

# ELPO Pendulum System - Preventive Maintenance

## ⚡ ⚠ WARNING ⚠ ⚡

- Before attempting any maintenance on this equipment all involved personnel should follow plant internal regulations along with any state, federal, or province regulations.
- The maintenance inspection, checks, and procedures listed in the preventive maintenance tables are assumed with the gated area electrically locked out.
- Before attempting any maintenance or service operation, make sure that:
  - You do not begin any repair procedure until the proper shutdown procedures and the appropriate power lockout procedures have been applied.
  - The system is de-energized; main electrical switches are open.

## ⓘ NOTICE ⓘ

The maintenance inspection, checks, and procedures listed in the preventive maintenance tables and corrective procedures should be performed when the equipment is immobilized and locked out.

This section contains preventive maintenance schedules with recommended lubrication intervals. Assemblies in this section include:

- *Pendulum Inlet Table*
- *Pendulum Drive Assembly*
- *Pendulum Take-Up*
- *Pendulum Chain*

## Daily Checks

### Observe

- Obvious signs of damage to the equipment. Listen to the conveyors - an unusual sound like screeching, grinding, or whining, are indicators of a problem.
- Damage or noticeable wear on the carrying and guide rollers.
- Signs of oil leaks on the equipment or on the floor below any gearbox.

### Evaluate

- If you notice any of the above issues, evaluate the cause and the risk involved.

### Act

- Schedule or perform necessary maintenance repairs as appropriate.

## Mechanical Preventive Maintenance - key

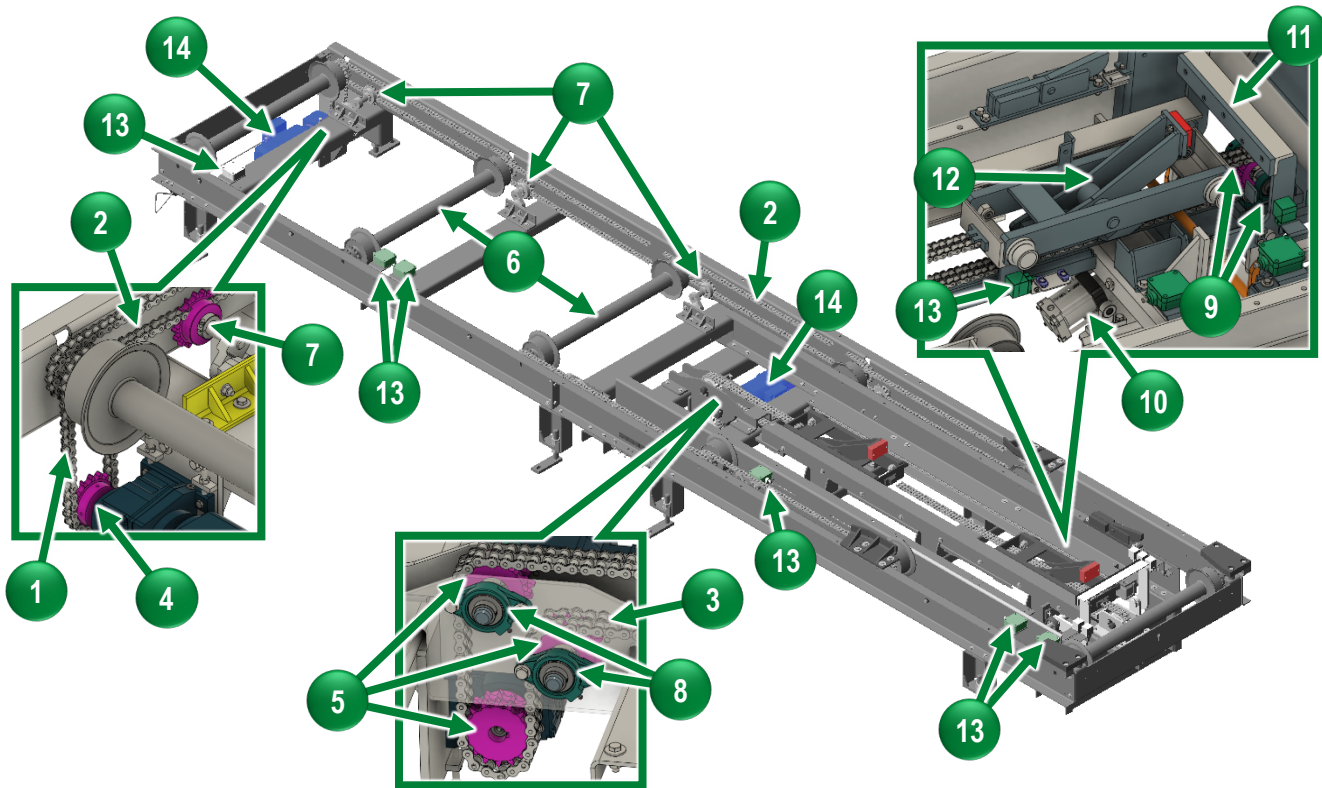
Preventive Maintenance tables consists of:

A
B
C
D
E

Item No.	Item Name	Required Operation	Description	Interval
1	Gearmotor	Inspection	<ul style="list-style-type: none"> <li>Visually inspect gear unit for oil leakage. Check for oil film or grease deposits – clean if necessary.</li> <li>Check mounting hardware, check paint marks...</li> </ul>	<b>6 Months</b>

- A. Indicates the callout number associated on the schematic drawing, image or figure.
- B. Component name within the assembly.
- C. Required preventive maintenance operation - i.e., inspection or lubrication.
- D. Detailed description of the operation(s) to be performed.
- E. Recommended frequency of PM task.

# Inlet Power Roll Table Preventive Maintenance Items



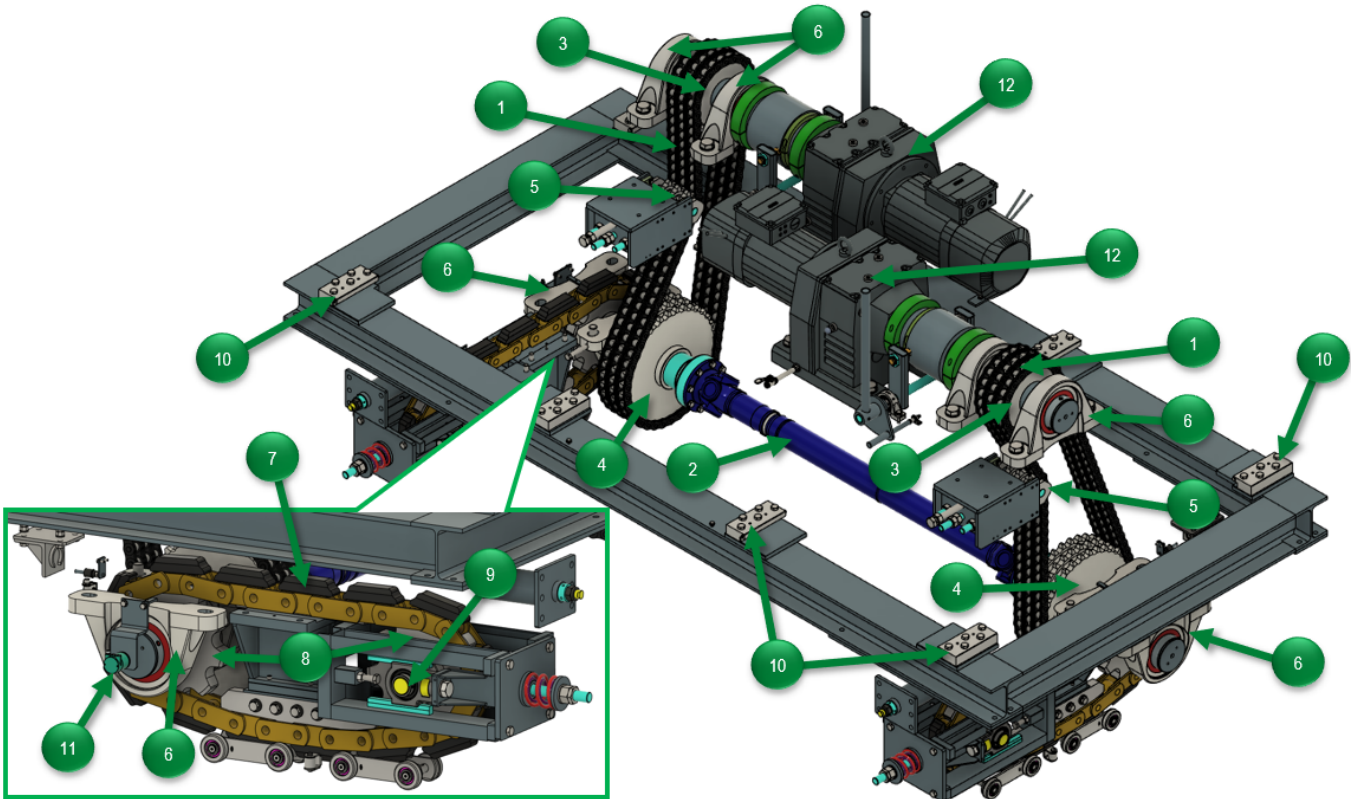
Item No.	Item Name	Required Operation	Description	Interval
1	Roller Drive Chain	Inspection	<ul style="list-style-type: none"> <li>Check for sufficient tension, if necessary, replace the chain.</li> <li>Check for stretched links.</li> </ul>	<b>3 Months</b>
2	Roller Driven Chain	Inspection	<ul style="list-style-type: none"> <li>Index the table. Check that chains run freely and without excessive noise</li> <li>Check for stretched links.</li> </ul>	
3	Pusher Chain	Inspection	<ul style="list-style-type: none"> <li>Check for sufficient tension, if necessary, replace the chain.</li> <li>Check for stretched links.</li> </ul>	
4	Roller Motor Drive Sprocket	Inspection	<ul style="list-style-type: none"> <li>Check secure mounting on drive shaft.</li> <li>Check for proper alignment of teeth with chain.</li> <li>Check for wear on teeth.</li> </ul>	
5	Pusher Motor Sprockets	Inspection	<ul style="list-style-type: none"> <li>Check secure mounting on drive shaft.</li> <li>Check for proper alignment of teeth with chain.</li> <li>Check for wear on teeth.</li> <li>Check tension of dual link chain and adjust accordingly.</li> </ul>	

Item No.	Item Name	Required Operation	Description	Interval
6	Rollers	Inspection	<ul style="list-style-type: none"> <li>Check rollers for bearing clearance, damage, and wear.</li> <li>Abrasion should not exceed 5 mm on diameter (minimum diameter is 120 mm), unevenness at the surface maximum 3 mm.</li> </ul>	<b>3 Months</b>
7	Chain Tension Unit	Inspection	<ul style="list-style-type: none"> <li>Observe for smooth operation.</li> <li>Check for proper alignment with other pulleys and for any broken cogs.</li> </ul>	
8	Flange Bearings	Inspection	<ul style="list-style-type: none"> <li>Check mounting hardware for proper tightness. Look for paint mark alignment on hardware – retighten if necessary.</li> <li>Check for housing damage.</li> <li>Check for binding or sticking in the bearing housing.</li> <li>Check alignment of the shaft between bearings.</li> </ul>	
		Lubrication	<ul style="list-style-type: none"> <li>Bearing is “Lubed for Life”</li> </ul>	
9	Pillow Block Bearing	Inspection	<ul style="list-style-type: none"> <li>Check mounting hardware for proper tightness. Look for paint mark alignment on hardware – retighten if necessary.</li> <li>Check for housing damage.</li> <li>Check for binding or sticking in the bearing housing.</li> <li>Check the alignment of the shaft between bearings.</li> </ul>	
		Lubrication	<ul style="list-style-type: none"> <li>Bearing is “Lubed for Life”</li> </ul>	
10	Air Cylinder	Inspection	<ul style="list-style-type: none"> <li>Check cylinder fittings and hoses for leaks and/or damage.</li> </ul>	
11	Skid Stop	Inspection	<ul style="list-style-type: none"> <li>Check for wear, and/or damage. Replace as necessary.</li> </ul>	

Item No.	Item Name	Required Operation	Description	Interval
12	Skid Pusher	Inspection	<ul style="list-style-type: none"> <li>• Check that it is free-moving and without obstruction.</li> <li>• Inspect pusher bumper for excessive wear.</li> </ul>	3 Months
13	Proximity Switches	Inspection	<ul style="list-style-type: none"> <li>• Check for proper operation and secure mounting.</li> <li>• Check that cables are connected securely.</li> </ul>	
14	Gearmotor	Inspection	<ul style="list-style-type: none"> <li>• Use the oil sight glass or remove the oil level plug to check the level of oil.</li> <li>• Check that all electrical connections are secure. If loose, tighten.</li> <li>• Check the electrical connections for evidence of arcing. If evidence of arcing has occurred, replace the damaged connection.</li> </ul>	
		Lubrication	<ul style="list-style-type: none"> <li>• Replace the oil in the gearbox after 3 years of use.</li> </ul>	36 Months

# Pendulum Drive System Preventive Maintenance Items

(Pre-Treatment, Pre-Treatment Intermediate Drive & Electro Dip Drive)

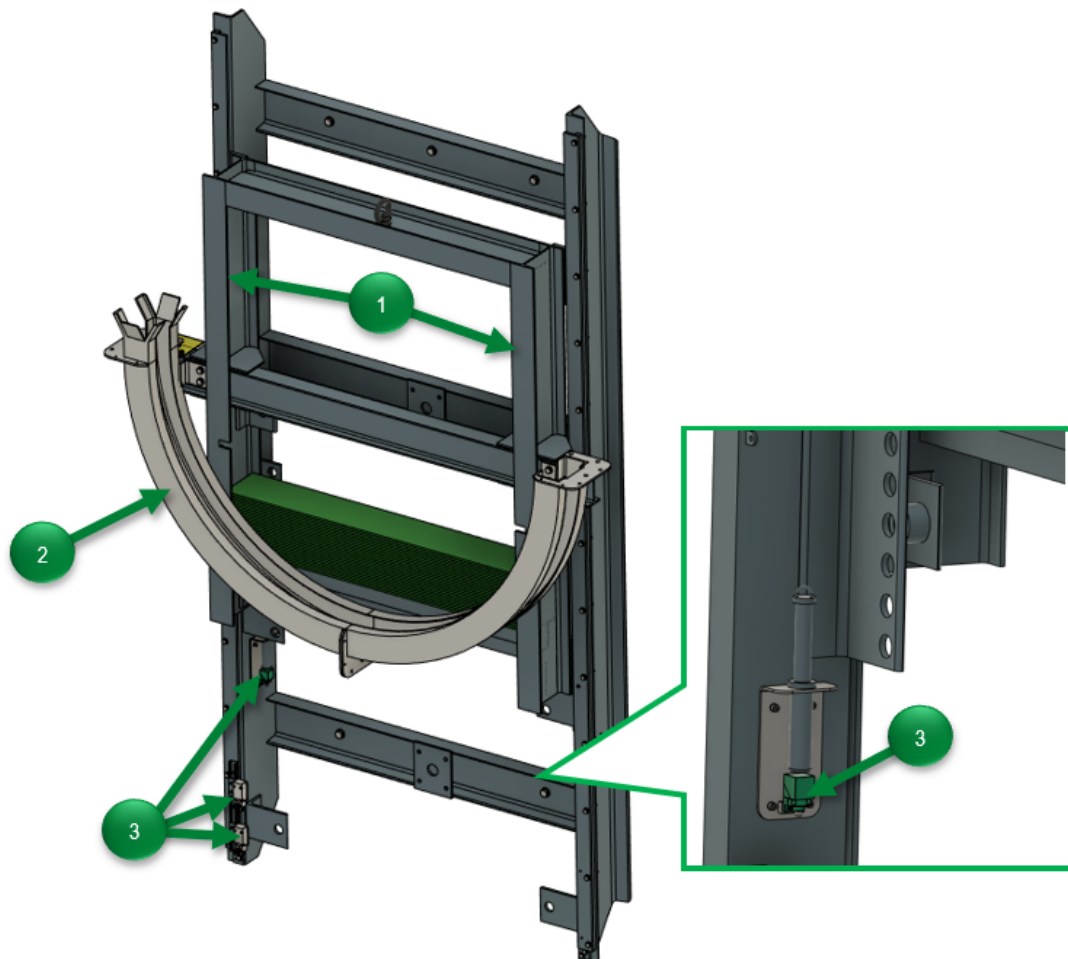


Item No.	Item Name	Required Operation	Description	Interval
1	Triple Chain Loop	Inspection	<ul style="list-style-type: none"> <li>Check for sufficient tension, if necessary, adjust the tension.</li> <li>Check for stretched links.</li> <li>Check that the chain is aligned with sprocket teeth.</li> </ul>	<b>3 Months</b>
2	Cardan Shaft	Inspection  Lubrication	<ul style="list-style-type: none"> <li>Inspect all connections and make sure they are secure, check all paint marks. Retighten as necessary.</li> <li>Inspect shaft and flanges for any cracks or damage, replace if damage is found.</li> <li>Grease directly inside U-Joint. To apply grease, carefully pump grease into the zerk fitting.</li> <li>U-Joint is fully lubricated when you see grease leak from all four seals. Clean off all excess grease.</li> </ul>	

Item No.	Item Name	Required Operation	Description	Interval
3	Triple Chain Drive Sprocket	Inspection	<ul style="list-style-type: none"> <li>Check the tooth side and depth for wear.</li> <li>If abnormal wear present, examine sprockets for misalignments or cross-settings.</li> </ul>	<b>3 Months</b>
4	Triple Chain Driven Sprocket	Inspection	<ul style="list-style-type: none"> <li>Check the tooth side and depth for wear.</li> <li>If abnormal wear is present, examine sprockets for misalignments or cross-settings.</li> </ul>	
5	Triple Chain Tensioner	Inspection	<ul style="list-style-type: none"> <li>Check the spring for damage. Replace as necessary.</li> </ul>	
6	Pillow Block Bearings / Take-Up Bearings	Inspection	<ul style="list-style-type: none"> <li>Check mounting hardware for proper tightness. Look for paint mark alignment on hardware – retighten if necessary.</li> <li>Check for housing damage.</li> <li>Check for binding or sticking in the bearing housing.</li> <li>Check the alignment of the shaft between bearings.</li> </ul>	
		Lubrication	<ul style="list-style-type: none"> <li>Grease directly using manifold. To apply grease, carefully pump grease into the zerk fitting.</li> </ul>	
7	Caterpillar Chain	Inspection	<ul style="list-style-type: none"> <li>Inspect chain for abrasion or wear on the dogs.</li> <li>Check dogs seat properly with pendulum chain.</li> <li>Check for smooth and free movement of chain.</li> </ul>	
8	Caterpillar Sprockets	Inspection	<ul style="list-style-type: none"> <li>Check the tooth side and depth for wear.</li> <li>If abnormal wear is present, examine sprockets for misalignments or cross-settings.</li> </ul>	
9	Caterpillar Chain Tensioner	Inspection	<ul style="list-style-type: none"> <li>Check proper tension is present.</li> </ul>	
10	Platform Slide Blocks (8)	Inspection	<ul style="list-style-type: none"> <li>Check block for abrasion or wear.</li> </ul>	
		Lubrication	<ul style="list-style-type: none"> <li>Grease directly using manifold. To apply grease, carefully pump grease into the zerk fitting.</li> </ul>	
11	Encoder	Inspection	<ul style="list-style-type: none"> <li>Check encoder for secure mounting and successful operation.</li> </ul>	

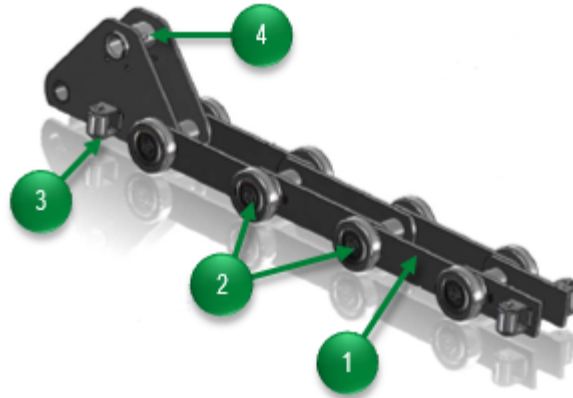
Item No.	Item Name	Required Operation	Description	Interval
12	Gearmotor	Inspection	<ul style="list-style-type: none"> <li>Use the oil sight glass or remove the oil level plug to check the level of oil.</li> <li>Check that all electrical connections are secure. If loose, tighten.</li> <li>Check the electrical connections for evidence of arcing. If evidence of arcing has occurred, replace the damaged connection.</li> </ul>	<b>3 Months</b>
		Lubrication	<ul style="list-style-type: none"> <li>Replace the oil in the gearbox after 3 years of use.</li> </ul>	<b>36 Months</b>

# Pendulum Take-Up Preventive Maintenance Items



Item No.	Item Name	Required Operation	Description	Interval
1	Slide Guides	Inspection	<ul style="list-style-type: none"> <li>Inspect the guides are moving freely and there is no excessive wear. Replace as needed.</li> <li>Listen for noise while running.</li> </ul>	3 Months
2	Conveyor Chain Track	Inspection	<ul style="list-style-type: none"> <li>Inspect the conveyor chain track. Be sure chain is moving freely around the curve.</li> </ul>	
3	Sensors	Inspection	<ul style="list-style-type: none"> <li>Inspect the sensors for secure mounting, proper position, and function. Do not move sensors.</li> </ul>	12 Months

# Pendulum Chain Preventive Maintenance Items

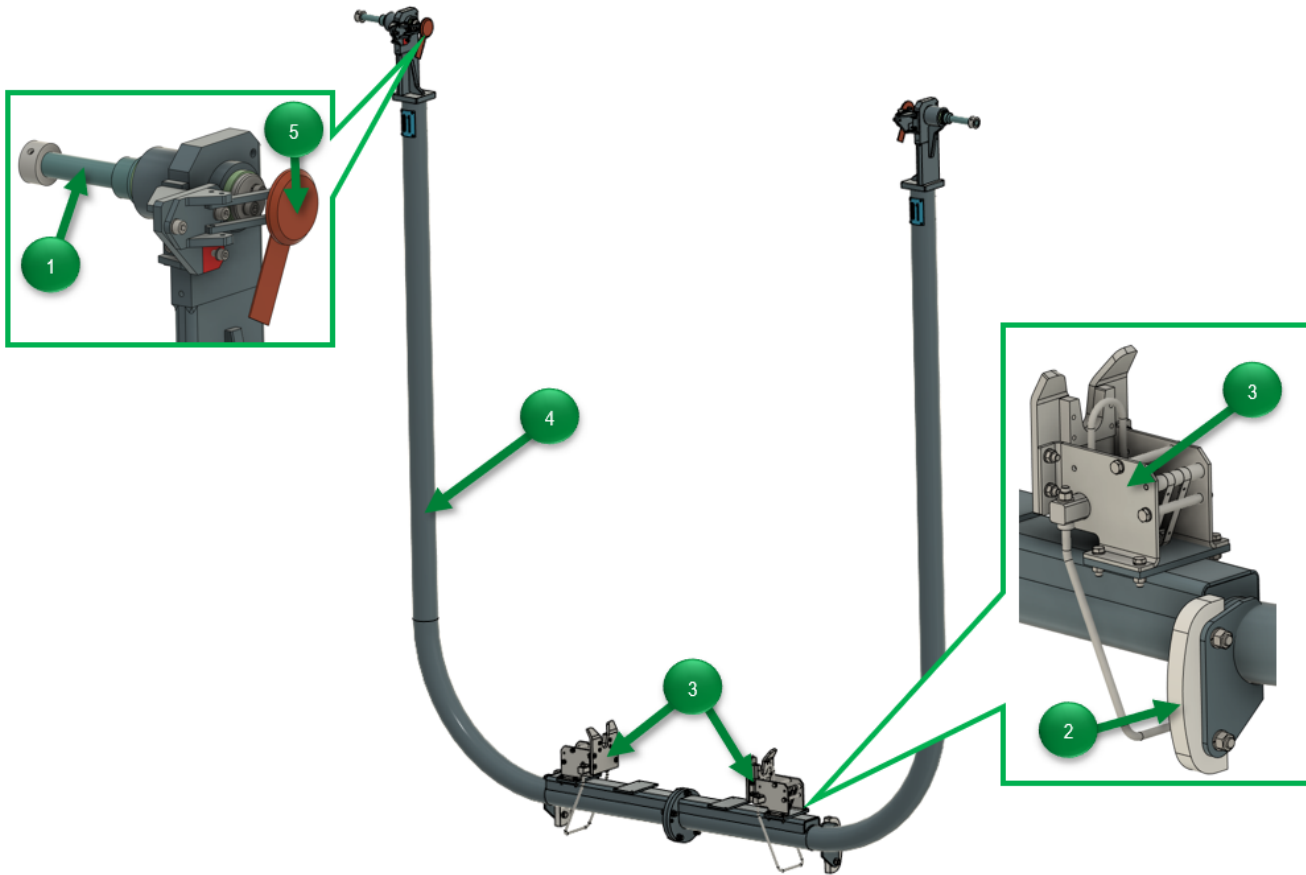


Item No.	Item Name	Required Operation	Description	Interval
1	Pendulum Chain	Inspection	<ul style="list-style-type: none"> <li>Inspect transmission chain pins, axles, and connections for wear.</li> <li>Replace chain or components as necessary.</li> </ul>	<b>3 Months</b>
2	Bearings	Inspection	<ul style="list-style-type: none"> <li>Inspect all the roller bearings for efficiency and noise.</li> <li>Replace if noisy at the chain inspection station.</li> </ul>	
3	Side Guide Rollers	Inspection	<ul style="list-style-type: none"> <li>Check for wear and free rotation.</li> </ul>	
4	Pendul Bushing Mount	Inspection	<ul style="list-style-type: none"> <li>Check the bushing mount for damage or wear.</li> <li>Replace chain or components as necessary.</li> </ul>	
		Lubrication	<ul style="list-style-type: none"> <li>Grease directly using manifold. To apply grease, carefully pump grease into the zerk fitting.</li> </ul>	
5	Auto-lubricator (Not shown)	Inspection	<ul style="list-style-type: none"> <li>Check containers to verify lubricant is present.</li> <li>Check the proper function of lubrication.</li> <li>Verify the proper amount of lubricant is dispensed.</li> </ul>	

## i NOTICE i

Please refer to the ZMC documentation — *Maintenance and Use Manual ZMC W497BL-CL* — for complete maintenance and service instructions for the conveyor chain. You will find this manual in the Appendix section of this manual.

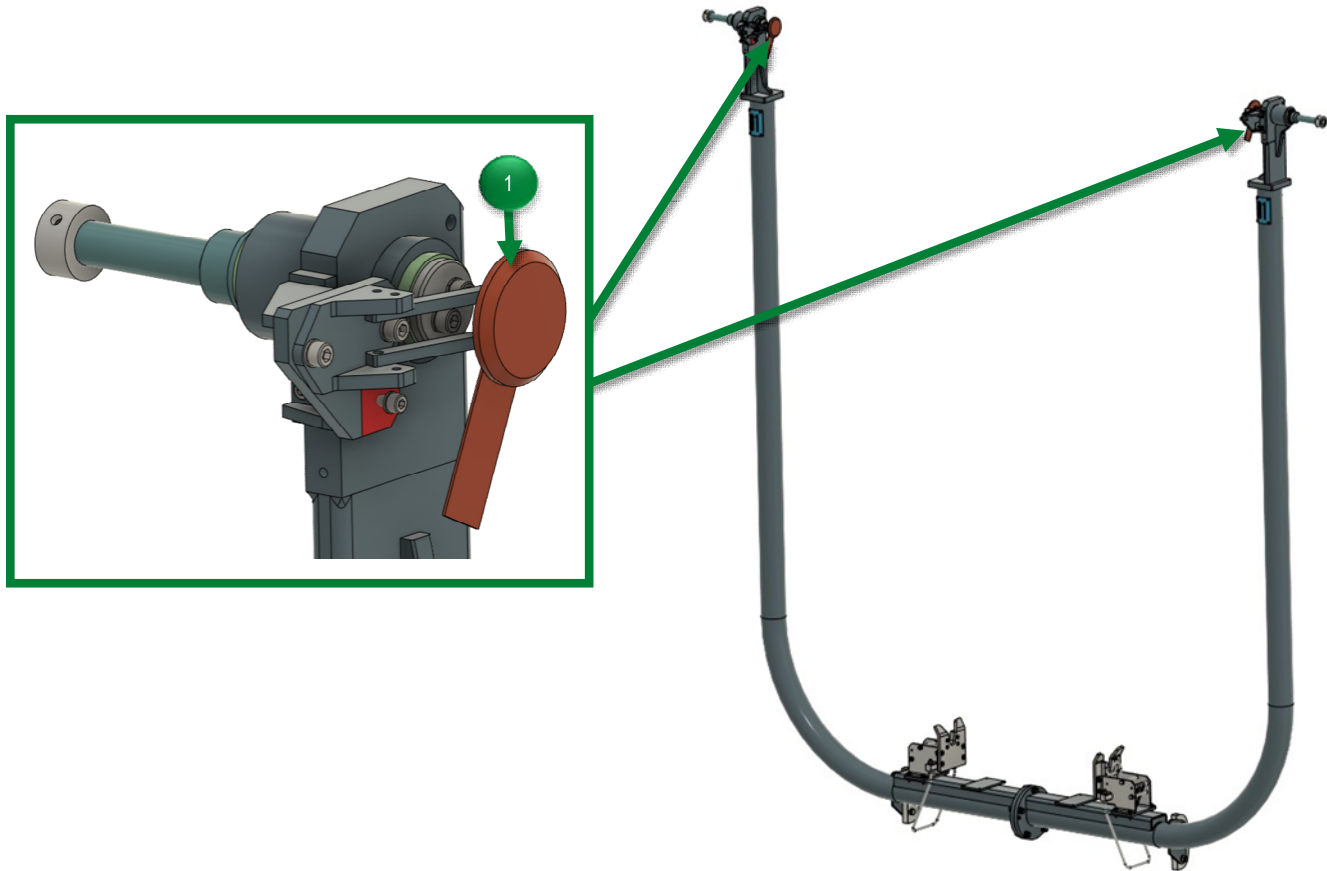
# Penduls Preventive Maintenance Items



Item No.	Item Name	Required Operation	Description	Interval
1	Connecting and Pivot Points	Inspection	<ul style="list-style-type: none"> <li>Inspect all connecting and pivot points for freedom of movement and wear.</li> </ul>	<b>3 Months</b>
2	Sliding Block	Inspection	<ul style="list-style-type: none"> <li>Check for wear. Ensure that hardware is secure. Replace if worn.</li> </ul>	
3	Locking Devices	Inspection	<ul style="list-style-type: none"> <li>Inspect locking devices for freedom of movement and function. Ensure that hardware is secure.</li> </ul>	
4	Pendul Arm	Inspection	<ul style="list-style-type: none"> <li>Inspect arms for warped condition and check details for accurate seating.</li> </ul>	
5	Current Collector*	Inspection	<ul style="list-style-type: none"> <li>See “Rougier Collector Shoes Preventive Maintenance” and “How to Assess Condition of Rougier Collector Shoes” for details.</li> </ul>	<b>Monthly</b>

\* - Current collectors are only installed in ELPO pendulum systems.

# Rougier Collector Shoes Preventive Maintenance



Current collectors (or “shoes”) on a Pendulum System are designed to maintain continuous electrical contact with a conductor rail or busbar, supplying power to the conveyor’s driving mechanisms and control systems. They are located at the top of the penduls used in the electrocoating (E-coat/ELPO) system.

The pendulum movement introduces unique mechanical stresses, including vibration, oscillation, and intermittent contact, all of which can accelerate wear.

Neglecting current collector maintenance can result in:

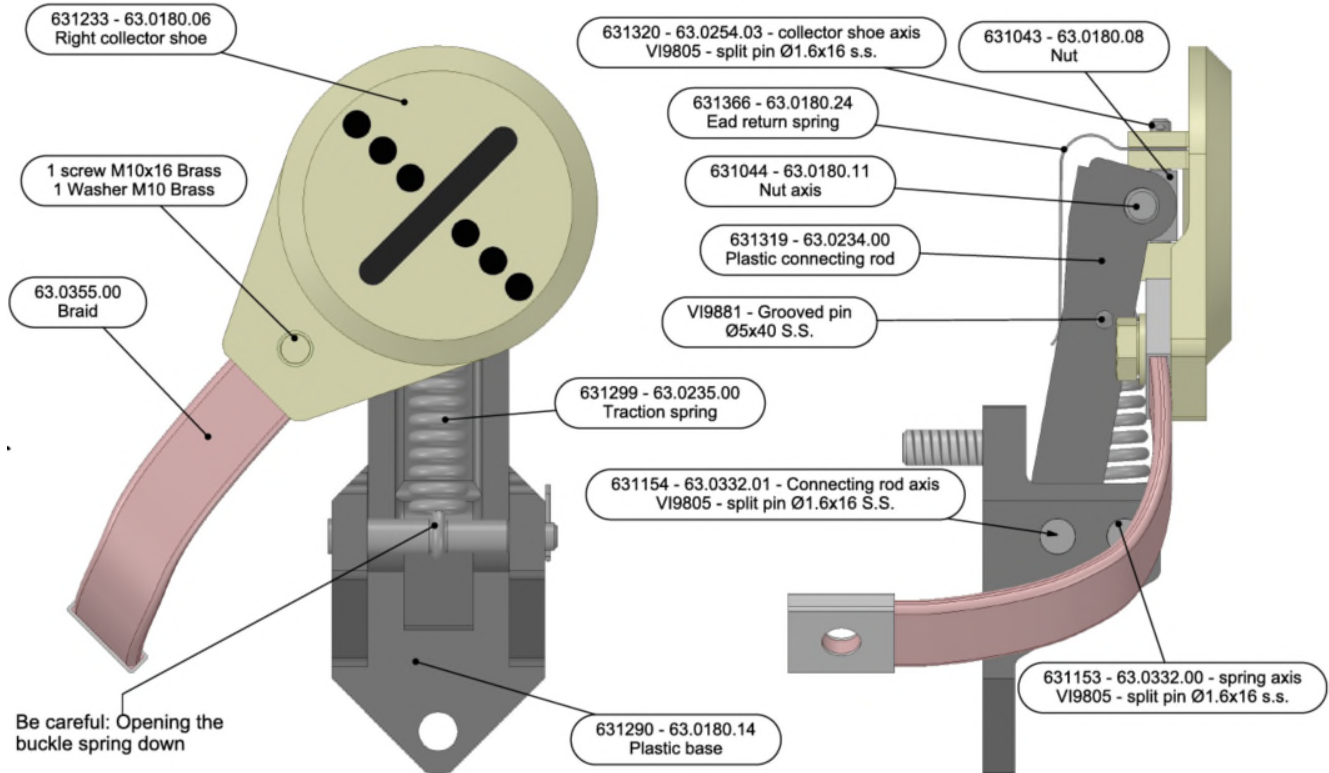
- Increased electrical resistance, leading to overheating and inefficiency
- Pitting and arcing damage to both the collector and the conductor rail
- Unexpected conveyor stoppage
- Premature failure of electrical components
- Safety hazards, including fire risk and electric shock

The following table identifies additional recommendations supplied by Rougier, the manufacturer of the collector sets, to address these potential risks proactively, extending the service life of both the current collector and the conveyor system.

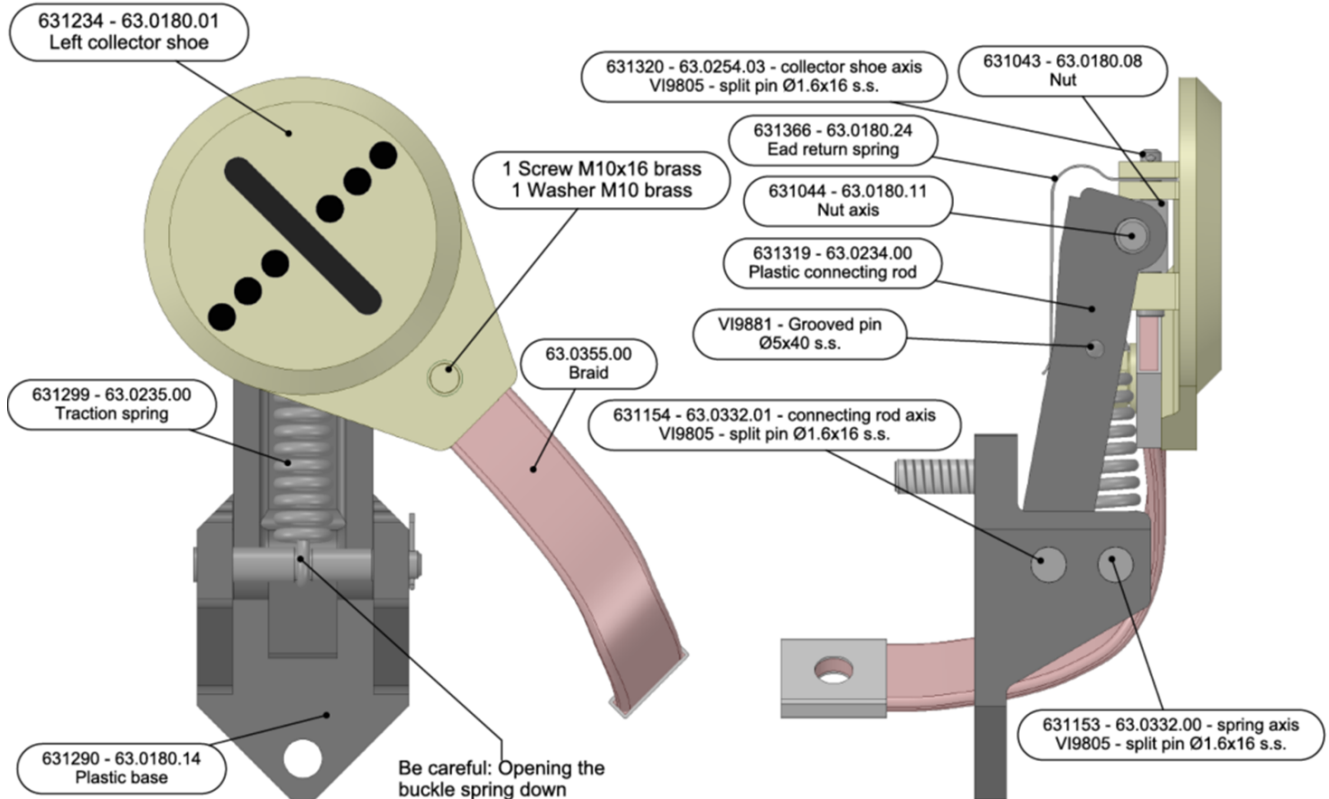
**Please note:** The information and maintenance periods suggested are indicative only. It is necessary to adapt them to suit each specific installation according to its own constraints.

Item No.	Item Name	Required Operation	Description	Interval
1	Current Collector (or Shoe)	Inspection	<ul style="list-style-type: none"> <li>• Check the condition of current collector shunts. Change all the shunts which have cuts in the copper wire or which has lost its pliability. This often occurs at the exit of bath, where there are paint projections. (Always remember to rub down the contact faces).</li> <li>• All the rubbing surfaces (rails and current collectors) are maintenance free, the film on the contact faces is a good conductor for the transit of current. Only accidental paint projections or electric flashes, occurring during operation, shall be eliminated by scraping.</li> <li>• Check the condition of current collectors' contact faces, and their thickness (not to be less than 6mm).</li> <li>• Check the presence of graphite in the collector shoes, it must be at the same level as the contact face. It is eliminated as shoes wear away.</li> <li>• Regularly verify the spring pressure and the mobility of the shoes.</li> </ul>	Monthly
		Replacement	<ul style="list-style-type: none"> <li>• Replace below as necessary:               <ul style="list-style-type: none"> <li>○ Shunts of the collector sets</li> <li>○ Current collector shoes</li> <li>○ Springs</li> </ul> </li> </ul>	As Necessary
		Inspection and Cleaning	<ul style="list-style-type: none"> <li>• Recharge the current collector shoes with graphite paste if necessary.</li> <li>• Rub down the current collector shoes.</li> <li>• Clean and rub down the rails.               <ul style="list-style-type: none"> <li>○ If sanding to remove oxidization/corrosion is necessary, then the rail must be re-greased.</li> <li>○ Rougier recommends Thermo-Lube with a maximal 100-150 gr per application.</li> </ul> </li> </ul>	2 Years

# How to Assess Condition of Rougier Collector Shoes



## Right Collector Shoe Detail



## Left Collector Shoe Detail

## Inspection Items:

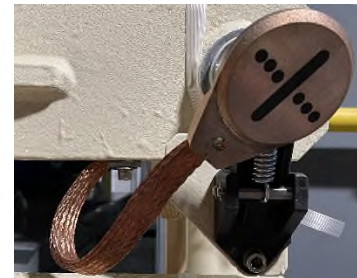
1

Examine the current collector for visible signs of wear, damage, contamination, or misalignment. Inspection intervals may vary based on operational intensity, but a monthly check is a common standard.



2

The contact surface should have a shiny and uniform appearance without signs of electrical impacts, which would indicate a malfunction of the installation.



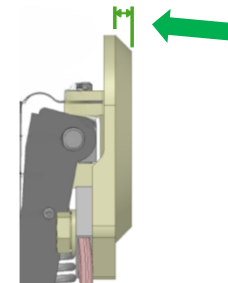
3

The graphite pad of the grooves should be present at the level of the contact surface, as its disappearance likely indicates that the collectors are overheating, which would be a sign of distress in the installation.



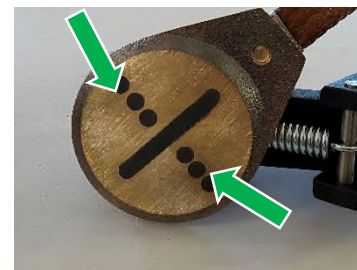
4

The collectors should maintain sufficient thickness (6mm), on one hand to avoid losing too much pressure effort, and to retain enough material to maintain their self-regeneration capacity in case of an electrical incident.

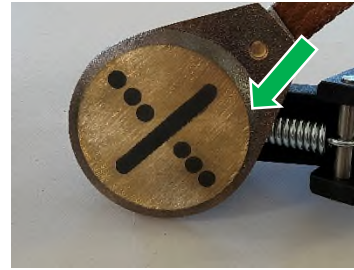


5

It may happen that the collectors do not wear evenly flat, but more on one side than the other. This is not a problem as long as, on average, they maintain the 6mm of wear (for example, 5mm on one side and 7mm on the other).



- 6 A simple way to visually assess wear is to refer to the large chamfer present on the collectors; generally, when wear causes the chamfer to disappear, it indicates that we are approaching maximum wear.



When changing the collectors, it is essential to ensure that the rail remains in good clean condition, as it can become coated with insulating paint, which will also cause issues for the collectors.

- 7 Generally, when the rail turns a greenish-gray color, it indicates that an insulating layer is forming, and it is advisable to lightly sand it to restore its full capacity for conducting electrical current.

**Please Note:** If sanding to remove oxidization/corrosion is necessary, then the rail must be re-greased. Rougier recommends Therma-Lube with a maximum of 100-150 grams per application.



## ⚠ WARNING ⚠

- In any case, signs of overheating should trigger an alert in an installation of this type.
- If you see shunts turning black, electrical flashes on the rail or on the collectors, drops of molten metal, or generally any signs of a "hot spot," it indicates that the installation is drifting, and action must be taken quickly to correct the issue.

# Gearmotor Oil Lubrication Requirements

Gearmotor oil can be determined by reading the attached data plates on each gearmotor. The examples below highlight the location to observe the required oil on the data plates. Do not mix oil grades when adding oil. Refer to the manufacturer's instruction manual for additional service requirements and technical data.

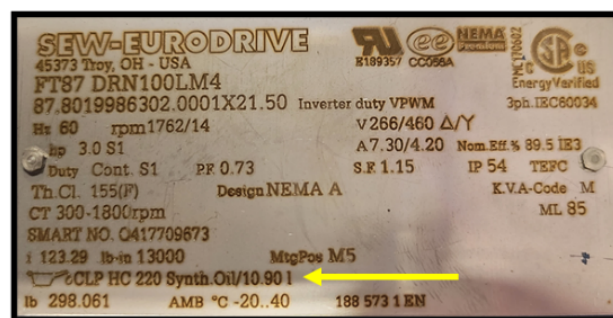
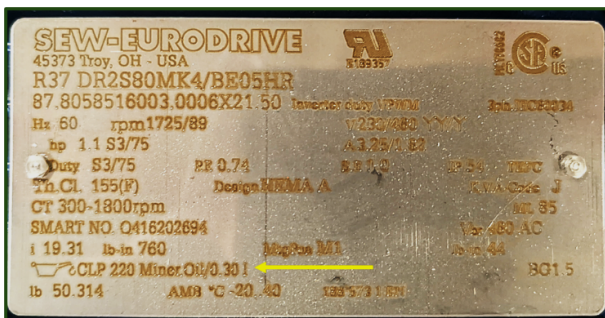
## NOTICE

If you are doing a lubricant drain and refill, Gearmotor manufacturers typically recommend that you use the same brand of lubricant originally supplied. If you are refilling the gearbox with a non-compatible lubricant, FATA recommends that you first remove any residual with a petroleum solvent or a hot water wash.

## CAUTION

Do not use trichloroethylene as a washing solvent.

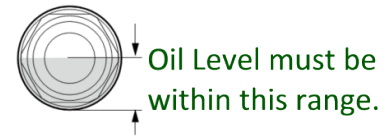
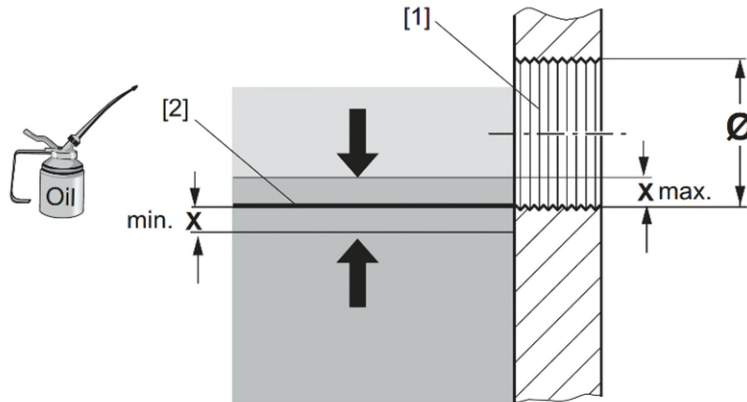
Data plates on the gearmotors identify the oil type and quantity that they use.



Gearmotor Data Plate Examples

## How to Check Oil Level of SEW Gearmotor

1. Locate the positions of the oil level plug and the breather valve.
2. If the gearmotor is equipped with an oil sight glass, you can determine the oil level according to the figure on the right.
3. If the gearmotor does not have a site glass, place a container underneath the oil level plug.
4. Slowly unscrew the oil level plug. Small amounts of oil may leak out as the permitted maximum oil level is higher than the lower edge of the oil level bore.
5. Check the oil level according to the following figure and the corresponding table.

[1] Oil Level Bore [2] Oil Level Setpoint [X] Min./Max. Oil Level

Ø Oil Level Bore	Approved fluctuation "x" of the oil level [mm]
M10 x 1	1.5
M12 x 1.5	2
M22 x 1.5	3
M33 x 2	4
M42 x 2	5

6. If the oil level is too low, proceed as follows:
  - a. Remove the breather valve from the breather bore.
  - b. Fill in fresh oil of the same type via the breather bore, up to the lower edge of the oil level bore.
  - c. Screw in the breather valve again. When doing this, please observe tightening torques.
7. Screw in the oil level plug again. When doing this, please observe tightening torques below for oil level plugs, oil drain plugs, breather valves, and oil sight glasses:

Thread	Tightening Torque (Nm)
M10 x 1	12
M12 x 1.5	15
M22 x 1.5	60
M33 x 2	100
M42 x 2	150

## Checking the Oil Consistency of SEW Gearmotor via Oil Drain Plug

1. Locate the positions of the oil level plug and the breather valve.
2. Remove a little oil from the oil drain plug.
3. Check the oil consistency:
  - a. Viscosity (have this carried out by a suitable laboratory if necessary)
  - d. If you can see that the oil is heavily contaminated, it is advisable to change the oil, even if this is outside the specified service intervals.
  - b. Check the oil level according **How to Check Oil Level of SEW Gearmotor** on previous page.

## Checking the Oil of SEW Gearmotor via Oil Drain Plug and Breather Valve

1. Locate the positions of the oil level plug and the breather valve.
2. Place a container underneath the oil drain plug.
3. Remove the oil level plug, the breather valve and the oil drain plug.
4. Drain all the oil.
5. Re-insert the oil drain plug. When doing this, please observe tightening torques.
6. Fill in fresh oil of the same type via the breather bore. Do not mix different synthetic lubricants.
  - a. Observe the oil quantities according to the specifications on the nameplate.
  - b. Check the oil level at the oil level plug.
7. Re-insert the oil level plug and the breather valve. When doing this, please observe tightening torques.

# Lubrication Requirements - Grease

The table below lists the plant approved lubricants to use in conveyor components that need lubrication.

## Plant Approved Lubrication Chart

Lubrication Name	Manufacturer	Application Points
<b>Molub-Alloy 860/220-1</b>	<i>Castrol</i>	Bearings Cardan Shafts Rollers
<b>Tribol 290/220</b>	<i>Castrol</i>	Chain

### Re-Lubrication Best Practices:

- Always clean the grease fitting of all dirt before attaching the grease gun. Failure to clean the grease fitting before applying grease could result in introducing contaminants into the component resulting in increased wear or clogging the grease fitting orifice so as not to allow the entry of grease. Inspect and replace any damaged fittings. It is helpful to use grease-fitting caps to keep them clean, but still wipe fittings clean before applying grease.
- Always make sure the dispensing nozzle of the grease gun is clean before using. Pump a small amount of grease out of the dispensing nozzle, then wipe the nozzle off with a clean rag or lint-free cloth before attaching it to the grease fitting.
- Do NOT over lubricate or apply excessive amounts of grease. This could lead to ruptured seals and excessive grease outside the fitting, which can attract contaminants and create additional unwanted conditions.
- Know that some greases are not compatible with each other. Ensure that the proper grease is used at every grease point. Applying the wrong grease can cause an incompatibility problem which can quickly cause failures.
- Once relubrication service is complete, clean off old grease and contaminants from the boot, grease/zerk fittings and surrounding components.