated	rev/min	Method of lubricant application
Glands and seals	Stuffing box		Fluid being sealed				Depends on design
Hydraulic systems	BHP Pump type (gear, piston vane)		Hydraulic fluid materials 'O' rings and cups, etc.				Lubricant type adjusting to loss rate
Linkages				Environmental heat conditions		Relative link speeds, ft/s, angular vel., rad/s	
Ropes	Steel hawser	Diameter			Frequency of use and pollution, etc.		
Slideways and guides						Surface relative speed, ft/min	

Reference: Neale, M.J., Lubrication: A Tribology Handbook. Butterworth-Heinemann Ltd., Oxford, England.

"Interchangeable Industrial Lubricants" and "Guide to Synthetic Lubricants" published by Plant Engineering Magazine (PEM) can be helpful. The PEM charts correlate products of many producers. The chart of synthetic lubricants correlates products by category (class).

(4) A substitution list or chart is valuable because it correlates the array of brand names used by producers. Furthermore, it eliminates producers who do not have the desired product in their line. A substitution list should be regarded as a starting point to quickly identify potential selections. The lists

Table 13-2
Types of Additive Oil Required for Various Types of Machinery

Type of Machinery	Usual Base Oil Type	Usual Additives	Special Requirements
Food processing	Medicinal white oil	None	Safety in case of ingestion
Oil hydraulic	Paraffinic down to about -20 °C (-4 °F), naphthenic below	Antioxidant Antirust Antiwear Pour point depressant VI improver Antifoam	Minimum viscosity change with temperature; minimum wear of steel/steel
Steam and gas turbines	Paraffinic or naphthenic distillates	Antioxidant Antirust	Ready separation from water, good oxidation stability
Steam engine cylinders	Unrefined or refined residual or high-viscosity distillates	None or fatty oil	Maintenance of oil film on hot surfaces; resistance to washing away by wet steam
Air compressor cylinders	Paraffinic or naphthenic distillates	Antioxidant Antirust	Low deposit formation tendency
Gears (steel/steel)	Paraffinic or naphthenic	Antiwear, EP Antioxidant Antifoam Pour point depressant	Protections against abrasion and scuffing
Gears (steel/bronze)	Paraffinic	Oiliness Antioxidant	Reduce friction, temperature rise, wear, and oxidation
Machine tool slideways	Paraffinic or naphthenic	Oiliness; tackiness	Maintains smooth sliding at very low speeds. Keeps film on vertical surfaces
Hermetically sealed refrigerators	Naphthenic	None	Good thermal stability, miscibility with refrigerant, low flow point
Diesel engines	Paraffinic or naphthenic	Detergent Dispersant Antioxidant Acid-neutralizer Antifoam Antiwear Corrosion inhibitor	Vary with type of engine thus affecting additive combination

Reference: Neale, M.J., Lubrication: A Tribology Handbook. Butterworth-Heinemann Ltd., Oxford, England.

do not suggest or imply that lubricants listed as being equivalent are identical. The lists do indicate that the two lubricants are in the name class, have the name viscosity, and are intended for the same general use. The chart of interchangeable industrial lubricants lists the following categories:

- General purpose lubricants
- Antiwear hydraulic oil
- Spindle oil

Table 13-3
Importance of Lubricant Properties in Relation to Bearing Type

	Type of Component					
Lubricant Property	**Plain Journal Bearing**	**Rolling Bearing**	**Closed Gears**	**Open Gears, Ropes, Chains, etc.**	**Clock and Instrument Pivots**	**Hinges, Slides, Latches, etc.**
1. Boundary lubricating properties	1	2	3	2	2	1
2. Cooling	2	2	3	-	-	-
3. Friction or torque	1	2	2	-	2	1
4. Ability to remain in bearing	1	2	-	1	3	1
5. Ability to seal out contaminants	-	2	-	1	-	1
6. Temperature range	1	2	2	1	-	1
7. Protection against corrosion	1	2	-	2	-	1
8. Volatility	1	1	-	2	2	1

Note: The relative importance of each lubricant property in a particular class of component is indicated on a scale from 3 = highly important to - = quite unimportant.
Reference: Neale, M.J., Lubrication: A Tribology Handbook. Butterworth-Heinemann Ltd., Oxford, England.

- Way oil
- Extreme pressure gear oil
- Worm gear oil
- Cling-type gear shield (open gears)
- General purpose extreme pressure lithium based grease
- Molybdenum disulfide extreme pressure grease.

(5) Spindle and way oils are not widely used. One of the last three classes on the list is a special preparation for open gears and the other two are classes of grease. General purpose oils, antiwear hydraulic oils, and EP gear oils are best described by comparison with the nonspecialized industrial oils discussed earlier. Nonspecialized oils contain a category called general purpose oils. This term is also used in the PEM list but it differs from the previously described general purpose oil category in that the additives may not be the same. In some cases, brand names indicate that EP additives have been included. In other cases, AW is indicated but not R&O. This raises the possibility that R&O additives are not present. AW hydraulic oil is a general purpose oil, but its antiwear properties are sufficient to pass the Vickers vane test for hydraulic applications when this is required.

(6) The EP gear oils should correspond to those described under nonspecialized industrial oils except that EP additives are included and viscosities may be as high as ISO 2200. The EP classification of gear oil should not be confused with the SAE gear oil classification which is for use in automotive gear systems. SAE gear oils are formulated differently and are not discussed in this manual.

(7) While grease preparation varies greatly among producers, only two types are given in the PEM list: No. 2 lithium EP and molybdenum disulfide EP No. 2. These are the two most widely used industrial greases. The name molybdenum disulfide designates lubricant type, and does not reflect the type of soap, but the soap will usually be lithium. While both types are intended to provide extra protection against wear, one contains EP additives and the other contains molybdenum disulfide.

(8) Lithium greases are the most widely used, but calcium, aluminum, polyurea, and sodium-calcium are also used. Furthermore, greases ranging from NLGI 00 to No. 3 are used. Consequently, in many cases, the PEM tables will not be useful for selecting greases.

(9) The cling-type gear shield lubricants are residual oils to which a tackiness agent has been added. They are extremely adhesive and so viscous that solvents are added to permit application. After application, the solvent evaporates leaving the adhesive viscous material. Some products contain no solvent and must be heated to reduce viscosity for application.

(10) Compounded oils are not included in the list as a separate class. When this type of oil is required, producers must be contacted directly.

(11) Ultimately, information brochures provided by the producers must be examined to verify the following:

(a) Viscosity. The product viscosity meets the manufacturer's recommendation or is the same as a previously used lubricant that performed well. When a grease is considered, the viscosity of the included oil should be the same as the previous lubricant.

(b) Intended use. The product's intended use, as given by the producer, corresponds to the application in which the lubricant will be used.

(c) Class of lubricant. The class of lubricant is the same as that recommended by the equipment manufacturer or the same as a previously used lubricant that performed well. If the manufacturer recommended an R&O, AW, or EP oil, or a No. 2 lithium grease, that is what should be used.

(d) Specification. The product specifications are equal to or better than those recommended by the equipment manufacturer or those of a previously used lubricant that performed well.

(e) Additives. The product additives perform the required function even though they may not be chemically identical in several possible alternative lubricants.

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13-4. Specification Types

Current government policy encourages use and adoption of nongovernment specifications and standards instead of developing new or updating existing federal and military specifications. Types of specifications, in order of usage preference are: (1) Nongovernment specifications; (2) Commercial Item Descriptions; and (3) Federal and military specifications.

a. Nongovernment. Federal and military specifications are being replaced by specifications and industry standards developed by trade associations such as SAE, AGMA, and API and professional private-sector organizations and technical societies such as ISO, ANSI (American National Standards Institute), and ASTM. Nongovernment specifications and standards (NGS) should not be confused with

lubricant producer standards. NGS promote competition and usually provide a broad base of suppliers, whereas producer-specific standards tend to limit competition to a single supplier.

b. Commercial item description. A Commercial Item Description (CID) is an indexed, simplified product description that describes by salient function or performance characteristics, available and acceptable commercial products that meet the government's needs. These items include references to ASTM, ANSI, and other industry standards. CIDs are issued by the General Services Administration (GSA) and are listed in the GSA "Index of Federal Specifications, Standards and Commercial Item Descriptions."

c. Federal and military. New Federal specifications are developed and existing specifications are updated to establish requirements for commercial products only if specific design, performance, interface, or other essential characteristics are not described adequately by nongovernment standards or Commercial Item Descriptions. Federal Specifications are issued by the General Services Administration and are listed in the GSA "Index of Federal Specifications, Standards and Commercial Item Descriptions." New military specifications are developed and existing specifications are updated to establish requirements for military-unique products or commercial products that must be substantively modified to include military-unique requirements. If a nongovernment standard exists that contains the basic technical requirements for a product or process, it is referenced in the military specification, and the military specification contains only those additional requirements needed by the Department of Defense. Military specifications are issued by the Department of Defense and are listed in the "Department of Defense Index of Specifications."

d. Proprietary. Proprietary specifications refer to specifications owned by an oil producer or used for acquisition of a product from a lone source.

(1) Oil producer. Some proprietary specifications contain confidential trade secrets, and are developed and exclusively controlled by a lubricant producer. Producer specifications published in company brochures, pamphlets, and handbooks contain nonproprietary information and are described in subparagraph 132-*a*(6) Oil Producers' Product Data and Specifications.

(2) Acquisition. Sometimes a proprietary specification is used as an acquisition method to specify a product that is available from only one source. It identifies a product by manufacturer's brand name, product number, type, or other unique designation. A specification can be considered proprietary even if brand name is not stated but the product is available from only one source. Specifying by product name is suitable and advantageous when a specific product has proven successful or its use is specified by an equipment manufacturer as an equipment warranty condition. Disadvantages to specifying a product by brand name are that it eliminates competition and the purchaser may pay a premium price.

13-5. Lubricant Consolidation

a. General. Older machines tend to operate at slow speeds and light loads. These machines also tend to have large clearances and few lubricating points. Lubrication of such older machines is not as critical, comparatively speaking, as for modern machines that operate at higher speeds, under heavier loads, and with closer mechanical tolerances. A common maintenance practice is to have inventories of several types of lubricant to service both older and newer versions of similar equipment (e.g., speed reducers). This problem is further aggravated by the different types of unrelated equipment operating at a complex facility (e.g., turbines, speed reducers, ropes and chains, etc.), each requiring lubrication. Consolidation of lubricants is usually undertaken to reduce inventories, storage requirements, safety and health hazards, and

cost. Consolidation, done properly, is a rational approach to handling the lubrication requirements at a facility while reducing the total number of lubricants in the inventory.

b. Manufacturer's recommendations. Manufacturers may recommend lubricants by brand name or by specifying the lubricant characteristics required for a machine. Depending on the machine, lubricant specifications may be restrictive, or they may be general, allowing considerable latitude. Usually the manufacturer's warranty will be honored only if the purchaser uses the lubricants recommended by the manufacturer. Voiding the terms of a warranty is not advisable, so the specified lubricants should be used until the warranty has expired. After warranty expiration the machine and its lubrication requirements may be included in the consolidation list for the facility.

c. Consolidation considerations. Consolidation of lubricants requires careful analysis and matching of equipment requirements and lubricant properties. Factors that influence selection of lubricants include operating conditions, viscosity, viscosity index, pour point, extreme pressure properties, oxidation inhibitors, rust inhibitors, detergent-dispersant additives, etc. With a grease, consideration must also include composition of the soap base, consistency, dropping point, pumpability. There are several precautions that must be followed when consolidating lubricants.

(1) Characteristics. Consideration should be given to the most severe requirements of any of the original and consolidated lubricants. To prevent equipment damage, the selected lubricant must also have these same characteristics. This is true for greases.

(2) Special requirements. Applications with very specific lubricant requirements should not be consolidated.

(3) Compatibility. Remember that some lubricant additives may not be compatible with certain metals or seals.

d. Consolidation procedure. Consolidation may be accomplished through the services of a lubricant producer or may be attempted by facility personnel who have knowledge of the equipment operating characteristics and lubricating requirements, and an ability to read lubricant producer's product data.

(1) Lubricant supplier. The preferred method for consolidating lubricants is to retain the services of a qualified lubrication engineer. All major oil companies have engineers available to help users with lubrication problems. There are also numerous independent lubricant suppliers with the necessary personnel and background to provide assistance. Ultimately, the knowledge, experience, integrity, and reputation of the lubricant supplier are the best assurance that the products recommended will meet the lubrication requirements for the equipment. The supplier must be given a list of equipment, along with any information about the operating characteristics, ambient conditions, and lubrication requirements. The engineer can use this information to consolidate lubricating requirements where possible, and to isolate equipment with highly specific requirements that cannot be consolidated. The primary disadvantage with this approach is that the lubricant supplier will, in all probability, recommend only those products within the company's product line. If this is a major concern, the services of an independent lubricating engineer or tribologist, not affiliated with any supplier, may be retained.

(2) Consolidation by in-house personnel.

(a) In-house personnel should begin the consolidation process by preparing a spreadsheet identifying equipment, lubricating requirements, lubricant characteristics, and brand names. The equipment should be

sorted by type of lubricant (oil, hydraulic fluid, synthetics, biodegradable, grease) required. Under each type, the properties of each lubricant should be grouped such as oil viscosity, detergent-dispersant requirements, EP requirements, rust and oxidation inhibitors, NLGI grade of grease, viscosity of oil component in the grease, pumpability, etc. See Figure 13-1 for an example of a spreadsheet showing the essential features.

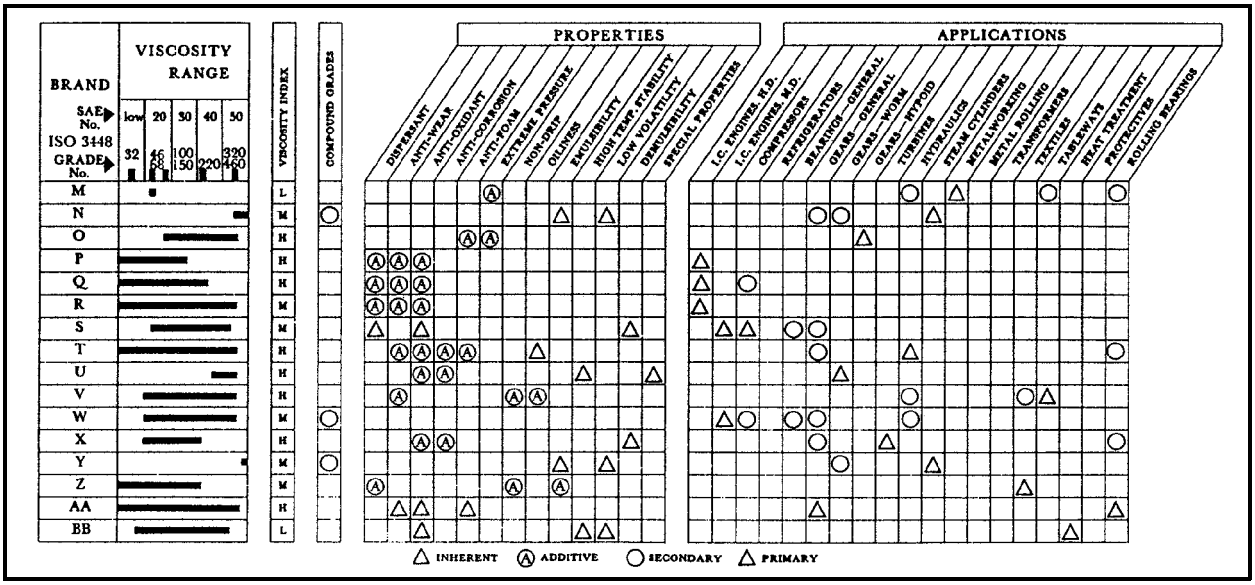

Figure 13-1. Lubricant consolidation chart (Reference: Neale, M. J., Lubrication: A Tribology Handbook. Butterworth-Heinemann Ltd., Oxford, England

(b) At this stage, viscosity grouping can be made. For instance, if three similar oils have viscosities of 110, 150, and 190 SUS at 100 °F, the 150 may be used as a final selection. If one of the original oils was rust and oxidation inhibited, the final product should also have this property. A second group of oils with viscosities of 280, 330, and 350 SUS at 100 °F could be reduced to one oil having a viscosity in the neighborhood of 315 SUS at 100 °F. As shown in Figure 13-1, the goal is to identify the viscosity requirements and range for various equipment and see if a single lubricant can span the range. If the range can be covered, then consolidation is possible. However, recall that paragraph 13-3 included a warning that the lubricant viscosity for a machine must comply with the manufacturer's requirements. Obviously, an exact match of viscosity for all equipment cannot be accomplished with the same lubricant when consolidation is the goal. Lubricants with vastly different viscosity requirements must not be consolidated.

(3) Use higher quality lubricants. Another alternative for consolidation is to use higher grade lubricants that are capable of meeting the requirements of various machinery. Although the cost of high-grade lubricants is greater, this may still be offset by the benefits of consolidation (e.g., reduction in the number of different lubricants needed, reduction in inventory-management requirements, possible price discounts for purchasing certain lubricants in greater quantity, etc.).

(4) Use multipurpose lubricants. Multipurpose lubricants and other general purpose oils can be applied to a wide range of equipment and help reduce the number of lubricants required. Although some lubricants are not listed as multipurpose they may be used in this capacity. For example, assume two lubricants by the same producer: one is listed as an R&O turbine oil and the other as a gear oil.

Examination of product literature shows that the R&O turbine oil can also be used in bearings, gear sets, compressors, hydraulic systems, machine tools, electric motors, and roller chains while the gear oil can also be used in circulating system, chain drives, plain and antifriction bearings, and slides. These oils may be suitable for use in a consolidating effort. Producers often have similar application overlaps in their product lines.