Construction Equipment Greasing

The art and science of your most important preventive-maintenance task

Produced for Chevron Lubricants by Preston Ingalls and Randall-Reilly

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Introduction

Proper lubrication practices are essential to keeping the machines your team manages up and running. Mistakes and inattention related to greasing tasks can lead to failed equipment and expensive downtime – as well as costly repairs. **Only 20% of bearings reach their life expectancy, and up to 80% of bearing failures are related to inappropriate lubrication.** Choosing the right grease products and creating an optimal lubrication program isn't easy. One size does not fit all when matching grease and greasing procedures to construction equipment.

At Chevron, our focus is helping customers build lubrication programs that are customized to every aspect of their operations. And now we've teamed up with noted construction-equipment-maintenance specialist Preston Ingalls to provide you with knowledge he has gained through decades of research and practical application.

Focusing on clear steps and best practices regarding equipment greasing, this ebook also provides background information and concise explanations to help practitioners understand not only what should be done to keep the machines they manage healthy, but also why. It begins with a brief history of grease, then examines its importance in modern equipment as a barrier that reduces friction and prevents wear, protects bearings against corrosion and acts as a sealant to prevent contaminants from entering. It then delves into the details of proper greasing practices, tackling fundamental questions as well as complex and often-misunderstood issues.

The most important type of preventive maintenance is lubrication, yet many technicians performing this work have limited understanding of oil and grease. We hope you can use the information and practices described here to train your employees, protect your equipment investments and avoid downtime and repairs.

About the Author

Preston Ingalls, president and CEO of TBR Strategies, has more than 45 years of maintenance and engineering experience. Based in Raleigh, North Carolina, TBR Strategies consults extensively with construction-industry companies operating heavy-equipment fleets and has guided hundreds of organizations toward improved efficiency and reliability through better asset management.

Ingalls holds undergraduate degrees in manufacturing engineering and engineering operations and a master's degree in organizational development. He is a member of the Association for Equipment Management Professionals, Society for Maintenance and Reliability Professionals and the Association of Energy Service Companies.

1 Early Use of Grease

The practice of using animal fat, or tallow, to grease wheels dates back centuries. Ancient Egyptians used animal fat on their chariot wheels. American pioneers brushed tallow, thickened with ash, on the hubs of their Conestoga wagons during their cross-country journey.

Francis "Borax" Smith, a mining magnate and businessman who headed the Pacific Coast Borax Company, insisted on packing wagon wheel hubs with tallow before the 160-mile trek through the desert, hauling up to 30 tons of borax ore with a 20-mule team. No wagon broke down between 1877 and 1891, when the mule team was replaced by rail.

Animal fat was a common lubricant until the rise of the petroleum and crude-oil industries in the 19th century. Early Egyptians also used olive oil to move large stones, and mud was historically used as a lubricant as well.

So greasing as a practice has long been a contributor to preventive maintenance. But greasing as a science is relatively new. Greasing is part of tribology, the science of interacting surfaces relative to motion. Simply put, sliding and rotating parts of machinery create friction, and friction creates wear and heat that accelerate component deterioration and failure. We depend on grease as a barrier between those surfaces to minimize friction and wear. Grease also protects bearings against corrosion and acts as a sealant to prevent contaminants from entering.

Photo courtesy of U.S. Borax

2 Bearing Basics

Two categories of bearings are common in the equipment construction operations use.

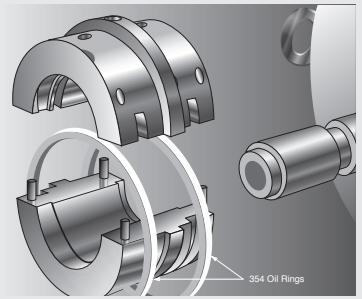
Journal and plain bearings (of which pins and bushings are a type)

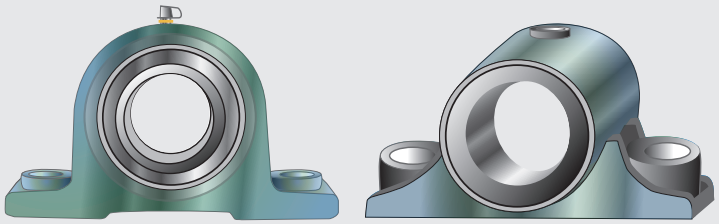
Journal or plain bearings contain a journal or shaft that rotates inside a support with a shell or metal sleeve. No rolling elements are present. The bearing is designed in a plain or straight configuration, with a flange that accommodates axial and radial loads. Pins and bushings are a type of journal bearing in which the shaft or shell typically does not make full rotations, but partial rotations at slow speed before reversing direction. In construction applications, journal bearings are typically used in kingpins, differentials, hinges, pedals, frame supports, articulated frame joints, pivot arm supports and other pivot points.

Rolling element bearings

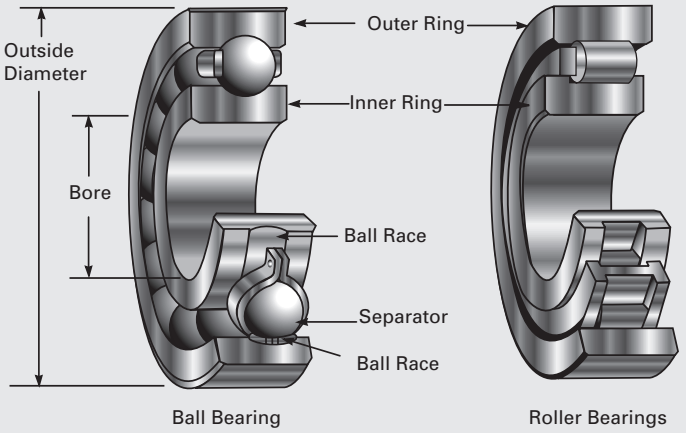
Rolling element bearings use rolling elements to support loads and reducing friction. While similar to ball bearings, roller bearings employ barrel-shaped rolling elements rather than spherical balls to maintain separation between moving parts of the bearing. They can support heavier loads than ball bearings of similar sizes, but, unlike ball bearings, cannot handle high speeds. In construction applications, rolling element bearings can be found in wheels, hydraulic pumps, rotating motors, axles, transmissions, torque converters and more.

Journal or Plain Bearings





Rolling Element Bearings



Grease as a friction barrier

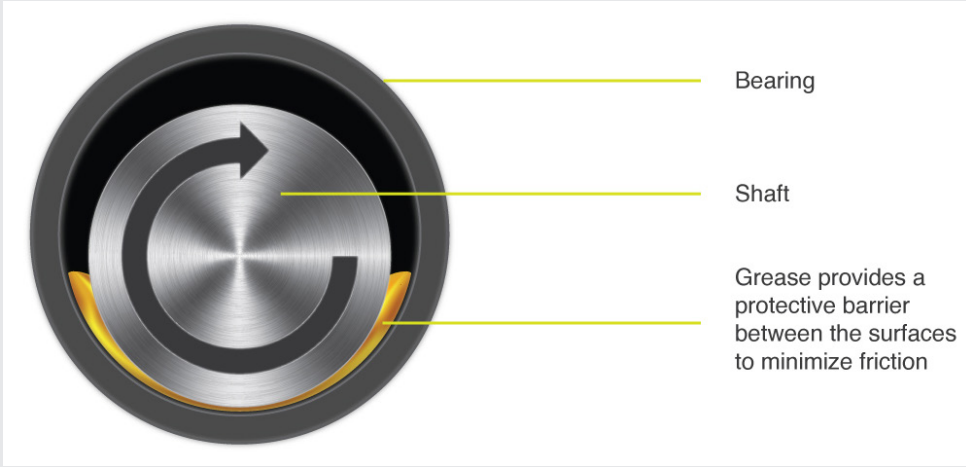
The illustration to the right shows how grease serves as a barrier in a journal bearing, providing a thin lubricant film between bearing surfaces.

Bearing failures

Studies have shown poor lubrication practices result in failed equipment. Research by RKB Bearings found up to 80% of bearing failures were attributed to inappropriate lubrication, while a study by SKF, a bearing and lubrication-system manufacturer, reveals more than 54% of bearing failures are related to improper lubrication practices.

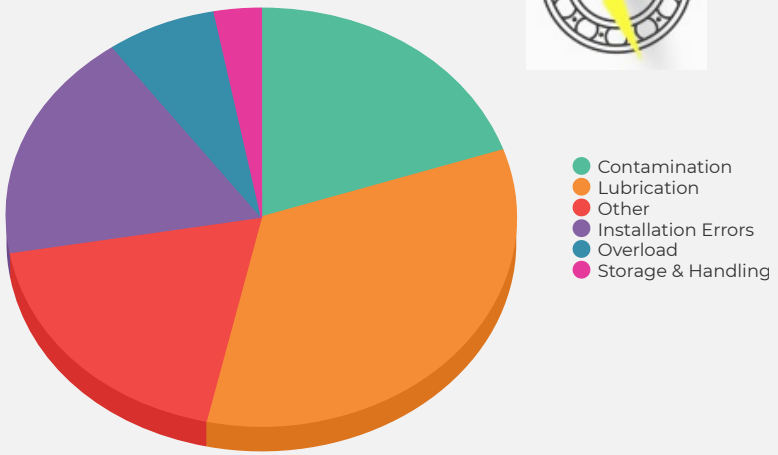
Greasing's key challenges involve type, frequency and amount: what kind of grease, how often you apply it and how much.

Grease in Journal Bearing



The Source of Bearing Failures

A study conducted by **SKF** found that over *50%* of all bearing failures are the result of *lubrication issues*



3 What Kind?

Despite the fact lubrication is the lifeblood of mechanical equipment, we certainly don't always treat it with the respect and attention it deserves.

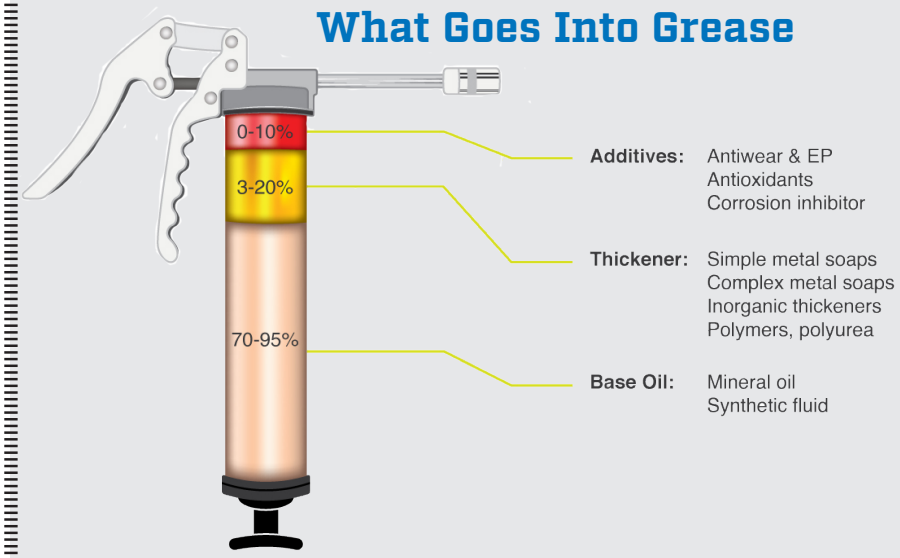
Here are some key points for maintaining robust lubrication.

Fundamentals

First, all grease is not the same. Grease manufacturers add colors ranging from ruby to amber to gray, white, black and blue to signal differences in load-carrying ability, water resistance, mechanical stability, high-temp life, thickener type and oxidation stability. One size can't fit all.

It's essential that grease rather than oil be used as a lubricant because it adheres to equipment's moving surfaces without easily dripping or flowing away like oil does. Grease is a semifluid to solid mixture of a fluid lubricant and a thickener, and may contain additives. The fluid lubricant that performs the actual lubrication can be mineral oil (petroleum-based), synthetic oil, or vegetable oil (used for food-processing equipment). Common thickeners are soaps and organic or inorganic nonsoap thickeners (see table). The thickener is used to help the oil adhere to surfaces. Remember, the real value is the oil that is "leeching" or "bleeding" from the thickener. However, when the grease is put under continuous pressure, the film may break down, meaning the lubrication value is now dependent on the thickener and not necessarily the base oil.

What Goes Into Grease



BASE OIL	THICKENER	PERFORMANCE ADDITIVE
Asphaltic	**Simple Soaps:**	Antioxidants
Naphthenic	Aluminum	Anti-wear additives
Paraffinic	Calcium - hydrated	Extreme Pressure Additives
Hydocracked	Calcium - anhydrous	Metal Deactivators
Synthetics:	Sodium	Corrosion Inhibitor
PAO	Barium	Rust Inhibitors
Esters	Lithium	Tackiness Additives
Silicone Fluids	Mixed bases of the above	Structure Modifiers
PFPE	**Complexes:**	Pour Point Depressants
Natural:	Barium Complex	Friction Modifiers
Vegetable Oil	Calcium Comples	Viscosity Index Improvers
	Lithium Complex	Dyes and Colorants
	Aluminum Comples	**Solid Additives:**
	Non-Soaps:	Molybdenum Disufide
	Polyurea	Graphite
	Clay	Zinc Oxide
	Silica	Calcium Carbonate
	Teflon	Titanium Oxide
	Lubricating Thickener:	
	Calcium Sulfonate	

Source: Michael Holloway

Example OEM Preventive Maintenance Spec

42 *(Cont.)*	**Check the Fan, Fan Clutch & Fan Solenoid Valve** *(Cont.)*	...is at operating temperature ...ged. If noise is detected, have the fan bearings inspected.			
		42.3 Check the fan drive for proper engagement and disengagement.	☐	☐	☐
		42.4 Check that the fan blade clearance around the fan shroud. The recommended distance is **1 in. (25 mm)** from front edge of any fan blade to the radiator side member. Minimum clearance is **3/4 in. (19mm).** The rear edge of any blade must be no closer than **3/8 in. (9mm)** to the nearest engine component. If this cannot be obtained, the fan spacer or fan is not correct. The leading edge of any fan blade must be **1 in. (25 mm)** from the inside edge of the shroud.	☐	☐	☐
43	**Check Power Steering Fluid**	**Note: Before removing reservoir cover, wipe outside of cover so that no dirt can fall into the reservoir.**			
		43.1 Check the fluid level and add fluid if necessary **(ATF) Type E or F or Dexron lll**.	☐	☐	☐
		43.2 Check fluid for contamination, discoloration, or burnt smell; correct source of such problems before replacing fluid and filter **(ATF) Type E or F or Dexron lll**.	☐	☐	☐
44	**Power Steering Fluid & Filter Replacement**	44.1 Drain power steering fluid and replace power steering filter. Refill with **(ATF) Type E or F or Dexron lll**.	☐	☐	☐
45	**Power Steering Gear**	45.1 Check the lash of the sector shaft and adjust as required.	☐	☐	☐
		45.2 Grease the trunnion bearing **(EP NLGI #2 lithium-based, moly-filled, HD grease)**.	☐	☐	☐
		45.3 Grease the input shaft seal **(EP NLGI #2 lithium-based, moly-filled, HD grease)**.	☐	☐	☐
46	**Power Steering Assist Cylinder**	46.1 Lubricate the ball joints. Inspect for leaking rod seals, damaged ball joint boots, and damage to cylinder rod or barrel.	☐	☐	☐
47	**Check Power Steering Hoses**	47.1 Check all power steering hoses and tubes for leaks and chaffing.	☐	☐	☐
48	**Check Steering Linkage**	48.1 Check all joints for excessive lash and replace if necessary.	☐	☐	☐
49	**Check Draglink Tube Clamp & Ball Socket**	49.1 Check the torque and tighten to specified torque value as required.	☐	☐	☐

OEM spec issues

Following equipment manufacturers' grease requirements can be tricky because many OEMs make machines that use bearings from various sources.

Another problem with following OEM specs verbatim is the conditions of use are based on an aggregate or average. The needs of a dozer or milling machine used part of the year in cold conditions in New York are different from those of the same machines used year-round in hot and humid conditions in Louisiana or Texas. Some OEM engineers are not versed in tribology and cannot recommend tables that compensate for climatic or environmental differences.

Does this mean OEM specs are useless? No, but they should be tempered with your own experience and that of your mechanics, technicians, lube suppliers and, ideally, a certified lube specialist.

Incompatibilities

Grease is the vehicle that carries a lubricating oil, much like a sponge carries water. The lubricating qualities are in the oils, which are suspended in the thickener. However, some greases are not compatible with others. When incompatible greases are mixed, such as in a bearing, a poor lubricant is the result.

For example, you don't want to use a grease containing an extreme pressure additive in electric motors because it attacks the insulation on the windings. The following table shows some compatibilities/incompatibilities in greases. As evident in the table, many greases don't play well with one another.

Compatibility Chart

Table 1 - Compatibility of Binary Grease Mixtures

	Lithium	Lithium Complex	Aluminum Complex	Calcium	Calcium Sulfonate Complex	Barium Complex	Sodium	Bentone (Clay)	Polyurea
Lithium									
Lithium Complex									
Aluminum Complex									
Calcium									
Calcium Sulfonate Complex									
Barium Complex									
Sodium									
Bentone (Clay)									
Polyurea									

Compatible

Check Compatibility with Chevron Lubetek®

Not Compatible – Full Clean Out Required for Change

Table 1 should be used only as a guideline for determining compatibility. For the purpose of changing products in the field, the compatibility of the greases in question should be determined by laboratory testing.

Consistency

Consistency, or penetration, is a measure of the firmness of grease and is determined on the National Lubricating Grease Institute scale called a grade, ranging from 000 (softest, like canola oil) to 6 (very firm, similar to a block of cheddar cheese). These were based on ASTM specifications. Most grease grades are in the ranges of 1 to 3. The viscosity of these grades would be similar to the range of the thickness of tomato paste to vegetable shortening. Grade 2 tends to be the most common.

When it comes to the kind or type, we want to make sure we are specifying the correct type for the application. Researching the OEM's recommendation, asking for lube suppliers' suggestions and ideally having the advice of a certified lubrication specialist will minimize the possibility of selecting the wrong type.

To learn more about choosing grease products for your operation, see page 21.

Grease Consistency Table

NLGI Number	ASTM worked (60 strokes) penetration at 25°C tenths of a millimeter	Appearance	Food analogy consistency
000	445-475	fluid	ketchup
00	400-430	semi-fluid	hotdog relish
0	355-385	very soft	brown mustard
1	310-340	soft	tomato paste
2	265-295	normal grease	peanut butter
3	220-250	firm	cream cheese
4	175-205	very firm	frozen yogurt
5	130-160	hard	liverwurst
6	85-115	solid	cheddar cheese

4 How Often and When?

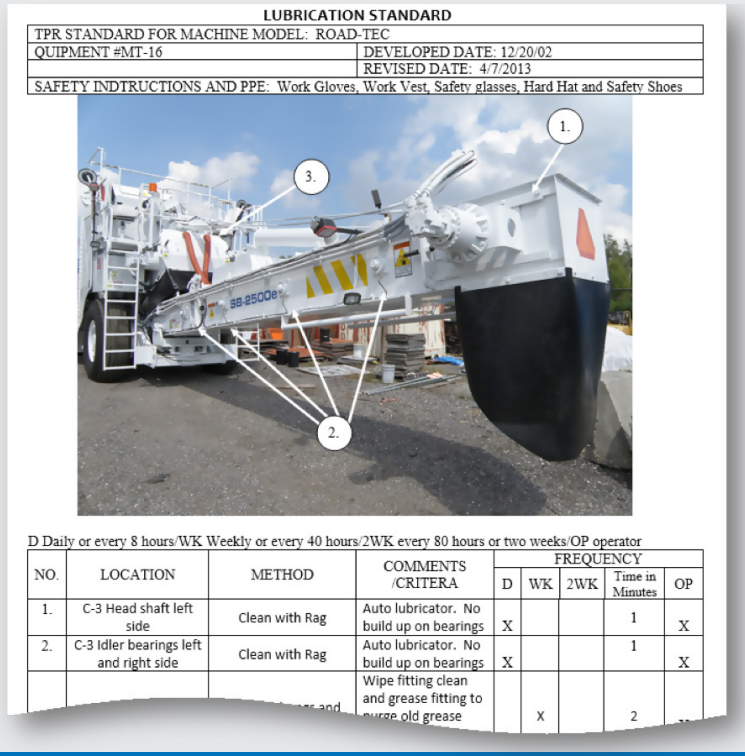
After examining the type of grease to use, it is appropriate to look at frequency. How often do we need to grease? And when? Frequency is usually specified by OEMs, but failure patterns, from historical analysis, can help identify logical frequency as well.

Use of Posted Standards

Placing lube standards (with required greasing intervals, recommended applications and step-by-step guides, if possible) on machines can minimize reliance on memory, which is often weak. You can laminate lubrication standards and post them on equipment, place them in weatherproof boxes on machines or put decals on equipment. Cover specifics in the standards. For example, according to Roadtec, a milling machine's leg systems must be greased with the machine elevated so the grease lines match up with the grease grooves in the brass.

Laminated Lubrication Standard

Lube Standard for Roadtec MTV



LUBRICATION STANDARD

TPR STANDARD FOR MACHINE MODEL: ROAD-TEC	
QUIPMENT #MT-16	DEVELOPED DATE: 12/20/02
	REVISED DATE: 4/7/2013
SAFETY INDTRUCTIONS AND PPE: Work Gloves, Work Vest, Safety glasses, Hard Hat and Safety Shoes	

D Daily or every 8 hours/WK Weekly or every 40 hours/2WK every 80 hours or two weeks/OP operator

NO.	LOCATION	METHOD	COMMENTS /CRITERA	FREQUENCY				
				D	WK	2WK	Time in Minutes	OP
1.	C-3 Head shaft left side	Clean with Rag	Auto lubricator. No build up on bearings	X			1	X
2.	C-3 Idler bearings left and right side	Clean with Rag	Auto lubricator. No build up on bearings	X			1	X
			Wipe fitting clean and grease fitting to purge old grease		X		2	

Grease warm machines

It is vital to stress to operators the importance of greasing at the end of the day when machines are warm, not in the morning when they are cold. Lubrication will flow better on warm components. Roadtec, Caterpillar, John Deere and other OEMs stress the importance of end-of-day lubing.

Heat-sensitive components are another reason to make sure machines are warm before lube activities. For example: On a milling machine, Roadtec recommends you run the clutch to warm the lines inside it before greasing the clutch bearing. A machine sitting out in the winter that is greased with high-temp grease will most certainly push the line off the bearing and, in this application (inside the clutch), you will never see it. Clutches in the drum drive milling machine application are expensive, and these simple steps, if performed correctly, reportedly allow the clutch to service for 5,000 hours.

Operators might work 14- to 16-hour days and be exhausted at the end of the shift, with little appetite for crawling over machines and hitting all the lube points. Explaining why greasing needs to be done when machines are warm could improve operator adherence.

5 How Much?

While auditing an excavator one time, I noticed there were large globs of grease oozing down the side of the machine. When I asked the operator how much and how often he greased, the response was, "Every darn day. As to how much, well, I was told one shot is good … means two's better… then 50's gotta be outstanding, right?"

No.

One point to remember is that 40-50% of the space in a closed-cavity bearing is for cooling purposes, so when someone overfills it with grease, they have displaced that ability to cool. The result: accelerated deterioration of the bearing. Imagine rolling elements having to push blobs of mud out of their way to glide — much like feet marching in mud. You want a fine film of lubricity, not a wad of mud that has to be pushed out of the way.

Calculating the amount

You can calculate the exact amount a bearing needs using the bearing speed, width, outer diameter and a factor for quantity.

Studies have shown an individual stroke or "shot" of grease from a grease gun can vary from a .5 gram to 3 grams. In other words, three strokes from one grease gun may produce 1.5 grams of grease, while three strokes from another could produce 9 grams. That is a 600% difference. This is not an issue when you are greasing a journal bearing to purge (when grease will be purging clean on the other side), but it will be if you are instructing operators to shoot two shots of grease in a closed-cavity bearing. A 600% different in volume can easily result in over-greasing and could break the seal intended to keep grease inside the bearing and contaminants out.

To help prevent this, measure the actual output from each gun and use it in your calculations. (See the "Calibrating Grease Guns" section on the next page.)

You also can use ultrasound to detect lube content since you can't see through the bearing, but ultrasound can detect lube contents. Another suggestion is to install a grease vent plug on a relief port in closed-cavity bearings. Most lube system suppliers carry these vents.

Calculating Amount

Here is a simple equation that takes a logical approach to determining the amount of grease to be added.

The formula is:

G = 0.114 x D x B.

G = the amount of grease in ounces

D = the bearing outside diameter (OD) in inches

B = the bearing width (W) in inches

Calibrating grease guns

One way to minimize the problem of volume variability among grease guns is calibrating each gun to determine the amount of grease it delivers with one full pump or stroke. A common way to calibrate grease guns is by measuring the average weight of several strokes of grease.

Take a sticky note, and place it on a scale. Measure its weight and zero out the scale. Now, shoot 10 full strokes or shots of grease onto the paper. Divide the total weight by 10. That is the average weight per stroke. Take a permanent marker or paint pen and mark that number on the grease gun, i.e. "2 gm/shot."

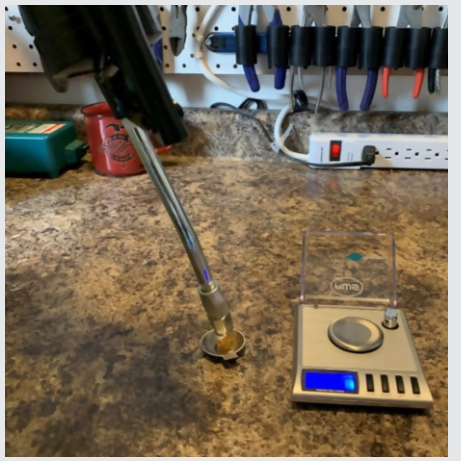
The photos to the right show how to use a scale with a removal dish to accomplish the same task. We start by zeroing out the scale with the dish in place.

As you can see, the shot range was from .884 up to 1.184 grams, or 48% variance with the same person shooting. That shows the benefit of taking an average. We finished with 1.06 grams or 1.1 grams, rounded off. Despite claims the average shot is 2 to 3 grams, this grease gun, secured from a common big-box home-supply store, produced just 1 gram. If the requirement were 3 grams, the gun would only fill one-third of the need.

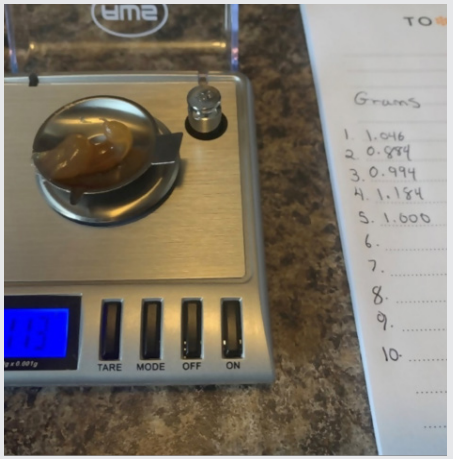
Another method of determining an average is to shoot 10 shots into a lab test tube, subtract the weight of the tube and then divide by 10.

Steps for Calibrating Grease Guns

Step 1 - Zero out the scale



Step 2 - Weigh 10 different shots on the scale



Step 3 - Record each shot and then average

Step 4 - Mark the average on the grease gun

6 Labeling and Color Coding

Labeling and color coding

Because of possible incompatibility, a grease and oil color-coding scheme, applied from storage containers to fill points, minimizes mistakes. Below are some storage examples.

Color-coded Storage Containers and Chart

Color-coded transfer containers Source: TBR Strategies and Superior Paving

Color-coded bulk lube storage Source: TBR Strategies and Superior Paving

Color-coded bulk lube storage magnet strips Source: TBR Strategies and Superior Paving

Color-coded chart for lube Source: TBR Strategies and Superior Paving

Color-coded grease guns

Color coding and/or labeling grease guns to distinguish between various grease types is important. See the examples to the right.

It is, of course, ideal to standardize the type of grease gun your operation uses and, therefore, the weight/stroke of all your grease guns.

Labeling grease points

Label each grease point with a decal or color indicating what grease is supposed to be used. This also will help those performing lube tasks see all the grease points.

Color coding grease fittings also can help indicate daily, weekly, monthly or quarterly lube activities. Another means could be to apply grease caps, sticky labels or tags. You also can indicate the amount (one shot, two shots, etc.) with the fitting caps.

It is best to accompany these with the laminated visual standards (see "How Often and When?" section on page 11) to minimize misinterpretation or reliance on recall or memory.

Color-Coded Grease Gun Bands and Caps

Lube points marked with red color and arrows indicating locations

7 Grease Guns

Types

There are three primary means to power grease guns: by hand, air or electricity. Hand-powered grease guns can employ either a lever or a pistol grip. Another major variation among grease guns is how grease is loaded: by suction fill, cartridge (tube) or bulk. Which type of grease gun is best depends primarily on the intended application and the lubrication technician's personal preference.

1. Lever (manual): This is the most common type of grease gun and can supply between 1 and 1.5 grams of grease per pump.

5

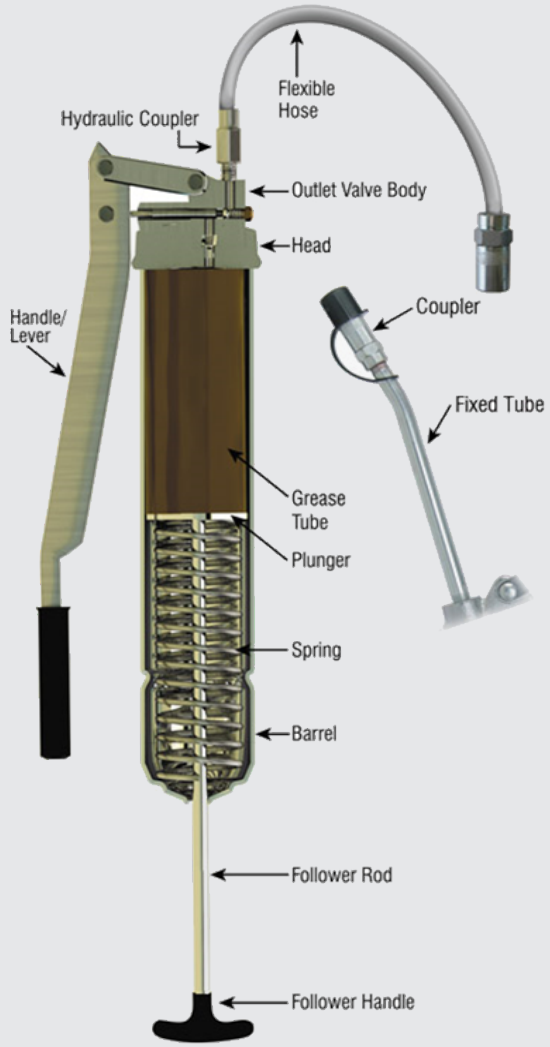
2. Pistol grip (manual): This variation of the lever-type grease gun allows for one-handed pumping. It provides a little less than 1 gram per pump.

3. Pneumatic: This grease gun uses compressed air (up to 15,000 psi). Many times, the grease provided to the gun is stored in large barrels, and the air compressor applies pressure from a pump at the top of the barrel, through a pneumatic hose and into the gun.

4. Battery (cordless): This is a low-voltage, battery-powered grease gun that works similarly to the pneumatic grease gun.

5. Foot-pump grease gun: Another grease-gun concept to consider, especially for greasing heavy equipment, is the foot pumper. These units are easy to pull around and are less tiring to operate than traditional grease guns.

Components of a Manual-Lever Grease Gun



Storage of rarely used grease guns

Store grease guns vertically, as the oils in the grease are more apt to leech from the grease in the horizontal position.

If you have a grease gun containing a specialty tube of grease that is rarely used, you can store it with tube socks over the ends. Then place the entire gun in a 5-gallon, resealable storage bag (see photo) for protection and cleanliness. Over time, material from the gun will bleed over and get tacky if you do not use this or a similar method.

8 Training

The key to training employees on properly performing lubrication tasks is to provide one-on-one or one-on-few instruction sessions. Here is an example instruction session: https://www.youtube.com/watch?v=8d0WFpX3R9c.

Train employees to use lubrication standards. Task experienced people with overseeing lube duties, because they will have the understanding to recognize abnormalities that an inexperienced person would not, and they can help train new operators or maintenance specialists to spot potential problems.

Training should include how to load grease guns. Here is a helpful instructional video that addresses the issue of clearing air locks by showing how to rotate the tube a few turns to relieve the pressure: https://www.youtube.com/watch?v=3-FOe4AZZbk.

Common Mistakes

Inattention to auto-lube systems

One of the biggest mistakes operators make is letting the presence of automatic lubrication systems lull them into a false sense of security. Train operators on the use and maintenance of auto-lube systems. Auto lubers don't refill themselves. Operators need to walk around machines, inspect bearings and check grease lines and fittings. They should know poly lube lines are sensitive to ultraviolet light and can crack or clog. Instruct operators to pay attention to whether bearings are actually getting greased. If they don't see signs of proper bearing lubrication or if they see damage/excessive wear, they need to report the issue.

Ignoring alarms

Many of today's auto-lube systems include alarm technology. Alarms can indicate problems with system pumps or indicate that grease is not reaching bearings. Operators need to act on alarms or bearings will fail. Keep in mind 80% of bearings do not reach their life expectancy.

Failing to clean fittings

Michael D. Holloway, owner of 5th Order Industry LLC, and an equipment-greasing expert, says cleaning fittings prior to greasing seems obvious, but is not common. "The majority of the reasons why bearings fail due to an aspect of lubrication has to do with contaminants – from outside sources or internally generated," Holloway says. "It stands to reason that if you reduce the opportunity to fail due to external sources, you will increase the longevity of a bearing."

This is the reason a rag should be in one hand and the grease gun in the other. Wipe excess grease from the fitting before regreasing to avoid pushing contaminants into the bearing.

While it might seem counterintuitive, wiping the fitting after greasing is not recommended. Leaving a little bit of grease outside the bearing will create an added barrier against contaminants.

Over-greasing

See the "How Much?" section.

9 How to Choose Grease Products

As mentioned before, one grease does not fit all for most construction operations. "People like to try to use one grade for all applications, and that's not the best practice," says Dan Holdmeyer, industrial sector manager for Chevron Lubricants.

For instance, off-highway equipment runs slower than on-highway equipment. As a general rule, you should use a grease containing higher viscosity oil in off-highway applications versus on-highway ones.

Weather plays a role as well. Typically, you should drop to a lower NLGI grade, which indicates a grease product's consistency, during the cold season. Auto-lube systems also have particular requirements. Because pumping heavy grease through auto-lubers' usually small lines is difficult, and because the greasing interval is relatively short, the suggested NLGI grade is generally lower with these systems.

Additives matter, too. For instance, grease containing a moly additive should be used with equipment outriggers and other vibrating/rocking-versus-rotating bearings, but they should not be used in rolling element bearings.

If your applications involve working in water, that also should be a consideration when you choose grease products. For example, "if you've got a shovel that's going into water, constantly digging out gravel underneath the water line, you want a grease that resists water washout," Holdmeyer says.

Minimize number of greases

Even though one grease probably won't work for all your applications, it is best practice to reduce the number of greases you use as much as possible while choosing products appropriate for each bearing, condition and season. Holdmeyer says many construction operations effectively use two or three types of greases.

"Year-round, you can stay within one family of greases for a particular application," he says. "You can go from a No. 2 grade grease in the summertime to a No. 1 grade grease in the winter time."

SELECTING THE RIGHT GREASE: HOW TO GET STARTED

Information gathering:

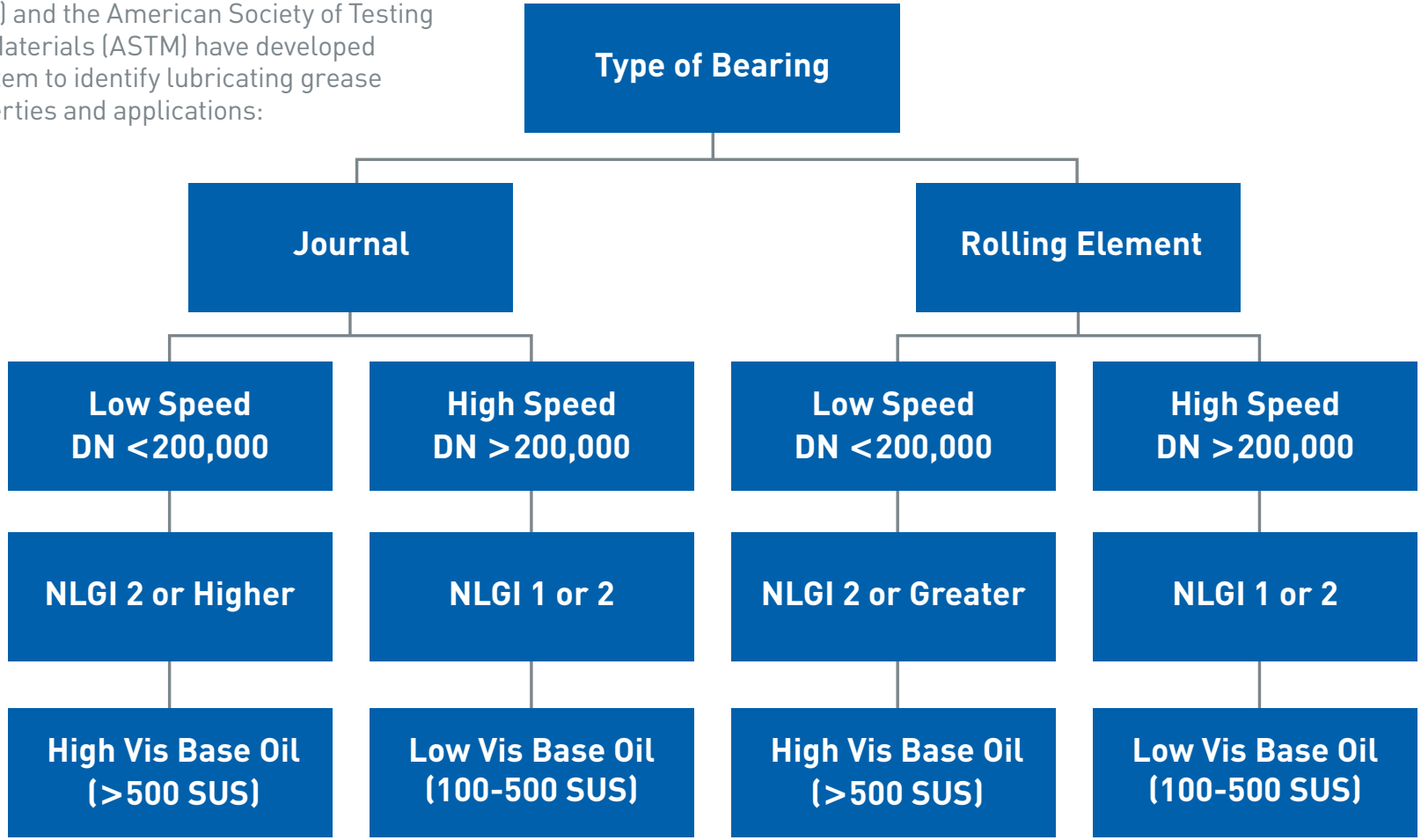
1. Evaluate equipment recommendations and conditions
2. Review OEM requirements
3. Review NLGI consistency/penetration numbers
4. Review NLGI service categories
5. Understand operating conditions of equipment and lubricant
6. Evaluate intervals and any problems with current greases

How to evaluate which Grease is right for you:

7. Where is it going?
8. How do we apply it?
9. How do we keep it in place?
10. Will it keep working?
11. Will it be compatible with the previous grease?

GENERAL GREASE BEARING RECOMMENDATIONS

The National Lubricating Grease Institute (NLGI) and the American Society of Testing and Materials (ASTM) have developed a system to identify lubricating grease properties and applications:



Note: US Bearing Mfgs - DN = N x RPM; where N is bore diameter (in mm).
European Bearing Mfgs - nD = ((D1+D2))/2 x RPM; where D1 and D2 are the outer and inner bore diameters respectively (in mm).

Free consultation and training services

We at Chevron want to be your lubrication-program partner, not just an oil and grease supplier. "When a new customer comes on board, we identify a lubrication program for them and help them build that program," Holdmeyer says.

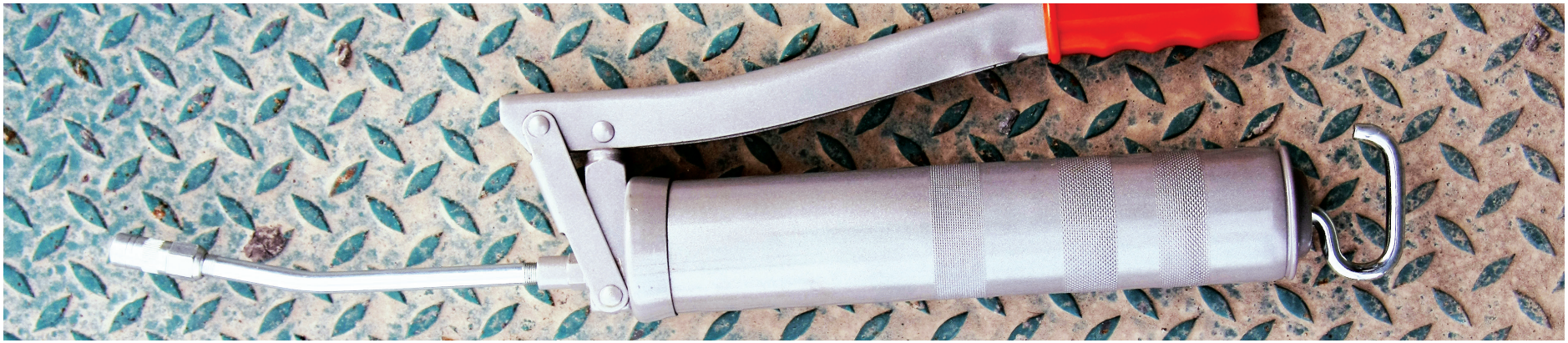
Chevron provides these services, along with training for all of a company's employees who have lubrication responsibilities, at no charge. The consultation begins with a lubrication survey, called a best-in-class assessment, that examines whether a company is following OEM specifications and whether it is having any grease-product-related problems. Then Chevron specialists recommend the best products for all the customer's applications while also reducing the number of different grease types to a minimum.

If a recommended grease product is potentially incompatible with a current one, Chevron takes a sample of the competitive grease, combines it with the Chevron product and puts it in an oven to see if it softens or hardens (change in NLGI grade). In either case, lubrication quality would be lost. If the greases are not compatible, Chevron will suggest methods for transitioning to the new grease.

Training services involve field training on why greasing is important as well as explanations, tips and tricks for how to grease. "We also give them sticker labels they can apply to lubrication points to identify what grease goes into those applications," Holdmeyer says.

In addition, Chevron reviews customers' storage and handling practices. "Quite a few times we'll see products not labeled in the storage area. That just tends to happen, kind of like in your closet, where excess clothes that you don't use build up over time and you need to get rid of them," Holdmeyer says. Chevron helps with that process and then adds charts in storage areas identifying different grease products and oils and their applications.

We go above and beyond with our product research and development, too. We take testing a step further by looking not only at the viscosity of the base oil that goes into grease products, but also at how the oil and its viscosity changes when it is extracted from grease. That tells us whether the oil's viscosity is correct at the point it goes into the bearing. We also measure wear protection, pumpability and water wash out to make sure our products far exceed application requirements.



10 Greasing Tips

1. **Minimize the number of greases your company uses by consolidating brands and types.** Chevron lubrication specialists will use their knowledge and expertise, free of charge, to help with this.

2. **Restrict how many types of grease guns employees use by standardizing based on type and brand.**

3. **Don't assume all fittings are in good shape. Inspect grease fittings and replace defective or damaged ones.**

4. **Wipe fittings before greasing to clear fittings of external contaminants.** Use clean, lint-free cloth to avoid shedding cotton or poly fibers. After greasing, leave a little bit of grease outside the bearing (don't wipe the fitting) to create an added barrier against contaminants.

5. **To engage a new grease-gun coupler sliding sleeve, grip the sleeve and forcefully push it forward while wiggling it clockwise and counterclockwise with a slight rocking motion.** New coupler sliding sleeves often possess a certain amount of resistance.

6. **To avoid over-greasing closed-cavity bearings, use slow strokes of grease guns (manual lever type) and natural "pressure feel," in addition to calibrating grease guns and determining the proper amount for each bearing as described in the "How Much?" section.** This means you should stop inserting grease into the bearing cavity when you feel slight resistance or back pressure against the trigger or lever.

7. **Be extra careful to avoid over-greasing electric motor bearings.** This could cause grease or oil to get into the windings, weakening and deteriorating the insulation. This might lead to arcing and shorting inside the motor, and that will generate excessive heat and wear on the stator and rotor.

8. **To purge contaminants from rolling element bearings, apply the correct, calculated amount of grease at shorter intervals.** The amount of grease a bearing needs is based on its dimensions and geometry. Over-greasing rolling element bearings does not help purge contaminants.

9. **If removing the grease-gun coupler from a pressurized fitting is difficult, use pliers to assist in depressing the thumb lever.**

10. **Do not place grease guns on dirty surfaces.**

11. **Keep grease guns covered when not in use to prevent them from collecting contaminants.**

12. **Consider using plastic caps on grease gun coupler nozzles when they aren't in use. This will restrict contamination on the tip.**

13. **To control contamination, repack grease guns on clean work surfaces using gun-loader fittings.**

Summary

Selecting the right grease products for your operation and making sure equipment operators and managers apply the right amounts at the appropriate intervals will drive machinery efficiency, extend the lifecycle of parts and equipment and help your business go further.

You can make greasing a priority in your organization. Doing this requires follow-up and follow through. Periodic audits and coaching are required. Catch people following standards well and reinforce those behaviors with rewards and recognition. What gets rewarded gets repeated.