TORO®

Commercial Products

Lubrication

Oils & Grease

PART NO. 99040SL

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Use of This Manual

The information contained in this manual is supplementary to material found in other sources, it is not a replacement for them. You should always consult Service Manuals, Service Bulletins, Operator's Manuals and Parts Books when necessary.

Service Manual Updates and Service Bulletins can be found on the internet at:
www.toro.com/golf/custsvc.html

This Manual and the training program, which it supports, are both designed to help you gain knowledge of the product, and to inform you of when and why to make the necessary repairs. We have also included tips for performing those repairs.

This program is designed for you. Your input and participation is appreciated.

There is plenty of space in this manual for you to add your own notes and observations

Lubrication

Oils & Grease

TORO Commercial Products

RED IRON Training

Lubrication is important to the long term life of the equipment.

A thorough understanding of oils and greases will help you make the proper choices.

Oil is Oil, Grease is Grease

- A few things to consider.
  - Automobiles use 30% of their available horsepower.
  - Trucks use 60% of their available horsepower.
  - Off road equipment uses 90% of their available horsepower.
  - Off road equipment demands lubricants designed for heavy duty performance.

Source :
Viscosity Oil Company

Turf equipment operates under more severe conditions then your average automobile or over the road truck.

This means that the selection of lubricants is more important for this category of equipment then others.

What Is Oil?

- Roughly 85% of the oil is “Base Oil”.
  - Often referred to as “Bright Stock”.
- About 15% is the additives.
  - This is what makes a hydraulic oil different from an engine oil.

Source :
Viscosity Oil Company

Hydraulic or Engine oil is made of roughly 85% base oil. This base oil is the same.

The 15% of the oil that is the additives is what make the oil a hydraulic or engine oil.

Typical Additives

- Hydraulic Oil
  - Rust Inhibitors
  - Oxidation Inhibitors
  - Anti-wear
  - Anti-Foam
  - Pour point Depressant
- Engine oil
  - Detergents
  - Dispersants
  - Corrosion Inhibitors
  - Anti-wear
    - Zinc Dialkyldithiophospate
  - Anti-Oxidant
  - Anti-Foam
  - Pour point Depressant

Source :
Viscosity Oil Company

The typical additives to oil are rust inhibitors, oxidation inhibitors, anti-wear inhibitors etc…

It is these additives that give the oil the required lubricating and service qualities to meet the requirements for the intended application.

Why does a lubricant fail to lubricate

Oils lose their desired properties

Lubricant Problem	Why	What Happens
Oxidation Control	Inhibitors used up, stopping attack on oil and additives	Oil Viscosity increases; deposits form. Acids corrode metals
Rust Inhibition	Inhibitors used up protecting iron surfaces	Oil fails to protect against further rusting.
Load Carrying	Additives consumed by reaction with metal surfaces, or removed by water.	Oil can't continue to protect against scuffing
Dispersancy	Dispersant becomes overloaded with liguid and solid contiminants	Solids (varnish, sludge) form

Lubricants can fail for a variety or reasons.

They can lose their ability to resist oxidation. This is caused when the additives to control oxidation are used up.

This can be noticed by an increase of oil viscosity, deposits may form and/or acids may begin to corrode the metal parts.

Rust inhibitors are used up and the metal is not protected from further rusting.

The oil may lose its ability to protect the metal components from damage caused by heavy operational loads.

The additives that keep contaminants in suspension can also be used up.

Most of these additives are consumable additives. That means that in the course of doing their job they are consumed or depleted.

Why does a lubricant fail to lubricate

They become contaminated

Lubricant Problem	Why	What Happens
Solids		
Dirt	Dirt comes from everywhere	Promotes wear, taxes lubricant properties
Wear Metals	A sign of an unhealthy machine	Shortened machine life unless corrected
Rust	Oxygen, water and iron have interacted	Contributes to wear.
Carbon matter	The oil has been overheated	Deposits clog oil passageways
Sludge and varnish	Oxidation products have become insoluble	Deposits form on machine parts and control valves

Oil can also become contaminated with solid debris.

This can include dirt, wear metals, rust, carbon from overheated oil or sludge and varnish.

Sludge and varnish is caused as the oil begins to oxidize and deteriorate.

Most of these contaminates can be controlled or removed through the use of proper filtration.

Why does a lubricant fail to lubricate

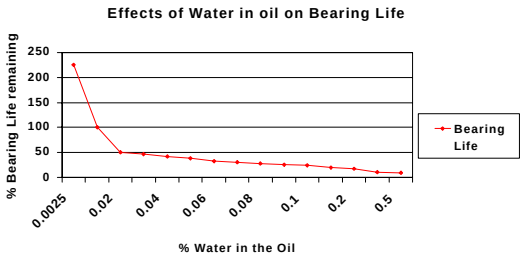
They become contaminated

Lubricant Problem	Why	What Happens
Liguids		
Water	A sign of leaky seals or condensation	Affects lubricant effeciency; promotes oil deterioration
Oxidation products	Excessive system temperatures	forerunner of more solid debris
Other lubricating oils	Missapplication of oil on hand	Can alter desirable properties of system lubricant
Lubricant suppliments	Usually added by well meaning servicemen	Can alter desirable properties of system lubricant

Liquid contaminates can pose more of a problem. They are usually not easily removed through the filtration process. These contaminates may include; water, oxidation products, other lubricating fluids, or lubricant supplements.

Water can come into a system through external seal or gasket leakage, or through condensation. Water contamination is probably the most common contamination problem.

It is the additive breakdown and the liquid contamination that really drives the oil change interval because to a certain extent the solid contamination can be controlled.



Effect of water in oil on bearing life(based on 100% life at .01% water in oil)
Reference: "Machine Design" July 86, How Dirt And Water Effect Bearing Life" by Timken Bearing Co.

The ability of the oil to protect bearings, decreases rapidly as water accumulates in the oil. From .01% to .02% water the life remaining drops by 1/2.

For this reason it is important to control the water content in the oil and change oil when water contamination is evident.

Can different oil be mixed in the same system?

- No
  - Different manufacturers may use different additives for wear or anti-foam etc...
  - These additives may not be compatible with the additives in the other oil.
  - An example, One anti-wear additive may render another anti-foam additive useless.

Under normal circumstances different oil should not be mixed.

The additives in one oil may not be compatible with the additives in the other oil.

This can make one or more of the additives ineffective.

Multi-grade Oils

- The Base oil is always the lower number.
- Polymers are added.
  - The oil is a 10wt when cold.
  - Polymers make oil act like a 30wt when hot.

With multi-grade oil the base oil is the lower number.

The higher number in the oil rating is the weight oil that the oil performs like when hot.

The oil does not get thicker when hot. It just does not thin out as much.

Viscosity Enhancers

- Cold Oil
  - Polymers coil up to take up less space.
- Warm oil
  - Polymers Un-coil up to take up more space.

The viscosity enhancers are actually microscopic plastic polymers.

These polymers uncoil as they get hot and take up more space.

It is these polymers changing that gives the oil it's different temperature characteristics.

Polymer Shear

- As the engine oil breaks down these Polymers begin to fatigue and tear.
- The upper weight of the oil will decrease.
- It is important that the oil change intervals be followed.

As a multi-grade oil begins to break down, these polymers will shear and the viscosity will decrease.

It is important that the oil change intervals be followed when using multi-grade oils.

Oil Ratings

The top of the symbol shows the oil performance level.

The Center of the symbol shows the oil's SAE viscosity grade.

The Bottom of the symbol shows if the oil has any energy conserving properties.

When purchasing oil the oil ratings on the oil is an important source of information.

The top of the label gives the service classification of the oil.

The center of the label lists the oil weight, and the bottom lists if the oil has any energy conserving properties.

Gasoline Engine Oil Service Categories

Category	Status	Service
SJ	Current	Indroduced as a API service symbol in 1996. For all automotive engines presently in use
SH	Obsolete	For all model year 1996 and older engines
SG	Obsolete	For 1993 and older engines
SF	Obsolete	For 1988 and older engines
SE	Obsolete	For 1979 and older engines
SD	Obsolete	For 1971 and older engines
SC	Obsolete	For 1967 and older engines
SB	Obsolete	For older engines. Use only when specifically recommended by manufacturer
SA	Obsolete	for older engines; no performance requirement Use only when specifically recommended by manufacturer

The current service category for gas engine oil is SJ.

The SJ rating replaces all the earlier ratings.

Diesel Engine Oil Service Categories

Category	Status	Service
CF	Current	Introduced in 1994 for off-road, Indirect-injected and other diesel engines, including those using fuel over 0.5% weight sulfur. Can be used in place of CD oils
CE	Obsolete	Introduced in 1987. For high-speed, four-stroke, naturally aspirated and turbocharged engines. Can be used in place of CD oils.
CD	Obsolete	Introduced in 1955. For certain naturally aspirated and turbocharged engines
CC	Obsolete	For engines introduced in 1961
CB	Obsolete	For moderate duty engines from 1949 to 1960
CA	Obsolete	For light duty engines (1940's and 1950's)

For diesel engine oil the most common rating is CF. The rating replaced all previous diesel oil ratings.

There have now been some changes in the diesel engine oil classifications.

Several new categories have been introduced.

New Diesel Engine Oil Service Categories

Category	Status	Service
CH-4	Current	Introduced December 1, 1998. For high-speed, four-stroke engines designed to meet 1998 exhaust emmission standards. CH-4 oils are specially for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE, CF-4, and CG
CG-4	Current	Introduced 1995. For high-speed, four-stroke engines using diesel fuel with less then 0.5% weight sulfur. Can be used in place of CD, CE, CF-4 oils
CF-4	Current	Introduced in 1990. For high-speed, four-stroke, naturally aspirated and turbocharged engines. Can be used in place of CE oils.
CF-2	Current	Introduced in 1994. For severe duty, two-stroke-cycle engines. Can be used inplace of CD-II oils

With all the new emission requirements there have been several new categories added for diesel engine oil.

These oils are more specifically rated for various engines.

Lubrication

Biodegradable Oil

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There is increasing interest in the use of biodegradable oil in turf mowing equipment.

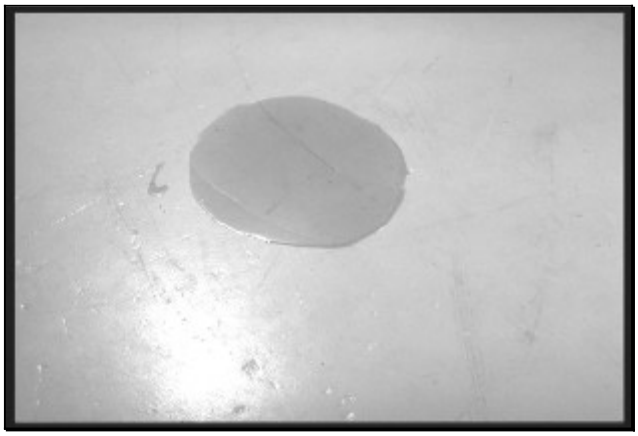
Biodegradable Hydraulic Fluid

Mobil EAL 224H approved in selected Toro equipment

System must be <u>Double Flushed</u>

The only biodegradable hydraulic oil that is currently approved for use in Toro equipment is the Mobile EAL 224H.

When a system is changed over to biodegradable oil, the system must be double flushed before the unit is put into service with the biodegradable fluid.



When oil is spilled or leaks in the shop, the spill does not pose a serious problem.

However, when oil is leaked on a fairway or green, the results can be more severe.

There are issues of the grass being killed and the soil being contaminated.

Patches of damaged turf can be readily seen after a loss of hydraulic fluid.

The use of biodegradable fluid will not prevent the grass from being damaged or killed.

The high temperature of the oil can kill the turf on it's own.

However, the advantage of the biodegradable fluids is that the recovery time can be shorter because the soil is not contaminated.

The grass will come back faster then if the damage was caused by a regular petroleum fluid.

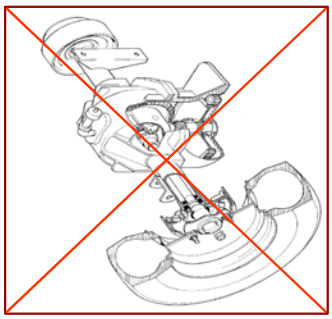
SUMMARY OF RECOMMENDED CORRECTIVE TREATMENTS AND RECOVERY TIMES FOR FIVE PETROLEUM SPILLS.

PETROLEUM PRODUCT	RECOMMENDED TREATMENTS	RECOVERY TIME (WEEKS) TREATED	UNTREATED
GASOLINE	NONE	4	4
MOTOR OIL	DETERGENT	4	8-10
HYDRAULIC FLUID	DETERGENT	4	8-10
BRAKE FLUID	DETERGENT	2-3	4
GREASE	NONE	8-10	8-10

(JOHNS & BEARD)

This chart shows some of the recovery times for grass when a petroleum spill is encountered.

Biodegradable Hydraulic Fluid



The current biodegradable fluids that are available are not approved for use in mechanical drive trains, or in units that use the mechanical drive train for the hydraulic reservoir for the system.

There is a hydraulic oil dye, Toro PN. 44-2500 that is available to help you find hydraulic oil leaks.

Grease

Selection and Application

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The proper selection and usage of grease can greatly improve the life of your equipment.

Grease

- Grease is expected to:
  - Reduce friction and wear.
  - Provide corrosion protection.
  - Resist leakage, dripping and throw-off.
  - Maintain mobility under conditions of application.
  - Be compatible with seals.
  - Tolerate or repel moisture.

Grease is expected to reduce friction and wear. Provide protection against corrosion.

Resist leakage, dripping and throw-off.

Grease must maintain mobility under all the conditions that the equipment operates under.

Grease must be compatible with seals.

And it must tolerate or repel moisture.

All of these requirements make the proper selection of grease important.

Grease

- What is Grease
  - 75 - 90% oil
    - The High percentage of oil requires that it be a high quality lubricating oil.

Grease is made up of approximately 75 to 90% oil.

Since the oil is such a large part of the final grease product, a good quality oil must be used.

Grease

- 5 - 20% Thickener
  - Common Thickeners are
    - Calcium
    - Lithium
    - Sodium
  - When you hear about Lithium base greases, that refers to the thickening component.

Between 5 and 20% of the grease is thickeners.

These thickeners have some very specific properties and they will affect the overall performance of the grease.

One of the most common thickeners is Lithium.

Grease

- 0-15% Additives
  - Oxidation inhibitors
    - Prolongs the life of the grease.
  - EP Agents
    - Guards against Scoring and Galling.
  - Anti-Corrosion Agents.
    - Protect metal against attack from water, sulfides or corrosive elements.
  - Anti wear agents.
    - Prevent abrasion and metal to metal contact.

The remaining additions to the grease are additives that improve the overall protecting qualities of the grease.

Grease selection

Properties	Calcium	Lithium	Sodium
Dropping Point	175-212°F	345-400°F	340-390°F
Max Temp	150°F	260°F	260°F
High temp use	Very Poor	Good	Good
Low temp mobility	Fair	Good	Good
Mech. Stability	Fair	Good	Fair
Water Restance	Exc.	Good	Fair
Oxidation Stability	Poor	Good	Poor
Texture	Smooth	Smooth	Fibrous or Smooth

Grease selection is important.

This chart shows the three main types of common greases.

The chart shows that the Lithium greases perform about the best in all of the important categories.

Greasing Practices

- How you grease is as important as which grease is used.
  - "Water contamination can cut bearing life by as much as 80%". Source: Noria Corporation
  - There are two main things that need to be done to control the water problem.
    - Keep the water out in the first place.
      - Manufacturers
    - Remove it before it can do harm.
      - Maintenance Personnel

How and when you grease is as important as what you grease with.

Water contamination is one of the most common things that happens to a greased component.

In order to maintain the proper life from the bearings, this water must be flushed from the component.

When the unit is greased, it should be greased after the unit is washed and before it is put away for the day.

Greasing purges the water from the component and this water should be removed before the unit is taken out of service.

Lubricant storage

- Select proper containers and quantities.
  - New, sealed oil containers should be used within 1 year.
  - Unopened grease should be used within 6 months.
- Purchase lubricants in the proper quantities.

Another factor that comes into play is the proper storage of lubricants.

Sealed new containers of oil should be used within one year.

Unopened grease should be used within 6 months.

This requires you to purchase your lubricants in the proper quantities.

Opened containers will keep approximately half as long as unopened containers.

Lubricant storage

- Lubricants should be stored in-doors.
  - Keep containers closed when not in use.
  - Label and date all lubricant storage containers.
    - Received and opened date.
- If outside storage is required, do not store containers upright.
  - This prevents water from entering container.

Whenever possible, lubricants should be stored indoors.

This will help prevent water getting into the container.

This is especially important for containers that have been opened.

If the containers must be stored outside, do not store them in an upright position, or be sure to cover them.