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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
**OFFICE OF THE SECRETARY**
Manila

12 JAN 2018

**DEPARTMENT ORDER )**
**)**
**NO. 05 )**
**Series of 2018 )** 01.16.18

**SUBJECT: Preventive Maintenance Manual for DPWH Most Commonly Used Equipment and Service Vehicles**

With the Department's systematic approach for the optimum utilization of physical assets and their associated performance, operational risks and safety program to ensure reliability of land-based equipment fleet throughout its life cycle, all concerned Offices and personnel are hereby directed to strictly implement and use the work procedures prescribed in this *Manual*.

The *Handbook* standardizes the proactive maintenance activities and times for each equipment type, providing a prompt ready guide for mechanics, electricians, operators/drivers and equipment shop personnel in conducting maintenance activities in a safe, efficient and effective manner.

The said *Manual* may be downloaded from the DPWH Intranet (http://dpwhweb).

This Order shall take effect immediately.

**MARK A. VILLAR**
Secretary

9.1.2 PRCJ/OOI/TNLI

Department of Public Works and Highways
Office of the Secretary
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# PREVENTIVE MAINTENANCE MANUAL FOR DPWH MOST COMMONLY USED EQUIPMENT AND SERVICE VEHICLES

**2017**

# FOREWORD

With the intention to achieve optimum utilization of our equipment, the conduct of proper preventive maintenance shall be strictly enforced. Any delay to equipment operations and productions caused by equipment downtime in undertaking preventive maintenance, will be recovered many times over thru the reliability of performance and freedom from more expensive damage which would possibly take the equipment out of service for a greater period of time.

This Handbook on Preventive Maintenance, with its compact size, contains concise sequence of maintenance activities, complete with hazards involved and safety reminders. It shall serve as an effective ready reference and procedural handbook for our mechanics, electricians and shop equipment personnel in performing Active Maintenance Time.

With the adoption of this Manual, the Department expects to minimize downtime and prolong serviceable life of our equipment.

**MARK A. VILLAR**
Secretary

# OBJECTIVES

The Equipment Management System of the Department is to strategically manage capable and adequate land-based equipment fleet throughout its life cycle. Purposely plans at keeping and restoring this equipment assets to serviceable condition at all times, in support for road maintenance, flood control, disaster response and other related emergency situations.

As part of our Equipment Preventive Maintenance Program Policy, relative to the issuance of Department Order Nos. 63 and 64, both Series of 2016, this Manual describes the procedures as a guide for the correct use and application of active maintenance time, aims at increasing equipment uptime and reliability, and reduce operational safety risks.

# INTRODUCTION

Preventive Maintenance (PM) is a series of inspection, lubrication and repair operations carried out on a predetermined interval or according to prescribed criteria and intended to reduce the probability of failure or malfunctioning of equipment and motor vehicles. It requires periodic inspection and maintenance schedules to eliminate the possibility of the onset of the elements of premature breakdown, and ensure utmost economy and the extended life of the equipment.

Categories of Preventive Maintenance

| PM Schedule | *When Done* |
|---|---|
| Daily Maintenance | *Before equipment operation* |
| Periodic Maintenance: | |
| PM 1 | *Every 50 hours or 1,000 kilometers* |
| PM 2 | *Every 250 hours or 5,000 kilometers* |
| PM 3 | *Every 500 hours or 10,000 kilometers* |
| PM 4 | *Every 1,000 hours or 20,000 kilometers* |
| Rehabilitation | *Usage of 3,500 hours or 70,000 kilometers* |

Under Section G, Item No. 3 as per DO No. 64 Series of 2016, the Area Equipment Section (AES) under the Equipment Management Division of the Regional Office (RO) and the Equipment Services Unit (ESU) under the Maintenance Section of the District Engineering Office (DEO) shall be jointly responsible in undertaking the PMs 2, 3, and 4, according to the above schedules.

In addition, the ESU shall be solely responsible in undertaking PM 1, as monitored and certified by the AES, while the operator/driver shall ensure the upkeep of all equipment and motor vehicle thru a daily/routine maintenance prescribed under DO No. 11 Series of 2016, with subject "Routine Maintenance for Service Vehicles and Most Commonly Used Equipment Manual."

Always adhere to the equipment manufacturer's Operation and Maintenance Manual for further details and safety instructions.

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# LEGEND

Visual Inspection-observe safety procedures.

Very Important! Regularly check these items.
Caution: Observe safety procedures at all times.

Report any unusual noise immediately.

# 1.0. HYDRAULIC CRANE (F4/F5)

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br><br>rag | 1-pc<br>as stated<br><br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 | | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.5. Swing gear bearing: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Fill grease thru grease nipples at two points using a hand or power grease gun | 5 | grease gun | 1-set | multi-purpose grease | 500 gm |
| | | | | | rag | 1/4 kg |
| 4 | Apply grease to the swing bearing until grease can be seen at the swing bearing seals.<br>Purge old grease with new. Take care not to supply an excessive amount of grease | 5 |  | | | |
| 5 | After greasing, clean off the surplus grease completely | 3 | | | | |
| | Total | 15 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.6. Arm and Front Attachments Pins: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Wipe off the grease nipples and the grease gun before greasing, to avoid introducing sand and dirt particles with the grease. | | | | | |
| 1 | Position the machine on a firm, level ground. Lower the front attachment to the ground and shut down the engine. | 2 |  | | | |
| 2 | Press the grease fitting and inject grease with the use of grease gun on the marked points:<br>▪ Boom cylinder head pin<br>▪ Boom foot pin<br>▪ Boom cylinder rod pin<br>▪ Arm cylinder head pin<br>▪ Boom arm joint pin<br>▪ Arm cylinder rod pin<br>▪ Bucket cylinder head pin | 15 | grease gun<br>wrench<br>screw driver | 1-set<br>1-pc<br>1-pc | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 3 | After injection, clean off the old grease that has been purged. | 3 |  | | | |
| | Note: If the machine has been running or working in water the front attachment should be greased on a 10-hour/ daily basis | | | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.7. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.8. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 2 1.9. Axle Hub oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.10.Swing drive unit oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Place a suitable sized container under the drain valve. | 1 | | | drain pan | 1-pc |
| 4 | Open the drain valve. | 1 | wrench<br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Drain the oil into the container. Wait until the last drop of oil for few minutes | 15 | | | | |
| 6 | Reinstall the drain plug. | 1 | | | | |
| 7 | Pull out oil dipstick, and fill oil to the correct level thru the oil filler hole. | 5 |  | | hydraulic oil | as stated |
| 8 | Check the oil level again and if necessary, top up.<br>Wait about 5 minutes for checking the level after filling. | 5 | | | | |
| | Total | 30 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.11. Swing bath grease: check/change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Remove the bolts and inspection cover | 3 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| 4 | Check the level and condition of the grease. Fill if needed.<br><br>If the grease is contaminated or discolored with water, remove the lower access cover, then replace the contaminated grease. Install the access cover. | 10 |  | | multi-purpose grease | 500 gm |
| | | | | | rag | 1/4 kg |
| 5 | Inspect the seal. Replace if damaged | 2 | | | cover seal | 1-pc |
| 6 | Install the inspection cover and tighten the bolts | 3 | | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.12. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |   | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.13. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: boom; tilting; outrigger | |  | | | |
| 1 | Lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.14. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water<br>rag | as stated<br>1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br><br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.15. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench<br>plier<br>screw driver<br>ampere volt multi-tester | 1-pc<br>1-pc<br>1-pc<br>1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease<br>1-inch paint brush<br>sand paper<br>rag | 250 gm<br>1-pc<br>1-pc<br>1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.16. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 3 1.17. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 | | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.18. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.19. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.20. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.21. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.22. Travel reduction device oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: Drain and replace the oil after the first 250 hours of operation and 1000 hours thereafter.<br><br>Rotate the track until the three (3) ports are in their proper positions., That is, Port 1 is the level plug, Port 2 is the drain plug and Port 3 is the fill plug. | 3 | | | | |
| 4 | Place a container under the drain plug and remove the plugs (1 to 3), to drain the travel reduction gear oil. | 5 | wrench | 1-pc | drain pan<br>rag | 1-pc<br>1/4 kg |
| 5 | Install the drain plug. Refill the travel reduction gear case with fluid thru the fill port until the fluid level is at level port. Install the level plug and fill plug. | 5 |  | | gear oil | as stated |
| | Total | 15 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.23. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.24. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.25. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4

1.26. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.27. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  | | | |
| | Total | 60 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.28. Track tension: check/adjust

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: The track adjusting mechanism is under very high-pressure. Never release pressure too suddenly. The track tension grease valve should never be backed off more than one (1) complete turn from the tightened down position<br>Under normal usage, the track shoe link pins and bushing wear- out and reducing the track tension | | | | | |
| 1 | Track tension is checked by jacking up one side of the truck side. Place blocking under frame while taking measurement. Turn the track backward 1-2 turns | 10 | wrench<br>mechanical jack<br>jack-up stand | 1-set<br>1-set<br>1-set |  | |
| 2 | Clean off the tracks before checking the clearance. Measurement can be inaccurate if there is too much mud or dirt or other material in the track assembly | 10 |  | | | |
| 3 | Measuring the distance between the bottom of the side frame and the top of the lowest crawler shoe. Recommended tension for operation over most types of terrain is 290 - 310 mm (11.42 - 12.20 inches) | 5 | tape measure | 1-set | | |
| 4 | Track tension adjustments are made thru the grease fitting located in the middle of each side frame. Adding grease increases the length of an adjustment cylinder. The longer the adjustment cylinder, the greater the pressure on the tension spring pushing the track idler wheel outward. | 15 | grease gun | 1-set | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 5 | If there is not enough slack or clearance in the tracks and the adjustment is too tight, the idler wheel and adjusting cylinder can be retracted by bleeding off grease thru hole in valve by loosening valve slowly. When grease starts to leak out, stop loosening it. | 15 |  <br>  | | | |
| 6 | After track is adjusted by loosening valve, be sure to tighten valve to 14 kg.m or 101 ft. lb. | 5 | | | | |
| | Total | 60 | | | | |

## 1.0. Hydraulic Crane

DPWH Property Code: F4/F5

Maintenance Activity: PM 4 1.29. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 2.0. HYDRAULIC EXCAVATOR (F16/F17)

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br><br>rag | 1-pc<br>as stated<br><br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 | | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.5. Swing gear bearing: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Fill grease thru grease nipples at two points using a hand or power grease gun | 5 | grease gun | 1-set | multi-purpose grease | 500 gm |
| | | | | | rag | 1/4 kg |
| 4 | Apply grease to the swing bearing until grease can be seen at the swing bearing seals.<br>Purge old grease with new. Take care not to supply an excessive amount of grease | 5 |  | | | |
| 5 | After greasing, clean off the surplus grease completely | 3 | | | | |
| | Total | 15 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.6. Arm and Front Attachments Pins: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Wipe off the grease nipples and the grease gun before greasing, to avoid introducing sand and dirt particles with the grease. | | | | | |
| 1 | Position the machine on a firm, level ground. Lower the front attachment to the ground and shut down the engine. | 2 |   | | | |
| 2 | Press the grease fitting and inject grease with the use of grease gun on the marked points:<br>▪ Boom cylinder head pin<br>▪ Boom foot pin<br>▪ Boom cylinder rod pin<br>▪ Arm cylinder head pin<br>▪ Boom arm joint pin<br>▪ Arm cylinder rod pin<br>▪ Breaker cylinder head pin | 15 | grease gun<br>wrench<br>screw driver | 1-set<br>1-pc<br>1-pc | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 3 | After injection, clean off the old grease that has been purged. | 3 |  | | | |
| | Note: If the machine has been running or working in water the front attachment should be greased on a 10-hour/ daily basis | | | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.7. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.8. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 2 2.9. Axle Hub oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.10. Swing drive unit oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Place a suitable sized container under the drain valve. | 1 | | | drain pan | 1-pc |
| 4 | Open the drain valve. | 1 | wrench<br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Drain the oil into the container. Wait until the last drop of oil for few minutes | 15 | | | | |
| 6 | Reinstall the drain plug. | 1 | | | | |
| 7 | Pull out oil dipstick, and fill oil to the correct level thru the oil filler hole. | 5 |  | | hydraulic oil | as stated |
| 8 | Check the oil level again and if necessary, top up.<br>Wait about 5 minutes for checking the level after filling. | 5 | | | | |
| | Total | 30 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

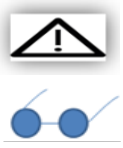
Maintenance Activity: PM 3 2.11. Swing bath grease: check/change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Remove the bolts and inspection cover | 3 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| 4 | Check the level and condition of the grease. Fill if needed.<br><br>If the grease is contaminated or discolored with water, remove the lower access cover, then replace the contaminated grease. Install the access cover. | 10 |  | | multi-purpose grease | 500 gm |
| | | | | | rag | 1/4 kg |
| 5 | Inspect the seal. Replace if damaged | 2 | | | cover seal | 1-pc |
| 6 | Install the inspection cover and tighten the bolts | 3 | | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.12. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following FUEL SYSTEM PRIMING:<br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |  | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.13. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: bucket; tilting; tandem; | |  | | | |
| 1 | lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.14. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water | as stated |
| | | | | | rag | 1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.15. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.16. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 3 2.17. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 |  | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.18. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.19. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.20. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.21. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.22. Travel reduction device oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: Drain and replace the oil after the first 250 hours of operation and 1000 hours thereafter.<br><br>Rotate the track until the three (3) ports are in their proper positions., That is, Port 1 is the level plug, Port 2 is the drain plug and Port 3 is the fill plug. | 3 | | | | |
| 4 | Place a container under the drain plug and remove the plugs (1 to 3), to drain the travel reduction gear oil. | 5 | wrench | 1-pc | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Install the drain plug. Refill the travel reduction gear case with fluid thru the fill port until the fluid level is at level port. Install the level plug and fill plug. | 5 |  | | gear oil | as stated |
| | Total | 15 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.23. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.24. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.25. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4

2.26. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

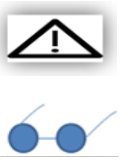
Maintenance Activity: PM 4 2.27. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  <br>  | | | |
| | Total | 60 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.28. Track tension: check/adjust

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: The track adjusting mechanism is under very high-pressure. Never release pressure too suddenly. The track tension grease valve should never be backed off more than one (1) complete turn from the tightened down position<br><br>Under normal usage, the track shoe link pins and bushing wear- out and reducing the track tension | | | | | |
| 1 | Track tension is checked by jacking up one side of the excavator. Place blocking under frame while taking measurement. Turn the track backward 1-2 turns | 10 | wrench<br>mechanical jack<br>jack-up stand | 1-set<br>1-set<br>1-set |  | |
| 2 | Clean off the tracks before checking the clearance. Measurement can be inaccurate if there is too much mud or dirt or other material in the track assembly | 10 |  | | | |
| 3 | Measuring the distance between the bottom of the side frame and the top of the lowest crawler shoe. Recommended tension for operation over most types of terrain is 290 - 310 mm (11.42 - 12.20 inches) | 5 | tape measure | 1-set | | |
| 4 | Track tension adjustments are made thru the grease fitting located in the middle of each side frame. Adding grease increases the length of an adjustment cylinder. The longer the adjustment cylinder, the greater the pressure on the tension spring pushing the track idler wheel outward. | 15 | grease gun | 1-set | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 5 | If there is not enough slack or clearance in the tracks and the adjustment is too tight, the idler wheel and adjusting cylinder can be retracted by bleeding off grease thru hole in valve by loosening valve slowly. When grease starts to leak out, stop loosening it. | 15 |  | | | |
| 6 | After track is adjusted by loosening valve, be sure to tighten valve to 14 kg.m or 101 ft. lb. | 5 | | | | |
| | Total | 60 | | | | |

## 2.0. Hydraulic Excavator

DPWH Property Code: F16/F17

Maintenance Activity: PM 4 2.29. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 3.0. SERVICE VEHICLE (H1)

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 2 3.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br><br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 2 3.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br>rag | 1-pc<br>as stated<br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 2 3.3. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br><br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 2 3.4. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 2 3.5. Axle Hub oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 3 3.6. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |  <br>  | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

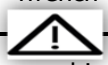
Maintenance Activity: PM 3 3.7. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: bucket; tilting; tandem; | |  | | | |
| 1 | Lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 3 3.8. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water | as stated |
| | | | | | rag | 1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 3 3.9. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 3 3.10. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4 3.11. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4 3.12. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4 3.13. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4 3.14. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4

3.15. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4 3.16. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  | | | |
| | Total | 60 | | | | |

## 3.0. Service Vehicle

DPWH Property Code: H1

Maintenance Activity: PM 4 3.17. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 4.0. DUMP TRUCK (H3)

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2 4.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br><br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2 4.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter | 1-pc |
| | | | | | engine oil | as stated |
| | | | | | rag | 1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2 4.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2 4.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 | | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2 4.5. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br><br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2

4.6. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 2

4.7. Axle Hub oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 3 4.8. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |  <br>  | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 3 4.9. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: bucket; tilting; tandem; | |  | | | |
| 1 | Lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 3 4.10.Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water<br>rag | as stated<br>1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 3 4.11. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 3 4.12. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 3 4.13. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 | | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.14. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.15. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.16.Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.17. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.18. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.19. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.20. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4

4.21. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 |  | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.22. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  <br>  | | | |
| | Total | 60 | | | | |

## 4.0. Dump Truck

DPWH Property Code: H3

Maintenance Activity: PM 4 4.23. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 5.0. SHUTTLE BUS (H12)

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 2 5.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br><br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 2 5.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br>rag | 1-pc<br>as stated<br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 2 5.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 2 5.4. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 2 5.5. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 2 5.6. Axle Hub oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 3 5.7. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |   | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 3 5.8. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water<br>rag | as stated<br><br>1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 3 5.9. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 3 5.10. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 3 5.11. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | |  | | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 |  | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4 5.12. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4 5.13. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4 5.14. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4 5.15. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4

5.16. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4 5.17. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  <br>  | | | |
| | Total | 60 | | | | |

## 5.0. Shuttle Bus

DPWH Property Code: H12

Maintenance Activity: PM 4 5.18. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 6.0. CRAWLER TRACTOR (L1)

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 2 6.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br><br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 2 6.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br>rag | 1-pc<br>as stated<br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 2 6.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 2 6.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 | | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 2 6.5. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br><br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 2

6.6. Front attachments, cylinders, pins and ball joints: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Wipe off the grease nipples and the grease gun before greasing, to avoid introducing sand and dirt particles with the grease. | | | | | |
| 1 | Position the machine on a firm, level ground. Rest the blade on the ground and shut down the engine. | 5 |  | | | |
| 2 | Press the grease fitting and inject grease with the use of grease gun on the marked points:<br>Leaning cylinder pin<br>Tie rod<br>Knuckle bracket king pin<br>Leaning pin<br>Steering cylinder<br>Front axle center pin<br>Drawbar ball joint<br>Scarifier ball joint<br>Scarifier cylinder pin<br>Blade lift cylinder yoke<br>Blade lift cylinder ball joint<br>Drawbar side shift cylinder ball<br>Bank control guide<br>Articulation center pin<br>Articulation cylinder pin | 25 | grease gun<br>wrench<br>screw driver<br>  | 1-set<br>1-pc<br>1-pc | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 3 | After injection, clean off the old grease that has been purged. | 10 |  | | | |
| | Total | 40 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 3 6.7. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |   | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

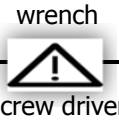
Maintenance Activity: PM 3 6.8. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: blade; tilting; tandem; | |  | | | |
| 1 | Lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 3 6.9. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water<br>rag | as stated<br>as stated<br>1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 3 6.10. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 3 6.11. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 3 6.12. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 |  | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.13. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.14. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.15. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.16.Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.17. Travel reduction device oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: Drain and replace the oil after the first 250 hours of operation and 1000 hours thereafter.<br><br>Rotate the track until the three (3) ports are in their proper positions., That is, Port 1 is the level plug, Port 2 is the drain plug and Port 3 is the fill plug. | 3 | | | | |
| 4 | Place a container under the drain plug and remove the plugs (1 to 3), to drain the travel reduction gear oil. | 5 | wrench | 1-pc | drain pan<br>rag | 1-pc<br>1/4 kg |
| 5 | Install the drain plug. Refill the travel reduction gear case with fluid thru the fill port until the fluid level is at level port. Install the level plug and fill plug. | 5 |  | | gear oil | as stated |
| | Total | 15 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.18. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4

6.19. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.20. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  <br>  | | | |
| | Total | 60 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.21. Track tension: check/adjust

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: The track adjusting mechanism is under very high-pressure. Never release pressure too suddenly. The track tension grease valve should never be backed off more than one (1) complete turn from the tightened down position<br>Under normal usage, the track shoe link pins and bushing wear- out and reducing the track tension | | | | | |
| 1 | Track tension is checked by jacking up one side of the truck side. Place blocking under frame while taking measurement. Turn the track backward 1-2 turns | 10 | wrench<br>mechanical jack<br>jack-up stand | 1-set<br>1-set<br>1-set |  | |
| 2 | Clean off the tracks before checking the clearance. Measurement can be inaccurate if there is too much mud or dirt or other material in the track assembly | 10 |  | | | |
| 3 | Measuring the distance between the bottom of the side frame and the top of the lowest crawler shoe. Recommended tension for operation over most types of terrain is 290 - 310 mm (11.42 - 12.20 inches) | 5 | tape measure | 1-set | | |
| 4 | Track tension adjustments are made thru the grease fitting located in the middle of each side frame. Adding grease increases the length of an adjustment cylinder. The longer the adjustment cylinder, the greater the pressure on the tension spring pushing the track idler wheel outward. | 15 | grease gun | 1-set | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 5 | If there is not enough slack or clearance in the tracks and the adjustment is too tight, the idler wheel and adjusting cylinder can be retracted by bleeding off grease thru hole in valve by loosening valve slowly. When grease starts to leak out, stop loosening it. | 15 |  <br>  | | | |
| 6 | After track is adjusted by loosening valve, be sure to tighten valve to 14 kg.m or 101 ft. lb. | 5 | | | | |
| | Total | 60 | | | | |

## 6.0. Crawler Tractor

DPWH Property Code: L1

Maintenance Activity: PM 4 6.22. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 7.0. FRONT-END LOADER (L2)

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br><br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.2.Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br>rag | 1-pc<br>as stated<br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 | | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.5. Arm and Front Attachments Pins: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Wipe off the grease nipples and the grease gun before greasing, to avoid introducing sand and dirt particles with the grease. | | | | | |
| 1 | Position the machine on a firm, level ground. Lower the front attachment to the ground and shut down the engine. | 2 |  | | | |
| 2 | Press the grease fitting and inject grease with the use of grease gun on the marked points:<br>▪ Boom cylinder head pin<br>▪ Boom foot pin<br>▪ Boom cylinder rod pin<br>▪ Arm cylinder head pin<br>▪ Boom arm joint pin<br>▪ Arm cylinder rod pin<br>▪ Bucket cylinder head pin | 15 | grease gun<br>wrench<br>screw driver | 1-set<br>1-pc<br>1-pc | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 3 | After injection, clean off the old grease that has been purged. | 3 |  | | | |
| | Note: If the machine has been running or working in water the front attachment should be greased on a 10-hour/ daily basis | | | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.6. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.7. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2 7.8. Axle Hub oil level: check

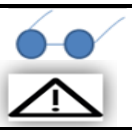
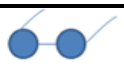
| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 2

7.9. Front attachments, cylinders, pins and ball joints: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Wipe off the grease nipples and the grease gun before greasing, to avoid introducing sand and dirt particles with the grease. | | | | | |
| 1 | Position the machine on a firm, level ground. Rest the blade on the ground and shut down the engine. | 5 |  | | | |
| 2 | Press the grease fitting and inject grease with the use of grease gun on the marked points: | 25 | grease gun | 1-set | multi-purpose grease | 500 gm |
| | Leaning cylinder pin | | wrench | 1-pc | rag | 1/4 kg |
| | Tie rod | | screw driver | 1-pc | | |
| | Knuckle bracket king pin | | | | | |
| | Leaning pin | | | | | |
| | Steering cylinder | | | | | |
| | Front axle center pin | | | | | |
| | Drawbar ball joint | | | | | |
| | Scarifier ball joint | | | | | |
| | Scarifier cylinder pin | | | | | |
| | Blade lift cylinder yoke | | | | | |
| | Blade lift cylinder ball joint | | | | | |
| | Drawbar side shift cylinder ball | | | | | |
| | Bank control guide | | | | | |
| | Articulation center pin | | | | | |
| | Articulation cylinder pin | | | | | |
| 3 | After injection, clean off the old grease that has been purged. | 10 |  | | | |
| | Total | 40 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 3 7.10. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |  <br>  | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 3 7.11. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: bucket; tilting; tandem; | |  | | | |
| 1 | Lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 3 7.12. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water<br>rag | as stated<br><br>1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 3 7.13. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 3 7.14. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 3 7.15. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 | | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.16. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.17. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.18. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.19. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower bucket to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.20. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.21. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.22. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4

7.23. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.24. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  | | | |
| | Total | 60 | | | | |

## 7.0. Front-end Loader

DPWH Property Code: L2

Maintenance Activity: PM 4 7.25. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 8.0. ROAD GRADER (N1)

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br><br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br>rag | 1-pc<br>as stated<br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower blade to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 |  | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.5. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.6. Axle carrier oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 2 |  | | | |
| 2 | Remove the filling and level checking plug (upper position). If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2 8.7. Axle Hub oil level: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 2 |  | | | |
| 2 | Position the filling and level checking plug on a horizontal axis (position of 3 o'clock) and remove the plug. If the oil is about to overflow from the hole, the oil level is normal. | 3 |  wrench | 1-pc | rag | 1/4 kg |
| 3 | If the oil is low, refill to the proper level. Then install the filling plug. | 5 | | | gear oil | as stated |
| | Total | 10 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 2

8.8. Front attachments, cylinders, pins and ball joints: greasing

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Wipe off the grease nipples and the grease gun before greasing, to avoid introducing sand and dirt particles with the grease. | | | | | |
| 1 | Position the machine on a firm, level ground. Rest the blade on the ground and shut down the engine. | 5 |  | | | |
| 2 | Press the grease fitting and inject grease with the use of grease gun on the marked points:<br>Leaning cylinder pin<br>Tie rod<br>Knuckle bracket king pin<br>Leaning pin<br>Steering cylinder<br>Front axle center pin<br>Drawbar ball joint<br>Scarifier ball joint<br>Scarifier cylinder pin<br>Blade lift cylinder yoke<br>Blade lift cylinder ball joint<br>Drawbar side shift cylinder ball<br>Bank control guide<br>Articulation center pin<br>Articulation cylinder pin | 25 | grease gun<br>wrench<br>screw driver | 1-set<br>1-pc<br>1-pc | multi-purpose grease<br>rag | 500 gm<br>1/4 kg |
| 3 | After injection, clean off the old grease that has been purged. | 10 |  | | | |
| | Total | 40 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 3 8.9. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following <u>FUEL SYSTEM PRIMING:</u><br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |  | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 3 8.10. Controls: check/adjust/lubricate

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Controls for: bucket; tilting; tandem; | |  | | | |
| 1 | Lubricate all joints and linkages | 20 | oiler | 1-pc | multi-purpose grease | 500 gm |
| | | | grease gun | 1-set | lubricating oil | as stated |
| | | | wrench | 1-pc | rag | 1/4 kg |
| 2 | Check and adjust clearance | 5 | | | | |
| 3 | Clean off surplus grease and oil completely. | 5 |  | | | |
| | Total | 30 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 3 8.11. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water<br>rag | as stated<br><br>1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 3 8.12. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 3 8.13. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 3 8.14. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | |  screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 |  | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.15. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower blade to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.16. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower blade to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.17. Transfer gearbox oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower blade to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case could eject the oil and plug.<br>Put a suitable sized container , above 3 liters, under the drain plug of transfer gearbox to receive the oil. | 15 | | | drain pan | 1-pc |
| 4 | Loosen the drain plug slowly, discharge the oil completely. | 15 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | Tighten the drain plug again and remove the filling plug and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil level is normal.<br>Then install the filling plug. | 3 |  | | engine oil | as stated |
| 6 | Check the oil level once again after a driving time of about 5 minutes. If necessary, refill the oil. | 5 | | | | |
| | Total | 40 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.18. Transfer gearbox: air bleeding

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower blade to the ground, move the control lock out lever down to lock the hydraulic system securely and shut down the engine | 1 | | | | |
| 3 | Note: After initial assembly of the machine or disconnecting high/low speed pressure line (from pump to transfer gearbox) and remounting, bleed the air from the transfer gearbox before travelling the machine.<br>Releaser the parking brake. | 15 | | | | |
| 4 | Set the gear speed change lever to 2nd. Open bleeder of the brake and bleed it for approximately 20 seconds. | 3 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 5 | When the brake is bleeded the first time, additionally open also bleeder of the emergency actuating device to bring it into its initial position. In this case no oil flows out. | 3 |  | | | |
| 6 | Close both bleeders. | 1 | | | | |
| 7 | Set the gear speed change lever to 1st (low speed). Open bleeder of the clutch and bleed it for approximately 20 seconds. | 2 | | | | |
| 8 | Close bleeder of the clutch. | 1 | | | | |
| 9 | Repeat bleeding the brake and clutch 2 times each for approximately 20 seconds. At the last bleeding procedure no air bubbles are allowed to be visible in the oil anymore. | 10 |  | | | |
| 10 | Check all screws connections for leaks.<br>Important: If the air in the transfer gearbox is not vented out, a serious fault may develop, such as damage of the clutch in the transfer gearbox may occur. | 3 | | | | |
| | Total | 40 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.19. Axle Carrier oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly. | 5 |  | | | |
| 2 | Put a suitable container under the drain plug (lower position) of axle carrier to receive the oil. | 2 | | | drain pan | 1-pc |
| 3 | Loosen the drain plug, then the filling plug (upper position) and discharge the oil completely. | 5 | wrench | 1-pc | rag | 1/4 kg |
| 4 | Tighten the drain plug and supply new oil thru the filling plug. If the oil is about to overflow from the hole, the oil level is normal. | 5 |  | | gear oil | as stated |
| 5 | Install the filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.20. Axle Hub oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Immediately after operating the machine, the oil is hot. Allow the oil to cool. Residual pressure in the transfer case, can eject the oil and plug. Loosen the plug slowly | 5 |  | | | |
| 2 | Put a suitable sized container under the drain plug of axle carrier to receive the oil. | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Position the drain plug on the vertical axis (position of 6 o'clock). | 1 | | | | |
| 4 | Loosen the drain plug and filling plug to discharge the oil completely. | 5 | wrench | 1-pc | gear oil | as stated |
| 5 | Tighten the drain plug again and supply oil thru the filling hole. If the oil is about to overflow from the hole, the oil is normal. | 5 |  | | | |
| 6 | Install filling plug and tighten securely. | 3 | | | | |
| | Total | 20 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.21. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4

8.22. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.23. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  | | | |
| | Total | 60 | | | | |

## 8.0. Road Grader

DPWH Property Code: N1

Maintenance Activity: PM 4 8.24. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

# 9.0. VIBRATORY ROLLER (Z18)

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 2 9.1. Engine oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Park the unit on a firm level ground | |  | | | |
| 1 | Open access | 1 | | | | |
| 2 | Put a suitable container under the drain plug at the bottom of the oil pan | 2 | drain pan | 1-pc | | |
| 3 | Remove the oil filler cap and oil filter | 5 | oil filter wrench | 1-pc | | |
| 4 | Remove the drain plug to drain the oil into a container<br>Note: While draining, clean the air filter | 20 | wrench | 1-pc | | |
| 5 | When engine oil drops intermittently, apply compressed air into the filler hole to hasten draining | 9 |  | | rag | 1-pc |
| 6 | Install drain plug and oil filter | 8 | | | oil filter | 1-pc |
| 7 | Fill new engine oil into the filler hole with the specified viscosity/SAE No | 10 | | | engine oil | as stated |
| 8 | Run the engine and check for leaks | 5 |  | | | |
| | Total | 60 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 2 9.2. Engine oil filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Replace the oil filter every time the oil is changed<br>Remove the oil filter | 3 | filter wrench | 1-pc | | |
| 2 | Clean the filter housing base and apply a light coat of engine oil to the gasket of the new filter | 2 |  | | new oil filter<br>engine oil<br><br>rag | 1-pc<br>as stated<br><br>1/4 kg |
| 3 | Fill the new filter with the specified engine oil | 1 | | | | |
| 4 | Screw on the new filter by hand until the gasket just touches the sealing surface. Tighten the filter a further 1/2 turn | 3 | | | | |
| 5 | Start the engine and check that the gasket is sealed. If not, remove the filter and check the sealing surface | 3 |  | | | |
| | Note: It is important that the new filter is filled with the prescribed engine oil before it is installed. This is to ensure lubrication of the engine immediately after starting | | | | | |
| | Total | 12 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 2 9.3. Primary Air filter: clean and replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Do not, under any circumstances, run the engine without air filter or with a damaged one. The degree of engine wear depends largely on the cleanliness of the induction air. | | | | | |
| 1 | Open the access door at the rear of the cabin | 1 | | | | |
| 2 | Remove the evacuator valve and air cleaner cover | 2 |  | | | |
| 3 | Press with both thumbs on primary filter at the same time as you pull it out. This is to prevent the secondary filter from coming out together with the primary filter. | 2 | | | | |
| 4 | Carefully tap the end of the air filter against a soft and clean surface | 5 | | | | |
| 5 | Use clean and dry compressed air, blow the filter from the inside along the folds | 5 | | | compressed air | as stated |
| 6 | If there is the smallest hole, scratch, crack or other damage, the filter must be discarded | 1 |  | | rag | 1/4 kg |
| 7 | Install the primary air filter and the cover | 4 | | | | |
| | Total | 20 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 2 9.4. Hydraulic drain filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 5 | wrench | 1-pc |  rag | 1/4 kg |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 4 | Place a container under the drain filter and turn the filter counter clockwise to remove it. | 5 | | | drain pan | 1-pc |
| 5 | Fill the new filter with oil, thinly coat O-ring with oil. | 1 | | | new filter | 1-pc |
| | | | | | hydraulic oil | as stated |
| 6 | Install the new filter | 7 | | | | |
| | Total | 20 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 2 9.5. Engine fan belt: check/replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: A loose fan belt can cause engine overheating, poor charging, and premature belt wear. A belt that is too tight can cause damage to the water pump, alternator bearing or belt.<br><br>With the engine shut off, and the starter switch is in the "OFF" position and the controls are tagged, check the tension of the fan belt by pressing downwards on the belt, midway between the fan pulley and alternator pulley. The belt should flex approximately 10 mm (0.4 in.) | 5 |  <br>  | | | |
| 2 | To adjust the belt, loosen the alternator adjustment plate bolts, adjust the belt tension and retighten the bolts. | 10 | wrench<br>screw driver | 1-pc<br>1-pc | rag | 1/4 kg |
| 3 | Replace the belts if it is badly worn, greasy and severely cracked.<br>Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable and if it is frayed or has pieces of material missing. | 5 | | | | |
| 4 | Install the new belts, make sure all pulley must be aligned. The grooves, bearings, shafts are in working order. Brackets are securely clamped. If damaged, replace. | 15 |  <br>  | | fan belt | 1-pc |
| 5 | Repeat activity nos. 1 and 2 | 15 |  | | | |
| | Reminder: Check/adjust the tension of new belts at 50 hours intervals until tension is stabilized and thereafter, every 250 hours. | | | | | |
| | Total | 50 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

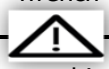
Maintenance Activity: PM 3 9.6. Fuel filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: Exchange filter after waiting for engine to cool. Be careful of fire hazards. Do not smoke.<br>Locate fuel filter inside engine compartment. Position a small container under the filter. | 2 | | | container | 1/2 pail |
| | | | | | rag | 1/4 kg |
| 2 | Unscrew fuel filter from head assembly. Discard fuel filter properly. | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| 3 | After cleaning filter head, install new fuel filter. Screw filter on head until gasket contacts head, and turn filter 1/2 turn more with a filter wrench.<br>Note: Coat fuel filter gasket with fuel and fill fuel filter with clean fuel. This will help reduce fuel system priming. | 5 | filter wrench | 1-pc | new fuel filter | 1-pc |
| | | | | | fuel oil | as stated |
| 4 | If the fuel filter has been replaced, air may need to be bleed using the following FUEL SYSTEM PRIMING:<br>Loosen plug on top of the fuel filter head. | 3 | | | | |
| 5 | Unscrew and pump the hand operated priming pump by the fuel injection pump. Pump priming pump until fuel is present at plug hole in fuel filter head. | 5 |  <br>  | | | |
| 6 | Tighten plug in fuel filter head. | 1 | | | | |
| 7 | Continue to pump the priming pump until a strong resistance is felt. Screw the priming pump knob back into housing to lock the plunger. | 3 |  | | | |
| 8 | Start engine and look for signs of leaks. Repeat procedure if necessary. | 3 |  | | | |
| | Total | 25 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3 9.7. Air-conditioning system: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: When a leak occurs, dirt will accumulate in the area where the leak is. | | | | | |
| 1 | All service and inspection of air-conditioning system should be performed with the starter switch in the "O" (Off) position. | 1 | | | | |
| 2 | Check the hoses for damage and cracks. | 1 |  | | | |
| 3 | Inspect the condenser for dust and debris. Clean if necessary. | 2 |  | | detergent<br>water | as stated |
| | | | | | rag | 1/4 kg |
| 4 | Push the "A/C" switch on in order to energize the magnetic clutch. Check the magnetic clutch for dirt and interference. | 2 | | | | |
| 5 | At correct belt tension, it should be possible to depress the belt approximately 10 mm (0.4 in.). Adjust if necessary. | 2 | wrench<br>  <br>screw driver | 1-pc<br>1-pc | | |
| 6 | If the unit is equipped with an air filtration system which filters out dirt and dust particles from air being circulated into the operator's cabin, clean the air-conditioning outer and inner filters. | 5 | | | | |
| 7 | Open the door in the left front of the machine, then remove the cover by loosening the four wing bolts. | 5 |  | | | |
| 8 | Remove the outer filter, then the inner filter and inspect for any damage. If the filter is damaged replace with a new one. | 2 | | | | |
| 9 | Use compressed air to clean the filters. If the filter is very dirty, use a mild soap or detergent and water to clean it. | 5 |  | | compressed air | as stated |
| 10 | If water was used, be certain the filters are completely dry. Install the filters and assemble it in reverse order. | 5 | | | | |
| | Total | 30 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3 9.8. Alternator assembly: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 | | | | |
| 2 | Disconnect the battery terminals | 2 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the alternator assembly | 30 |  | | | |
| 4 | Overhaul and clean | 40 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease, bushing for wear. Replace if necessary. | 5 | | | | |
| 6 | Assemble the alternator and install. If possible, check the alternator ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 7 | Check the alternator belt tension by pressing downwards on the belt, midway between the fan pulley and alternator pulley. | 5 |  | | | |
| 8 | Adjust the belt tension by loosening the alternator adjustment plate bolts. The belt should flex approximately 10 mm (0.4 in.) Retighten the bolts. | 5 |  | | | |
| 9 | Run the engine and check for any jarring noise and excessive vibration. | 2 |  | | | |
| | Total | 120 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3 9.9. Starting motor: check/inspect

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: The battery disconnect switch must always remain turned on while the engine is running. When welding, servicing of electrical system or after finishing work, for safety the battery disconnect switch should be turned off. | | | | | |
| 1 | Inside the battery box, turn off the battery disconnect switch. | 1 |  | | | |
| 2 | Disconnect the battery terminals | 1 | wrench | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | ampere volt multi-tester | 1-set | | |
| 3 | Pull down the starting motor | 30 |  | | | |
| 4 | Overhaul and clean | 25 | | | multi-purpose grease | 250 gm |
| | | | | | 1-inch paint brush | 1-pc |
| | | | | | sand paper | 1-pc |
| | | | | | rag | 1/4 kg |
| 5 | Check the carbon brush for wear; bearing may have run out of grease; bushing for wear. Replace if necessary. | 1 |  | | | |
| 6 | Assemble the starting motor and install. If possible, check the starting motor ratings on bench testing machine. | 30 | bench testing machine | 1-set | | |
| 9 | Run the engine and check for any jarring noise and vibration. | 2 |  | | | |
| | Total | 90 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3 9.10. Roller drum scraper: adjust

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | If the scrapers are worn to such an extend that the scrapers do not rub against the drum, it must be adjusted at the clamp connection | | | | | |
| 1 | Switch off diesel engine and remove ignition key | 1 |  | | | |
| 2 | Loosen clamp connection | 10 | wrench | 1-pc | rag | 1/4 kg |
| 3 | Push scraper to the roller drum | 1 | | | | |
| 4 | Tigthen the clamp connection | 10 | | | | |
| 5 | To apply the scrapers against the drum, throw the stop lever to I position | 8 |  | | | |
| | When installing a new scraper, make certain that the screws are at the lowqest positions in the elongated holes | | | | | |
| | Total | 30 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3 9.11. Roller tyre scraper: adjust

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | If the scrapers are worn to such an extend that the scrapers do not rub against the tyre with the stop screw loose, it must be adjusted at the clamp connection | | | | | |
| 1 | Switch off diesel engine and remove ignition key | 1 |  | | | |
| 2 | Loosen the stop lever and lift the scraper console to the stop. Tighten the stop lever | 5 | wrench | 1-pc | rag | 1/4 kg |
| 3 | Loosen clamp connection | 5 | | | | |
| 4 | Push scraper to the tyres. Establish a clearance of 10 mm between the tryres and the scrapers | 5 | | | | |
| 5 | Tighten clamp connection | 5 |  | | | |
| 6 | Loosen the stop lever for a short time and retighten it again | 10 | | | | |
| | When installing a new scraper, make certain that the screws are at the lowest positions in the elongated holes | | | | | |
| | Total | 30 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3

9.12. Roller drum damping elements (vibration): check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Vibration oscillations can spread in the ground over a wide area and are generated in circles around the roller drum and effect also the deeper ground. Do not switch in vibration function when driving across inclines or on underground | | | | | |
| 1 | Switch off diesel engine and remove ignition key | 1 |  | | | |
| 2 | Check the damping elements of the roller drum suspension for cracks. | 4 | screw driver | 1-pc | rag | 1/4 kg |
| 3 | If the damping element is damaged, replace with new one | 10 |  | | | |
| | Total | 15 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 3 9.13. Water separator element: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Turn priming pump counterclockwise to unlock the plunger then turn shut-off valve clockwise 90 degrees | 1 | wrench | 1-pc | | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| 2 | Place a suitable sized container under the drain hose | 1 | | | drain pan | 1-pc |
| | | | | | rag | 1/4 kg |
| 3 | Open drain valve and drain the fuel from the water separator, afterwards close the drain valve | 5 | | | | |
| 4 | Disconnect sensor connector | 1 | | | | |
| 5 | Remove bowl assembly and set it aside for installation and remove filter element | 5 | filter wrench | 1-pc | | |
| 6 | Clean the inside surface of the filter head and of the bowl; check the condition of the O-ring. Replace the O-ring if damaged | 30 | | | | |
| 7 | Apply a small amount of fuel to the gasket of the new filter; install the new filter by hand until it contacts the mounting surface. Tighten the filter | 30 | | | new filter | 1-pc |
| | | | | | fuel oil | as stated |
| 8 | Install bowl assembly; reconnect sensor connector | 5 | | | | |
| 9 | Turn shut-off valve counterclockwise 90 degrees | 2 | | | | |
| 10 | Bleed the system | 10 | | | | |
| | Total | 90 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 4 9.14. Hydraulic oil: change

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Warning! Take care when changing the oil. Hot oil can cause burns on unprotected skin | | | | | |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 | | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 3 | wrench | 1-pc |  | |
| | | | screw driver | 1-pc | | |
| | | | plier | 1-pc | rag | 1/4 kg |
| 4 | Open the cover after removing the screws and remove O-ring then pull out the strainer. | 20 | | | | |
| 6 | Place a suitable container under the drain plug of hydraulic tank | 1 | | | drain pan | 1-pc |
| 7 | Remove the drain plug | 3 | | | | |
| 8 | Drain the oil into the container. Wait till the last drop of oil for few minutes | 20 |  | | | |
| 9 | Reinstall the drain plug | 5 | | | | |
| 10 | Clean the magnetic rings of strainer thoroughly. Check O-ring and if damaged, replace it with a new one and reinstall the strainer. | 5 | | | compressed air | as stated |
| 11 | Refill oil and reinstall the cover | 20 | | | hydraulic oil | as stated |
| 12 | Check the oil in the sight gauge. | 1 |  | | | |
| 13 | Perform test run to check for any leaks | 10 | | | | |
| | Total | 90 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 4 9.15. Hydraulic pilot filter: replace

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Park the equipment on a firm, level ground | 1 |  | | | |
| 2 | Lower upper attachments to the ground, move the control lock out lever down to lock the system securely and shut down the engine | 1 |  | | | |
| 3 | Open access. Release the internal pressure of the hydraulic tank through air breather | 2 | | | | |
| 4 | Place a container under the pilot filter. | 1 | | | drain pan | 1-pc |
| 5 | Unscrew/remove the filter bowl or canister, O-ring and inner element.<br>Note: The bowl/canister will be filled with oil. Use caution when removing this assembly. | 5 | wrench<br>  <br>plier | 1-pc<br>1-pc | rag | 1/4 kg |
| 6 | Install a new inner filter element and O-ring.<br>Apply a small amount of oil around the entire O-ring. | 5 | | | pilot filter element<br>o-ring<br>hydraulic oil | 1-pc<br>1-pc<br>as stated |
| 7 | Reinstall the filter bowl/canister. | 2 | | | | |
| 8 | After changing the pilot filter element, vent air from pump and check level of hydraulic oil tank. | 3 |  | | | |
| | Total | 20 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 4 9.16. Hydraulic System: venting and priming

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Note: If pump is run without sufficient oil in the main hydraulic pump, damage can occur. Always vent pump of air after draining hydraulic system.<br>With the engine stopped, remove vent plug to see if any oil is present. | 3 | wrench  | 1-pc | rag | 1/4 kg |
| 2 | If oil is not present, fill pump with oil thru port. | 5 | | | hydraulic oil | as stated |
| 3 | Install vent plug first. | 2 | | | | |
| 4 | Start engine and run it for several minutes at low idle engine speed. This will pressurize the hydraulic oil tank and system. | 5 |  | | | |
| 5 | Slowly loosen vent plug several turns, until hydraulic oil flows out of plug. This shows that air has been released. Tighten the plug. | 5 |  | | | |
| | Total | 20 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 4

9.17. A. Check/adjust engine valve clearance

B. Check/retight cylinder head bolt

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| 1 | Open access | 1 | | | | |
| 2 | Remove parts/accessories to give way for the adjustment of engine valve | 5 | flat screw driver | 1-pc |  | |
| | | | cross screw driver | 1-pc | | |
| | | | plier | 1-pc | | |
| | | | combination wrench | 1-pc | | |
| 3 | Remove valve cover | 5 | | | rag | 1/4 kg |
| 4 | Check/untorque cylinder head bolt | 15 | | | | |
| 5 | Adjust valve clearance | 30 | feeler gauge | 1-set | | |
| 6 | After valve clearance adjustment, repeat the procedure in reverse order | 25 | | | sealant | 1-tube |
| | | | | | gasket | 1-set |
| 7 | Start the engine and check for leak and any distorting noise | 5 |  | | | |
| | Note: Follow procedure of engine valve clearance/adjustment according to manufacturer's guide and standards | | | | | |
| | Total | 86 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 4 9.18. Turbocharger: check/clean

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Important: Leave the engine running at low idling speed for at least a minute after start and a few minutes before it is stopped. This is to safeguard the lubrication of the turbocharger. | | | | | |
| 1 | Remove the oil filler pipe and drain pipe, then remove the intake air pipe connector and blower housing so that the blower impeller can be seen. | 10 | wrench<br>screw driver<br>plier | 1-pc<br>1-pc<br>1-pc |  | |
| 2 | NOTE: excessive carbon or oil sludge adhering to turbocharger blower may lead to performance deterioration and possible damage.<br>Using light oil as a cleaning agent, remove the carbon, sludge, and other dirt from the blower impeller. | 5 |  | | light oil<br>rag | as stated<br>1/4 kg |
| 3 | Pour in light oil thru the turbocharger oil filler and rotate the blower impeller several times to wash out the sludge. | 5 | | | | |
| 4 | Rotate the impeller by hand at least one turn at speed to check that there is contact noise or catching inside. If the impeller does not turn smoothly, contact the equipment manufacturer for repair or replacement. | 10 |  | | | |
| 5 | If there is no abnormality, dry off the light oil with compressed air after inspection, then add engine oil. | 5 | | | compressed air | as stated |
| 6 | Reassemble in reverse order. | 20 | | | | |
| 7 | Run the engine and if any jarring noises be heard and shows unusual vibration, it must be reconditioned or changed immediately. | 5 |  <br>  | | | |
| | Total | 60 | | | | |

## 9.0. Vibratory Roller

DPWH Property Code: Z18

Maintenance Activity: PM 4 9.19. Air conditioner refrigerant: check

| Activity Number | Activity | Duration (minutes) | Tools | | Materials | |
|---|---|---|---|---|---|---|
| | | | Tool Class | No. of unit | Material | No. of unit |
| | Note: Inhaling air conditioner refrigerant gas thru a lit cigarette or other smoking method or inhaling fumes released from a flame contacting refrigerant gas can cause bodily harm or death | | | | | |
| 1 | Run engine at about 1,800 rpm. Operate for a minimum of ten (10) minutes to stabilize the air conditioning system | 10 |  | | | |
| 2 | Press the "HI" fan speed switch to set maximum airflow<br>Put the temperature control switch in maximum cooling position<br>Press the "Internal Air Circulation switch | 1 | | | | |
| 3 | Compare the flow of bubbles in the sight glass of receiver dryer in the following table: | 1 |  | | | |
| 4 | Amount of refrigerant: Almost clear. Any bubbles disappear. Normal; No bubbles are seen. High. Withdraw the system with the correct amount of HFC 134a refrigerant; A flow of bubbles is visible. Low. Charge the system with the correct amount of HFC 134a | 8 | | | rag | 1/4 kg |
| | Important: Overfilling refrigerant can cause dangerous high-pressure and poor cooling action; and low refrigerant level can cause compressor damage | | | | | |
| | Total | 20 | | | | |

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- Solar 180W-V Wheel Excavator, DOOSAN
- DX225LCA Crawler Excavator, Volvo Construction Equipment
- Super 1100-2/1300-2 Road Paver, Vogele/Wirtgen
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