PM Lubrication and Service

Section 02-01-04

Komatsu has made every effort to make this manual as accurate as possible based on the information available at the time of publication and printing. Continuous improvement and advancement of product design may cause changes to machines which may not have been included in this publication. Komatsu reserves the right to make changes and improvements at any time. To ensure the most current information, please contact your service center.

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Scope of This Publication

PREVENTIVE MAINTENANCE contains ESSENTIAL information for owners, maintenance personnel, and operators, for warranty requirements and operating specifications. It is ESSENTIAL for all maintenance personnel associated with the machine to become familiar with this information and the instructions contained in the other publications in this manual BEFORE performing any type of work on the machine.

Safety

This publication contains special instructions that pertain to safety, operation, maintenance, and repair of the machine. Listed below are the signal words and symbols that precede these instructions and their meanings:

⚠ DANGER

- **The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING

- **The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

⚠ CAUTION

- **The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol ⚠).**

CAUTION

- **The caution label (without safety alert symbol) is used to address practices not related to personal injury – only equipment damage.**

NOTICE

The NOTICE graphic is to indicate areas of importance to the reader that are not related to personal injury or machine damage.

Safety, Warnings, and Cautions

CAUTION

LUBRICATION REQUIREMENTS

- **Using lubricants other than what is specified by the manufacturer (including viscosity differences) can cause severe damage to the planetary drive components.**
- **Do not mix brands or type of lubricant without consulting lubricant manufacturers. Damage to bearings or other components may result from the mixing of incompatible lubricants.**

- **Be sure all lubrication/oil is suitable for the climate at your location. See your oil vendor to assure the oil will flow at minimum temperature experienced. Using lubricants other than what is specified by the manufacturer (including viscosity differences) can cause severe damage to components**

OIL SAMPLING

- **In order to have consistent samples and to remove all contaminates - it is important that the oil be sampled or drained as soon as possible after stopping the machine so that any metal particles or contaminants will remain suspended in the oil.**

COLD TEMPERATURES

- **If the machine is to sit outside when not working with the ambient temperature below -4° F (-20˚ C): The engine must be running at high idle, or all heaters must be plugged into a power supply external to the machine and operational if the engine is not running. Failure to comply with these instructions could result in serious damage to the machine.**

Lubrication and Service Requirements and Recommendations (Overview)

Regular lubrication and service of P&H wheel loaders is essential to obtaining maximum component life and reducing downtime. Lubrication related component failures are most often caused by one of the following:

- Unsuitable grade or type of lubricant.
- The lubricant is contaminated by dust, dirt, water or dilution by fuel.
- A suitable lubrication schedule is not followed.

While lubrication can slow down wear, it cannot entirely prevent it. Wear can result from dust contamination or failure of the lubricating system to maintain a proper film on moving parts.

CAUTION

Using lubricants other than what is specified by the manufacturer (including viscosity differences) can cause severe damage to the planetary drive components.

CAUTION

If the machine is to sit outside when not working with the ambient temperature below -20° C:

1. The engine must be running at high idle.
2. Or all heaters must be plugged in to a power supply external to the machine and operational if the engine is not running.

Failure to comply with these instructions could result in serious damage to the machine.

Recommended Lubricants and Lubrication Intervals

Recommended Lubricants

Recommended lubricants are indicated in various tables within this section. These lubricants are listed for informational purposes only and based on normal operating conditions. Equivalent grades and types may be substituted UNLESS a specific lubricant is specified.

CAUTION

Do not mix brands or type of lubricant without consulting lubricant manufacturers. Damage to bearings or other components may result from the mixing of incompatible lubricants.

NOTICE

The planetary drive and hydraulic pump gearbox is factory equipped with synthetic oil. It is recommended that this same oil be used for subsequent servicing.

NOTICE

Change lubricant grades when temperatures are consistently in the next higher or lower temperature range as specified in the table.

Recommended Lubrication Intervals - Normal Operation

Lubrication interval recommendations are based on normal operating conditions. For extreme operating conditions, refer to “Lubricating the Machine under Extreme Conditions”, below.

Lubricating the Machine under Extreme Conditions

Lubricate more frequently when the machine is subjected to extremes of temperature, prolonged operation, sandy or dusty conditions or exposure to moisture. Lubrication periods may be extended during periods of inactivity.

A lubricant supplier and/or authorized Komatsu distributor should be contacted periodically to arrange for a lubrication engineer to accompany maintenance personnel on a thorough inspection of the lubrication points on the machine. The focus of this inspection should be verification that the lubricants used and the lubrication intervals are adequate for the conditions under which the machine is being operated.

By working with the lubrication engineer, it can be determined where modifications to recommendations for normal operating conditions might be required to make the equipment run more smoothly, longer and more economically. It may also be determined if a more suitable grade of lubricant might give better protection, improve safety, reduce fire hazards, and cut the cost of removing lubricant should the machine be used in other than normal conditions.

Lubricant Storage

It is ESSENTIAL to store lubricants in a location indoors and to develop a definite schedule for taking stock, refilling containers or lubricating systems, and cleaning, with assigned personnel responsible for the schedule.

NOTICE

Lubricants contaminated with dirt, sand, or water should not be used.

Generator and Drive Motor Lubrication

The Generator and traction motors on the machine are equipped with sealed bearings. These bearings require no lubrication unless the generator or motor is disassembled. Disassembly of the generator and traction motors should only be performed by a Komatsu authorized rebuild center.

Fluid Capacities

NOTICE

The capacities provided in this document are approximate values. Always be prepared to catch any excess fluid when it is being removed or added to components; including hydraulic fluid, engine coolant, lubricant, grease, fuel, engine DEF, or battery fluid. Always dispose of fluids in a manner consistent with all local regulations, rules, or laws. Failure to contain liquids and to properly dispose of them could result in an environmental spill.

Component	Model and Engine		Capacity		Lubricant or fluid
Engine	L-1350	Detroit	58 gallons	219 liters	Check manufacturer
		Cummins	48 gallons	182 liters	
	L-1850	Detroit	66 gallons	250 liters	
		Cummins	54 gallons	204 liters	
	L-2350	Detroit	66 gallons	250 liters	
		Cummins	58 gallons	219 liters	

Table 1. Engine crankcase capacity

Component	Model and Engine		Capacity		Lubricant or fluid
Engine Cooling System	L-1350	Detroit	101 gallons	382 liters	Check manufacturer
		Cummins			
	L-1850	Detroit	110 gallons	416 liters	
		Cummins			
	L-2350	Detroit	130 gallons	492 liters	
		Cummins			

Table 2. Engine cooling system capacity

Component	Model	Capacity		Lubricant
Lubricant Barrel	FlowMaster Model 85768 Series “A”	240 lbs.	109 kg	See “Automatic Lubrication System” below.

Table 3. Auto lube system

Component	Model		Capacity		Fluid
Drive Module Cooling System	L-1350	Coolant Reservoir	31 gallons	117 liters	Use engine manufacturer's Engine specifications
	L-1850	Coolant Reservoir	40 gallons	151 liters	
	L-2350	Coolant Reservoir	41 gallons	155 liters	

Table 4. Drive module cooling system capacity

Component	Model	Capacity		Lubricant or fluid
Hydraulic Reservoir	L-1350	375 gallons	1,419 liters	See following chart for approved oils for a given temperature range
	L-1850	375 gallons	1,419 liters	
	L-2350	382 gallons	1,446 liters	

Table 5. Hydraulic reservoir capacity

Lubrication Specifications

CAUTION

Be sure all lubrication/oil is suitable for the climate at your location. See your oil vendor to assure the oil will flow at minimum temperature experienced. Using lubricants other than what is specified by the manufacturer (including viscosity differences) can cause severe damage to components

Hydraulic Oil Lubrication Requirements

General Requirements

Hydraulic oils used in P&H wheel loaders must be category HV oils with improved viscosity/temperature properties, and zinc additives for wear in addition to those modifiers to inhibit oxidation, foam, rust, and corrosion.

ISO Viscosity Grade

ISO viscosity grade of hydraulic oil must be as follows:

Hydraulic System Operating Temperature Range*	ISO Viscosity Grade
45°C to 60°C (113°F to 140°F)	32
49°C to 74°C (120°F to 165°F)	46
57°C to 85°C (135°F to 185°F)	68

* Arctic conditions are defined as an ambient temperature consistently below 0°F (-18°C). These conditions represent a specialized field where extensive use is made of heating equipment before starting, and/or use specially developed oils for arctic conditions, such as synthetics.

Hydraulic Oil Properties

Properties of oil must comply with the following table:

Property	Value		
	ISO 32 Grade	ISO 46 Grade	ISO 68 Grade
Kinematic Viscosity at 40°C (cSt), min	28.8-35.2	41.4-50.6	61.2-74.8
Kinematic Viscosity at 100°C (cSt), min	5.0	6.1	7.8
Viscosity Index, minimum	150	140	140
Pour point, maximum [1]	-30°C	-30°C	-25°C
FZG Gear Scuffing (ISO 14635-1) Failure Load Stage, min.	10	10	10
Vane Pump Testing (DIN 51389-2) mass loss in mg, ring/vane, max.	120/30	120/30	120/30
Copper Corrosion (DIN EN ISO 2160 – 3 hrs@100°C), max	2		
Foaming (ISO 6247) maximum (ml/ml)	150/0		
Rust protection (DIN ISO 7120, Proc. A)	Passed		

1 Oil with different pour point may be used, provided the pour point is 5°C lower than the minimum ambient temperature.

Special Conditions

Special operating conditions or limited hydraulic oil availability may necessitate the use of oils having properties that fall outside this specification. Approval for use of these oils will be considered on a case-by-case basis. The use of non-recommended oils or the mixing of incompatible oils may damage components and void the warranty. Refer to the following information for a list of approved oils.

Approved Oils

Hydraulic oils listed in the following table are granted approval for use in loaders, within the specifications and conditions stated for each. Oils may be submitted for approval by providing the associated product data sheet to the Joy/P&H Mining Products engineering department. Oils submitted for approval will be considered on a case-by-case basis. Some may be required to go through a performance trial period prior to approval that is at the user's risk. Length of trial period will be determined by engineering review of the oil properties. The use of non-recommended oils or the mixing of incompatible oils may damage components and void the warranty. Approvals may be revoked at any time without notice.

Properties of the oil and conditions for use must comply with the following table:

Source	Description	Nominal Operating Temp (deg.C)[1]	ISO Viscosity Grade	Kinematic Viscosity at 40°C (cSt)	Kinematic Viscosity at 100°C (cSt)	Viscosity Index	Flash Point (deg.C)	Pour Point (deg.C)	Denison Spec	Rexroth Spec	Conditions / Notes
BP	Bartran HV	57-85	68	70.5	10.8	142	208	-39		Yes	approval based on history of use
BP	HLP-HM	45-65	46	46.0	6.8	95	215	-27	HF-0	RE90220	
BP	HLP-HM	55-75	68	68.0	8.8	95	226	-24	HF-0	RE90220	approval based on history of use
Caltex	Rando HD	45-65	46	44.0	6.8	110	238	-33	HF-0	---	approval based on history of use
Castrol	Hyspin AWH-M	45-70	46	46	8.32	150	215	-42	HF-0	RE90220	
Fuchs	Renolin B HVI Plus	47-73	46	46	8.1	149	186	-45	HF-0	---	approval based on history of use
Mobil	DTE 10 Excel	38-62	32	32.7	6.6	164	250	-54	HF-0	RE90220-01	
Mobil	DTE 10 Excel	46-72	46	45.6	8.5	164	232	-45	HF-0	RE90220-01	Ref.Joy p/n 4123226
Mobil	DTE 10 Excel	57-84	68	68.4	11.2	156	240	-39	HF-0	RE90220-01	
Mobil	DTE 20 (25)	45-65	46	44.2	6.7	98	232	-27	HF-0,-1,-2	---	
Mobil	Mobilfluid 424	51-77	---	55.0	9.3	145	198	-42	HF-0,-1,-2	Approved	Ref.Joy p/n 4123226
Shell	Tellus S3 M	46-67	46	46	6.8	105	220	-33	HF-0,-1,-2	---	approval based on history of use
Shell	Tellus S68	54-77	68	68	8.7	97	222	-30	HF-0,-1,-2	Yes	approval based on history of use
Shell	Tellus S100	63-86	100	100	11.2	96	234	-24	---	Yes	approval based on history of use
Shell	Tellus 68	54-77	68	68	8.7	98	225	-27	HF-0,-1,-2	Yes	approval based on history of use

1. Approval based on oil operating temperatures within range shown.

Table 6. Approved hydraulic oils

Hydraulic Pump Drive (HPD) (PTO) Gearbox

Model	Component	Capacity		Lubrication
L1350/L1850/L2350	Hydraulic Pump Drive Gearbox[2]	7 gallons	27 liters	SAE 75W-140W synthetic gear oil or SAE 80W-90W gear oil.
1 ARCTIC CONDITIONS represent a specialized field where extensive use is made of heating equipment before starting. 2 Refer to Section 3 of this manual. The hydraulic pump drive gearbox is factory equipped with synthetic oil.				

Table 7. HPD gearbox fluid specifications

Planetary Drive (Driver) General Lubrication Requirements

Lubricants used in Komatsu wheel loader planetary drives (drivers) must be synthetic gear oils with EP additive packages.

Component	Model and Size		Capacity (each)		Lubricant
Planetary Drive	L-1350	51A3	36 gallons	135 liters	See following chart for approved lubricant
	L-1850	57	40 gallons	151 liters	
	L-2350	57	40 gallons	151 liters	

Table 8. Planetary drive capacities

ISO Viscosity Grade

ISO viscosity grade of lubricant must be as follows for individual drivers: (see exception in endnote #3)

Driver	Conditions	
	Standard	Arctic*
51A/51A2/51A3/51B	460	220
57	460	220
* Arctic conditions are defined as an ambient temperature consistently below 0°F (-18°C).		

Table 9. Planetary drive lubricant viscosity grade

Lubricant properties

Properties of lubricant must comply with the following table: (see exception in endnote #3)

Property	Value	
	ISO 220 Grade	ISO 460 Grade
Kinematic Viscosity at 40°C (cSt)	198-242	414-506
Kinematic Viscosity at 100°C, minimum (cSt)	25	45
Viscosity Index, minimum	150	
Pour point, maximum [1]	-36°C	
4-Ball EP Test (ASTM D2783): Weld load (kg) [2]	250	
Timken OK Load (lb.) [2]	60	
FZG Gear Scuffing (ISO 14635-1) Pass Stage	12 or greater	
Copper Corrosion (ASTM D130 – 3 hrs@100°C)	1B	
Foaming (ASTM D892, Sequence I, II, III) maximum values (ml/ml)	5/0, 10/0, 5/0	
Rust protection (ASTM D665 – Method B)	Pass	

Endnotes

[1] Lubricant with higher pour point may be used, provided the pour point is 5°C lower than the minimum ambient temperature.

[2] Oil manufacturer may report either 4-Ball EP test or Timken OK load. However, if both results are reported, fluid must meet requirements of both tests.

[3] **Mobil SHC Gear OH** is available in a lowest viscosity grade of 320. However, this upgraded lubricant will outperform the older-technology MobilGear SHC 220 in arctic temperatures due to its higher viscosity index and lower pour point.

Table 10. Planetary drive lubrication properties

Automatic Lubrication System

**Type of Grease	**Minimum Ambient Temperature	**Grease Grade
Pumpable auto lube grease fortified with extremely high pressure and anti-wear properties for slow speed, high shock application The grease is required to have minimum 3% to maximum 5% MoS_2 “Molybdenum Disulfide” additive.	+70ºF (+20°C) and above	NLGI #2 grease
	+50ºF (+10°C) and above	NLGI #1 grease
	+10ºF(-12°C) to 50ºF(+10°C)	NLGI #0 grease
	-30ºF(-34°C) to +10ºF(-12°C)	NLGI #00 grease

CAUTION

**** The values listed for grade and temperature in the table GREASE SPECIFICATIONS are only general guidelines for grease grade. Grease specifications can vary widely, depending on the location where the grease was blended and local conditions. Each grease meeting the 3-5% Molybdenum Disulfide requirement should also have the Lincoln Ventmeter number verified to make sure it meets system requirements. Use of incorrect grease that does not meet the Ventmeter specification may cause pump problems and the injectors may not cycle and refill properly.**

Depending on the characteristics of the grease it is possible that a thicker NLGI grade of grease may be used at lower temperatures than shown in the table GREASE SPECIFICATIONS as long as the grease meets the Lincoln Ventmeter specifications.

NOTICE

LINCOLN VENTMETER SPECIFICATION

At a temperature that is 10°F (5°C) below the minimum ambient temperature to which the machine will be exposed, the Lincoln Ventmeter reading should be:

Injector Type	Ventmeter Reading
SL-1 injectors	500 psi (34.5 bar) or less
SL-V and SL-V XL injectors	900 psi (62.0 bar) or less

For Example:

- The minimum mine temperature is 0°F (-17.8°C).

Mine site temperature	Minus	10°F (5°C)	Equals	Target Temperature
0°F (-17.8°C)	minus	10°F (5°C)	=	-10°F (-23.3°C)

Examples:

Grease/Grade	Ventmeter Reading	Target Temperature	Acceptability
Brand XYZ	900 psi (62 bar)	15°F (-9.4°C)	Unacceptable
Brand ABC	400 psi (27.6 bar)	-10°F (-23.3°C).	Acceptable

The Lincoln Ventmeter test is typically performed by Lincoln and/or the grease manufacturer, by using a Ventmeter tool as shown.

TA15373-77

All Machines	Lincoln Automatic Lubrication Pump	15 oz.	444 ml.	10W30 motor oil

Table 11. Auto lube pump lubrication and grease specifications

Overview of Recommended Filter Replacement and Special Cleaning Requirements

This chart provides a summary overview of the various filters that must be replaced as part of a routine preventive maintenance program. Refer to illustration “Filter – general machine locations" for general location of each filter listed. Refer to PARTS MANUAL for filter part numbers specific to your machine. Special cleaning requirements for various components, in addition to filter replacement, are also listed.

NOTICE

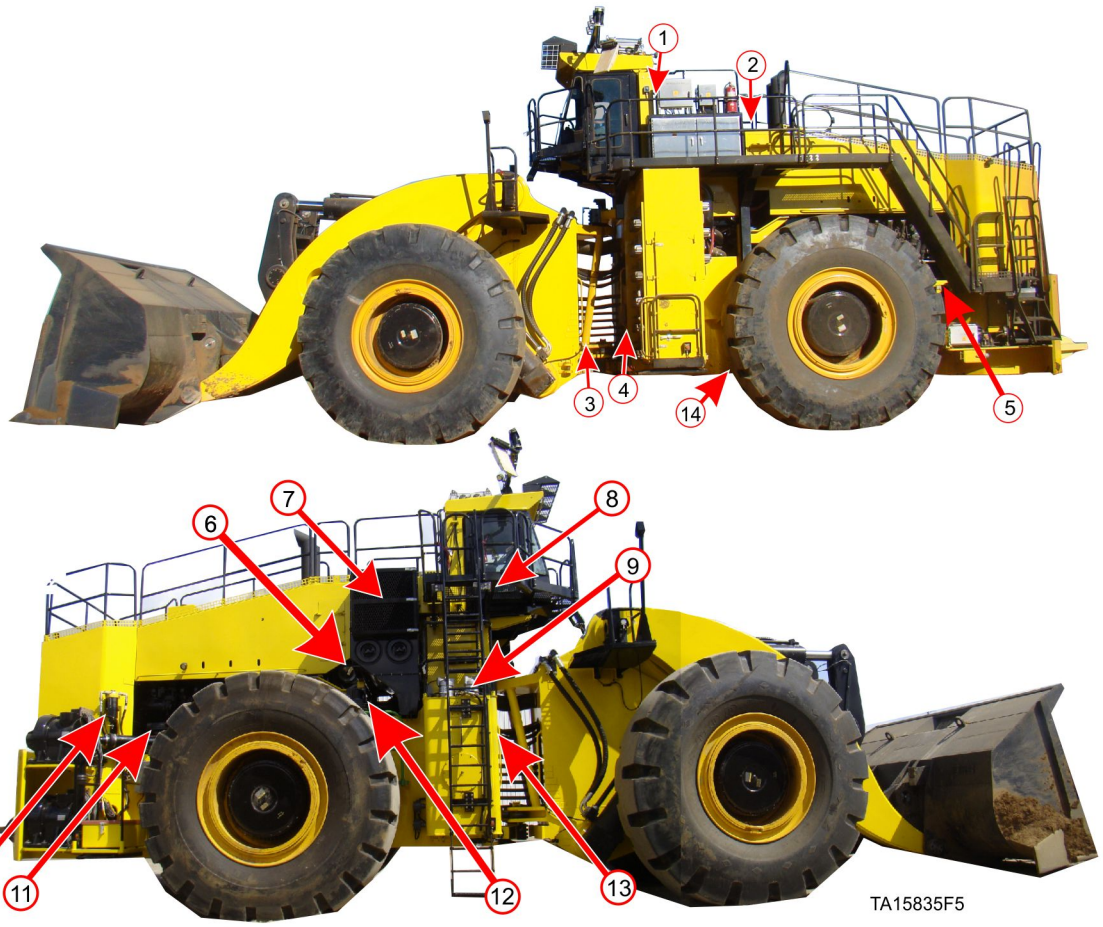
It is essential to review the instructions within this manual and the engine manufacturer’s owner’s manual (available on the manufacturer’s website) regarding the replacement of these filters before attempting to service the machine. The right hand column provides the location of applicable instructions within the SERVICE MANUAL or the engine manufacturer’s manual.

Component	Filter	Filter type/number	Recommended[1] replacement interval	Operating and service manual reference (as applicable)
Engine	Oil	Spin-on – Number varies with engine model[2].	500 hours	Refer to engine manufacturer owner’s manual.
	Fuel	Spin-on - Number varies with engine model[2].	500 hours	Refer to engine manufacturer owner’s manual.
	Fuel Processor (Detroit Diesel)	Spin-on (1)	500 hours	MECHANICAL, ENGINE, Section 03
	By-Pass (Detroit Diesel Equipped Machines Only)	Spin-on - Number varies with manufacturer	500 hours	Refer to engine manufacturer owner’s manual.
	Air	Safety element - number varies with machine model[3].	Monitor air restriction indicators. Check filters every 100 hours.	AIR SYSTEMS, COOLING AIR Section 05
	Coolant Conditioning (Cummins Engine Only)	Spin-on - Number varies with engine model.	500 hours	Refer to engine manufacturer owner’s manual.
Hydraulic System	Auxiliary Oil Cooler (if present)	Canister (1)	1500 hours	HYDRAULIC & GREASE SYSTEM, Section 04
	Hydraulic Reservoir Return	Canister (2) L-2350 (3)	1500 hours	HYDRAULIC & GREASE SYSTEM, Section 04
	Case Drain	Canister L-1350, L-1850 , L-2350 (2)	1500 hours	HYDRAULIC & GREASE SYSTEM, Section 04
	Hydraulic Pump Drive Gearbox	Canister (1)	1500 hours	HYDRAULIC & GREASE SYSTEM, Section 04
	Hydraulic Pump Gear - Box Air Breather	Spin-on (1)	1500 hours	
	Auxiliary Oil Cooler (optional)	Canister (1)	1500 hours	
Auto lube System	In-line	Strainer (2)	Clean or replace every 30 days	GREASE SYSTEM (AUTO-LUBE), Section 04
Operator’s Cab	Environmental Controls	Paper Element (1)	250 hours	AIR SYSTEMS, AIR CONDITIONING Section 05
Cartridge Air Filtration System KLENZ™ System	Air	Paper element number varies with model[4]	Check every 500 hours - replace as required.	AIR SYSTEMS, COOLING AIR Section 05
Driver Filtration (If present)	Inline	Strainer (4)	1500	Hydraulic & Grease Systems
		Filter (4)	1500	

1. Recommended replacement/cleaning intervals are based on normal conditions. Your application may require modification of these recommendations. Contact your authorized Komatsu distributor for assistance.
2. Pre-fill filters with clean engine oil or fuel (as applicable) via the outer row of holes.
3. DO NOT clean. Replace ONLY.
4. DO NOT clean or blow out with air. REPLACE only.

Special Cleaning Requirements				
Component	**Filter**	**Filter Type/Number**	**Recommended[1] Cleaning Interval**	**Operating and Service Manual Reference**
Cartridge Air Filtration System "KLENZ™" System	Mist Eliminator Panel	Screen	Clean after several hours' use in wet conditions.	Air Systems, Cooling Air, Section 05
	Air Intake Screen		Inspect daily for build-up of coal dust and/or dirt - clean as required.	
Hydraulic Reservoir	Remove side and bottom access panels, flush reservoir	Replace all filters.	As indicated by oil analysis.	Hydraulic & Grease System, Section 04
Fuel Reservoir	Drain water from bottom of reservoir	Replace all filters	Drain water every six months or 2000 hours. Flush before onset of freezing weather.	Mechanical, Engine, Section 03
Entire Machine	N/A	N/A	Every 1000 hours inspect structural members for cracks and weld condition.	Mechanical, Structural, Section 03
High Voltage Cabinet	N/A	N/A	500 hours or more often in extreme conditions	Preventive Maintenance, Cleaning And Component Inspection Section 02
Inside Axles	N/A	N/A		

1.Recommended replacement/cleaning intervals are based on normal conditions. Your application may require modification of these recommendations. Contact your authorized Komatsu distributor for assistance.

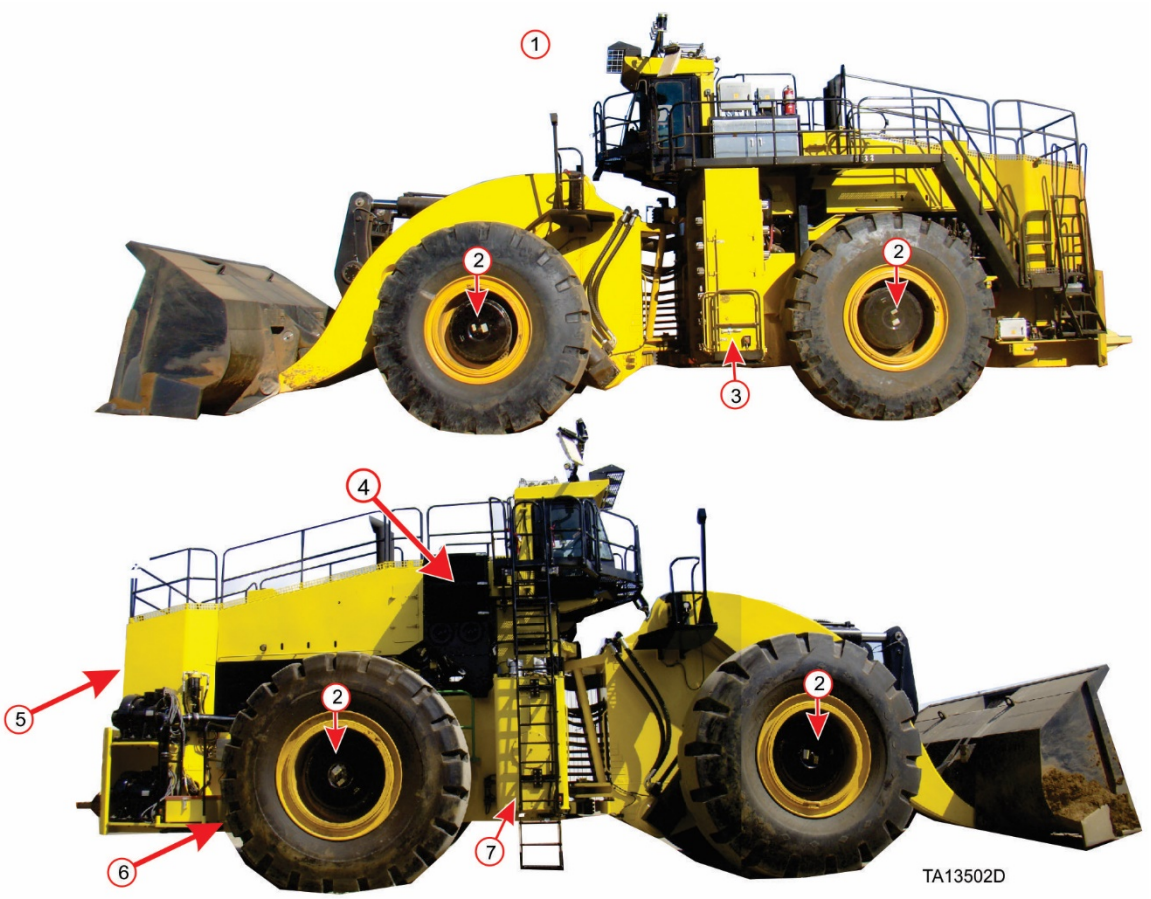


1. Hydraulic pump gearbox breather filter (some models in location #2)
2. Engine air filter-left side
3. Automatic lubrication inline filters & planetary drive filtration inside front frame
4. Hydraulic pump gear box oil circulation filter
5. Coolant conditioning filters (coolant conditioning filters - cummins application only)
6. Engine air filter - right side
7. KLENZ™ Filters
8. Air conditioner filters (inside cab, behind operator seat).
9. Hydraulic reservoir return filters
10. Fuel processor - Detroit Diesel equipped machines (not shown)
11. Engine oil filters (typical location)
12. Air dryer
13. Hydraulic system case drain filters
14. Planetary drive filtration rear frame

Figure 1. Filters – general machine locations (typical 1350 Gen3 machine)

1. Hydraulic pump gearbox breather filter (some models in location #2)	**8.** Air conditioner filters (inside cab, behind operator seat).
2. Engine air filter-left side	**9.** Hydraulic reservoir return filters
3. Automatic lubrication inline filters & planetary drive filtration inside front frame	**10.** Fuel processor - Detroit Diesel equipped machines (not shown)
4. Hydraulic pump gear box oil circulation filter	**11.** Engine oil filters (typical location)
5. Coolant conditioning filters (coolant conditioning filters - cummins application only)	**12.** Air dryer
6. Engine air filter - right side	**13.** Hydraulic system case drain filters
7. KLENZ™ Filters	**14.** Planetary drive filtration rear frame

Figure 2. Filters – general machine locations (typical 1850/2350 machine)



1. Entire machine for structural inspection – elimination of potential fire hazards	**5.** Radiator and oil cooler cores
2. Inside axles	**6.** Fuel reservoir
3. Inside electrical converter cabinet	**7.** Hydraulic reservoir
4. KLENZ™ mist eliminator	

Figure 3. Special cleaning requirements (typical 1350 Gen 3 machine)

1. Entire machine for structural inspection – elimination of potential fire hazards	**5.** Radiator and oil cooler cores
2. Inside axles	**6.** Auxiliary oil cooler core (optional)
3. Inside electrical converter cabinet	**7.** Fuel reservoir
4. KLENZ™ mist eliminator	**8.** Hydraulic reservoir

Figure 4. Special cleaning requirements (typical 1850/2350 machine)

Lubricating Oil Analysis

An effective preventive maintenance program will give the owner or equipment manager the ability to predict and control downtime. An on-going oil analysis program is very important in identifying components that are in need of replacement, overhaul or a change in their maintenance to prevent an unscheduled breakdown or premature failure.

NOTICE

An on-going oil analysis program, with samples collected every 500 hours is mandatory to meet warranty requirements. Contact your authorized Komatsu distributor for additional information.

The Role of Lubricating Oil Analysis in a Preventive Maintenance Program

Service intervals for the planetary drives and gearbox on the machine are included in, PREVENTIVE MAINTENANCE", "MODULAR PREVENTIVE MAINTENANCE SCHEDULES" in the Service manual. Recommended service intervals for the engine are found in the engine manufacturers' service manuals.

These recommendations are based on normal conditions and a lubricating oil analysis program should be used to supplement these recommendations, not to extend service intervals. If the machine is used in extremes of temperatures, prolonged operation, sandy or dusty conditions or exposure to moisture, the lubrication intervals may have to be modified. An on-going lubricating oil analysis program can help to identify problems resulting from the above mentioned conditions and others that may cause accelerated component failure which are unique to your operation. A preventive maintenance program custom tailored for a specific application is the most effective manner in which to maintain heavy equipment.

NOTICE

Lubricating oil analysis is designed to detect only that type of failure that characteristically begins with an increase in metal wear; that is, worn bearings, worn gears and slowly progressing fatigue failures. Component failures that are catastrophic and instantaneous in nature are not necessarily predicted by lubricating oil analysis.

Program Operation

With lubricating oil analysis, the wear trend of internal components can be determined without taking the machine apart. Every 500 hours a sample of the oil should be collected and sent to a testing facility that analyzes its microscopic metal content with special emission or atomic absorption spectrophotometry equipment. When this is done regularly, a record of wear trend may be established for that component or group of components from several machines. The amount of certain metal or other foreign matter rising suddenly above the normal wear trend, can indicate failure is imminent. The type of metal or material detected in the oil (copper, iron, aluminum, silica, or chromium) indicates what part is wearing.

Lubricating oil analysis is not effective unless it is done on a continual basis in order to establish a wear trend. At least two or three samples must be taken and recorded to establish this trend that reflects the conditions in which the machine is working. After the trend is established, records will readily show any accelerated increase in this pattern. Comparisons to other machines with like components and working in similar conditions can also be made and used in forecasting downtime and production scheduling.

Analysis of Lubricating Oil

Sample Collection

Oil samples should be drawn and analyzed every 500 hours of operation, again prior to an oil change and more often if suspicious of component operation. The machine should be operated for at least 1 hour with continual operation of the component prior to taking a sample from a planetary drive, gearbox, hydraulic reservoir, or engine. The oil samples should then be taken within 10 minutes of stopping the machine. Approximately 3-5 oz. is normally required for analysis. Prolonged elapsed time allows for metal particulate to settle, and this might interfere with accurate sampling.

Quick connect fittings are optionally provided on the hydraulic reservoir and engine blocks for collecting oil samples (refer to illustration “Engine oil and hydraulic fluid oil sampling quick connect fittings (optional)," below. A suction pump should be used to draw oil samples from the planetary drive and hydraulic pump gearbox. If the optional quick connect fittings for collecting samples from the hydraulic reservoir and engine are not present, a suction pump should also be used for collecting samples from these components. BE SURE to thoroughly clean the suction pump between taking samples from several components.

Samples must be sent promptly to the testing facility. Analysis and reporting must be likewise equally prompt. Any delay could negate the application of the analysis report. All samples must be analyzed under identical conditions or the results will not be usable.

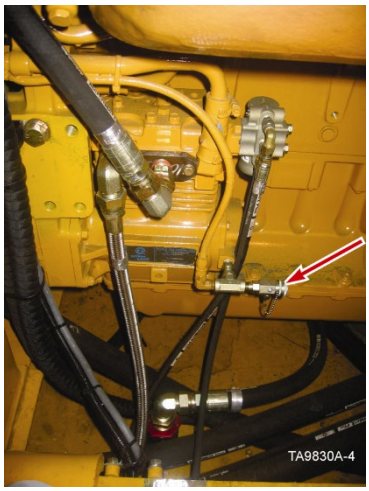
	
Engine oil sampling quick connect fitting (engine shown is typical)	**Hydraulic reservoir oil sampling quick connect fitting**

Figure 5. Engine oil and hydraulic fluid oil sampling quick connect fittings (optional)

Newly changed oil or oil recently added to a system will not provide accurate data when it is analyzed. Also, deviation from accepted standardized procedures in taking the sample can invalidate the analysis results. Any of these conditions could have dangerous or misleading consequences because the sample analysis would be incorrect and not indicate the true condition of the component.

If a component magnetic plug is present, it should also be inspected and cleaned regularly. The hydraulic pump drive will have to be drained before removing the magnetic plug (if present). Record the appearance and weight of metal accumulated. In the event of the appearance of a large increase in the amount of metallic particles or chips, the hydraulic pump drive or planetary drive should be inspected internally. If no damage is readily evident, the component should be removed from service and disassembled and the source(s) of the contamination identified and repaired.

Proper Documentation

Proper documentation is critical to the success of an ongoing lubricating oil analysis program. It is especially important to maintain accurate and detailed records when analyzing several components on one machine or a group of machines. It is also important that proper sampling techniques be employed. This documentation should include:

- Date of sample.
- Serial or identification numbers of the component.
- Total hours of component life.
- Hours of operation since last oil change.
- Complete results of all tests conducted.
- Serial number of the machine and position of the gearbox or planetary drive (left/right - front/back).
- Weight and appearance of magnetic plug accumulation.
- Any other applicable comments about the component's operation.

NOTICE

A suggested format for a reporting form is provided on illustration "OIL ANALYSIS REPORT FORM," within this section.

Recommended Tests

Spectrographic analysis: This test checks for the metal content in the oil. The amounts in parts per million should be compared to the previous sample. If a significant increase in any of the elements appears, perform a gear case inspection. A sudden increase in iron content will indicate excessive wear of one or more of the drive train components. A sudden increase in chromium should indicate unusual wear of a bearing. If silicon content only shows a large step change, the oil should be changed.

NOTICE

It is important to emphasize that a large increase in iron or chromium content between two consecutive tests indicates component failure.

Viscosity test: If viscosity shows a large increase or decrease, then change the oil. The oil should also be changed if viscosity increases over 30 percent of original.

Insoluble material test: If the amount of insoluble material test shows a large increase, the oil should be changed. This could indicate the failure of a seal and the seals should be closely examined.

Total Acid Number (TAN.) or pH: This test detects the amount of acid or pH in the sample.

Wear Trend Analysis

Of particular concern are the levels of silicate (contamination) and iron (wear). The results of each sample taken should be compared to at least two or three previous samples (from the same component) in order to conduct wear trend analysis. A sudden change could signal the need for corrective action such as flushing or disassembly of the component.

NOTICE

Changing the planetary drive or hydraulic pump drive oil is strongly recommended if contaminates exceed the amount listed under “Recommended cleanliness targets”. If these high levels of iron content continue after changing, disassembly and inspection should be considered. In order to maximize component life, the amount of iron contained in the oil must be kept as low as possible.

CAUTION

To have consistent samples and to remove all contaminates - it is important that the oil be sampled or drained as soon as possible after stopping the machine so that any metal particles or contaminants will remain suspended in the oil.

NOTICE

Refer to Sections 02 and 03 for additional information on servicing planetary drives and gearboxes. Also, refer to “Auto lube pump lubrication and grease specifications" (this section), for lubricants recommended for use in planetary drives and gearboxes.

Synthetic and Specialty Lubricants

Synthetic and specialty lubricants are beneficial where temperature extremes (hot and cold) are encountered. The planetary drives are factory equipped with MOBILE SHC GEAR OH synthetic lubricant, OF THE VISCOSITY GRADE SPECIFIC IN Table “PLANITARY DRIVE LUBRICATION SPECIFICATION. It is recommended this oil be used.

Analysis of Hydraulic Fluid

Samples should be collected from the hydraulic tank every 500 hours. Oil analysis results should be reviewed to determine the need for replacement of hydraulic fluid due to degradation or solid particle contamination. Refer to “Cleanliness Targets” within this section.

Analysis of Hydraulic Pump Drive (HPD) Gearbox Pump Oil

Samples should be collected from the hydraulic pump drive every 500 hours of operation. If contaminates exceed the amount listed under Table “Recommended cleanliness targets” on two or more consecutive tests, component failure is imminent and disassembly should be considered.

Cleanliness Targets

To prevent particle contamination from reducing component life, a fluid cleanliness level must be maintained on a continuous basis. With regular sampling and proper analysis, used oil analysis should provide an early warning of machine faults unless severe damage resulted from a transient condition. Wear debris irregularities should always be followed up with further analysis to determine its source and severity.

The recommended cleanliness target is a two-digit ISO Code (ISO 4406). The two digits represent particles 5 micron and 15 microns in size respectively. The Particle Count data is obtained from the regularly scheduled oil sampling program. In addition to the ISO Cleanliness Level the amount of Silicon and Water introduced into the fluid is considered as is the Viscosity and Total Acid Number (TAN).

Field Operations	
Hydraulic Systems	ISO 18/15 minimum
HPD Gearbox	ISO 19/16 minimum
Drivers	ISO 19/16 minimum
Silicon	<25 ppm
Water	<200 ppm
Viscosity	+15%/-10%
TAN	+2 over base oil

Table 12. Recommended cleanliness targets

ISO 16/13 minimum

Table 13. Fill oils

NOTICE

The used oil analysis limits provided are intended to be used as general interpretation guidelines and should not be the sole criteria judgment of fluid reclamation, continued use, or change-out.

During the run-in period (before first oil change, <150 hrs.) the particle count can be at higher levels. The planetary drive oil should be changed if the particle count rises into the problem area and then re-sampled. The oil should also be changed at oil change intervals to remove any contaminants. Synthetic oil may be drained, filtered, and reused as long as the additive package and oil still meets specifications as indicated by sampling.

A trend of particle counts over several samplings should be compared to determine if the amounts are excessive or not, rather than using only the results of one single analysis. Increased particle amounts from one sample to another, indicates a possible situation that could require inspection and/or service of the planetary drive.

The above listed particle counts serve only as guidelines for indications of possible contaminants that could be found in the drive lube oil, some of which may be the result of effects external to the drive.

Analysis of Engine Lubrication Oil

Engine oil should be changed immediately if any contamination is present in concentrations exceeding limits recommended by the engine manufacturer for the particular engine. It should not be concluded that the engine is worn out based on a single measurement that exceeds manufacturer's limits. Imminent engine wear out can only be determined through a continuous oil analysis program wherein the change in data or deviation from baseline data can be used to interpret condition of engine parts.

Characteristics relating to lubricating oil dilution should trigger corrective action to identify and fix the source(s). Confirmation of the need for engine overhaul should be based on operational data, increasing oil consumption, crankcase pressure, and physical inspection of the parts.

NOTICE

It is important to verify that the testing methods used will provide data as specified by the engine manufacturer's manuals.

NOTICE

The ultimate success of a lubricating oil analysis program rests with the owner or equipment manager. If good samples are taken, forwarded promptly, and the feedback used wisely, a lubricating oil analysis program will be very effective.

Log of Oil Samples Taken and Analysis Results							
	Planetary drive				Hyd. Res.	HPD gearbox*	Engine
	RF	RR	LF	LR			
Date of Sample							
S/N of Machine							
Hour meter Reading							
Hours of Operation on Machine Since Last Oil Change							
Results of Magnetic Oil Plug Samples							
Oil Sample Drawn							
Type of Oil							
Oil Sample Analysis Completed							
Spectrographic Analysis*							
Viscosity Test*							
Insoluble Material Test*							
Total Acid Number Test*							
Water Content*							
Action Taken							
Sampling Done By							
Oil Analysis Done By							
Mag. Plug Analysis Done By							

This is a suggested format for logging samples and recording that analyses have been received and recorded and also to log in any changes that may be enacted to counteract any unfavorable results from the analyses.

*Record laboratory test results.

* Hydraulic pump drive gearbox

Figure 6. Oil analysis report form

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