

BASIC MAINTENANCE SCHEDULE FOR ICE HANDLING EQUIPMENT

INTRODUCTION

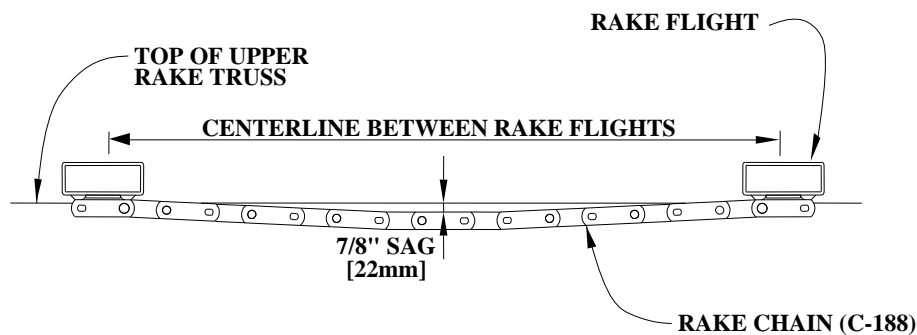
Regular maintenance of North Star ice handling equipment will ensure years of trouble free service. North Star has developed a recommended schedule for maintaining our ice handling equipment which is outlined below and following is a list of recommended lubricants.

DAILY

Daily emptying of the bin is recommended to allow inspection of rake trusses, flights, slide gates, discharge spouts and screw conveyors, and to allow the removal any ice buildup, fused ice lumps or spillage outside the raked area.

EVERY THREE (3) MONTHS

1. Inspect rake flight wear pads. Replace pads when they show wear of 1/8" [3mm], or are 3/8" [10mm] thick.
2. Inspect the rake chain for proper tension as shown below.



This illustration shows the correct tension for C-188 chain (stainless or galvanized), for NH78 chain (plastic) there should be no visible sag at working temperature.

EVERY SIX (6) MONTHS

1. Check oil level in all gear reducers. Add oil if necessary, see list for recommendations.
2. Grease all bearings.
3. Grease flexible coupling halves located on each side of fluid coupling.
4. Apply oil to roller chain and check tension. Adjust if necessary to maintain tension.
5. Grease flexible coupling located between primary reducer and secondary reducer.

6. Check that the rake is level. Take up on the cables, if required.
7. Check tension of all belts. Adjust if necessary to maintain tension.
8. Wipe the rake truss angle surfaces with an oily rag to maintain a slick surface.

ANNUALLY (EVERY 12 MONTHS, IN ADDITION TO ALL OF THE ABOVE)

1. Change oil in all gear reducers.
2. Inspect wear of the rake drive and idle end sprockets. Replace if required.

LUBRICATION LIST

This section covers the lubrication of North Star equipment in general, although some items listed on the following pages may not be included in the job.

In the interest of simplicity and uniformity, the range of lubricant types has been limited. Lubricants shown on the chart are not exclusive recommendations. When choosing a lubricant, ensure that it meets the correct specifications. Contact North Star if additional information is required.

RECOMMENDED LUBRICANTS AND CAPACITIES (APPROXIMATE)

The basic functions of a lubricant are friction and wear reduction, heat removal, and contaminant suspension. The lubricants that North Star recommends fall into three categories: Mineral (MIN) oil, Polyalphaolefin (PAO) oil, or Polyalkylene Glycol (PAG) oil. It is recommended not mix different types of oil.

Mineral (MIN) lubricants are based on petroleum oils and typically contain up to 90% of petroleum oil and about 10% additives that determine the oil properties and its application.

Polyalphaolefin (PAO) oil is a synthetic lubricant. Synthetic oils are man-made lubricants that have chemical structure much like mineral oils but they have a longer service life (which means they require lubricant changes less often). They have a greater reduction of wear and friction than mineral lubricants, resulting in a longer gear box life and improved gear efficiency.

Polyalkylene Glycol (PAG or PG) oil is also a synthetic lubricant with the same qualities as PAO oil but it does not mix with PAO oil.

IMPORTANT NOTES:

1. The reducers marked as ⁽¹⁾ were shipped dry prior March 2011 and North Star did not provide any lubricant for these reducers. From March 2011 to present the lubricant for initial fill of this reducer is shipped in one-gallon container(s) along with new equipment.

2. The reducers marked as ⁽²⁾ were shipped dry prior March 2011 and North Star did not provide any lubricant for these reducers. From March 2011 to present these reducers were shipped prefilled with the indicated lubricant.
3. Starting in March 2011, the lubricant marked as ⁽³⁾ is shipped along with new equipment in limited quantity for initial fill of the corresponding reducer.
4. The lubricant marked as ⁽⁴⁾ is a NSF N1 Food Grade Lubricant.
5. Prior to March 2011, ice maker speed reducers (marked as ⁽⁵⁾) were prefilled with Mobil 600W Super Cylinder Oil. From March 2011 to present, ice maker speed reducers are prefilled with Mobil Glygoyle 460 Oil, which should be reflected on the sticker attached to the reducer.
6. Designation for Oil Class or Type:

MIN	Mineral Oil (Petroleum Based Oil)
PAO	Synthetic Polyalphaolefin Oil
PAG	Synthetic Polyalkylene Glycol Oil

SAE	SAE Grade Oil
HO	Hydraulic Oil
MO	Motor Oil

7. Quantities listed are approximate. Check and fill to appropriate level indicator on gear reducer. Refer to manufacturer's bulletin for lubricant specification.

Description	Shipping conditions	Quantity Required		Environmental Conditions	Recommended Lubricant		General Notes / Suggested Manufacturer Type / Brands
		Quart or Fluid Ounces	Liter		Viscosity, ISO, AGMA, NGLI	Type	
Rake (See RAKE INSTALLATION drawing to determine appropriate reducer)							
Gear Reducer-Primary TXT105	Shipped Dry ⁽¹⁾	20 Fl.Oz	0.6	Below and above 32°F (0°C)	ISO 150	PAO	Lubriplate SFGO Ultra-150 ⁽³⁾⁽⁴⁾ Mobil SHC 629, Shell OMALA 150 RL, Chevron HiPerSYN-150 or equivalent
Gear Reducer-Secondary TXT425 (SMR, LMR, JMR, HMR 15" Rect. Rakes)	Shipped Dry ⁽¹⁾	1.88 Quarts	1.8	Below and above 32°F (0°C)	ISO 150	PAO	Lubriplate SFGO Ultra-150 ⁽³⁾⁽⁴⁾ Mobil SHC 629, Shell OMALA 150 RL, Chevron HiPerSYN-150 or equivalent
Gear Reducer-Secondary TXT 525 (GMR, FMR and 17" Rect. Rakes)	Shipped Dry ⁽¹⁾	3.25 Quarts	3.1	Below and above 32°F (0°C)	ISO 150	PAO	Lubriplate SFGO Ultra-150 ⁽³⁾⁽⁴⁾ Mobil SHC 629, Shell OMALA 150 RL, Chevron HiPerSYN-150 or equivalent
Fluid Coupling 7.0 HCM	Filled with SAE 10W	30 Fl.Oz	0.9	Below and above 32°F (0°C)	SAE 10W ISO 32		Automotive (Motor Oil) mono-grade SAE 10W, Hydraulic Oils: Mobil DTE 24, Chevron Hydraulic Oil EP

Description	Shipping conditions	Quantity Required		Environmental Conditions	Recommended Lubricant		General Notes / Suggested Manufacturer Type / Brands
		Quart or Fluid Ounces	Liter		Viscosity, ISO, AGMA NGLI	Type	
(SMR and LMR only)							32, Shell Tellus 32. Refer to the manufacturer's bulletin for more recommendations. <u>For refilling refer to Rake Installation section in manual.</u>
Fluid Coupling 9.4 HCM		49 Fl.Oz	1.4	60Hz; Below and above 32°F (0°C)		MO or HO	
Fluid Coupling 9.4 HCM		55 Fl.Oz	1.6	50Hz; Below and above 32°F (0°C)			
Drive End Bearing	Filled with Timken Pillow Block Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Lubriplate®EM, Mobilgrease®AW2, Shell alvania RL3™, SKF LGHP2™, Exxon Mobil Polyrex®EM, Conoco Phillips Polyurea™ 2. Contact North Star or Timken for other lubricants compatible with applied grease
Idle End Bearing	Filled with Lubriplate 930-AA Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 1	Bentone (Clay) based grease	Bentone (clay) based greases. 930-AA grease is compatible with Calcium Stearate, Calcium 12 and Silica Gel based greases only. Thoroughly clean components before applying different greases.
Flex Coupling (each side of Fluid Coupling)							
Drive Motor (Bearings)	Filled with Exxon Polyrex EM grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Exxon PolyRex EM, Mobil PolyRex EM, Chevron SRI Grease NGLI-2 and other Polyurea based greases suitable for application.

Hoist

(See HOIST INSTALLATION drawing to determine appropriate reducer)

Worm Gear Reducer - 30W-DB	Reducer ⁽²⁾ filled with Lubriplate PGO-460 Oil	2 ½ Quarts	2.3	Below and above 32°F (0°C)	ISO 460 AGMA 7S	PAG	Fill to low level mark on the dipstick. <u>Do not overfill.</u> Lubriplate PGO-460 Oil, Mobil Glygoyle 460 ⁽⁴⁾ or equivalent suitable for low temperature application.
				Above 32°F (0°C)	ISO 460 AGMA 7C AGMA 7S	MIN	Fill to low level mark on the dipstick. <u>Do not overfill.</u> Mobil 600W Super Cylinder, Shell Valvata J460, Texaco Vanguard 460 or equivalent.
Worm Gear Reducer - 40W-DB	Reducer ⁽²⁾ filled with Lubriplate PGO-460 Oil	3 ¾ Quarts	3.5	Below and above 32°F (0°C)	ISO 460 AGMA 7S	PAG	Fill to low level mark on the dipstick. <u>Do not overfill.</u> Mobil Glygoyle 460 or equivalent suitable for low temperature application
				Above 32°F (0°C)	ISO 460 AGMA 7C AGMA 7S	MIN	Fill to low level mark on the dipstick. <u>Do not overfill.</u> Mobil 600W Super Cylinder, Shell Valvata J460, Texaco Vanguard 460 or equivalent.
Drive Motor (Bearings)	Filled with Exxon Polyrex EM grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Exxon PolyRex EM, Mobil PolyRex EM, Chevron SRI Grease NGLI-2 and other Polyurea based greases suitable for application.

Description	Shipping conditions	Quantity Required		Environmental Conditions	Recommended Lubricant		General Notes / Suggested Manufacturer Type / Brands
		Quart or Fluid Ounces	Liter		Viscosity, ISO, AGMA NGLI	Type	
Bearing	Filled with Timken Pillow Block Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Timken Pillow Block Grease , Lubriplate®EM, Mobilgrease®AW2, Shell alvania RL3™, SKF LGHP2™, Exxon Mobil Polyrex®EM, Conoco Phillips Polyurea™ 2. Contact North Star or Timken for other lubricants compatible with applied grease
Chain Tensioner		-	-	10°F to 100°F (-12°C to 38°C)	NGLI 1.5 NGLI 2	-	Fabricated with oil impregnated bronze bushing. Does not need lubrication unless excessive wear is noticed. Apply Mobil 1 Synthetic Grease (NLGI-2) or Lubriplate LowTemp (L0172-092), or equivalent as required.
Chain	Greased	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 1 NGLI 1.5		Chevron Ultra-Plex Synthetic Grease EP or Lubriplate LowTemp (L0172-092) or equivalent as required.
Bin Door Operator							
Worm Gear Reducer (Reducer is a double reduction gear reducer with two reservoirs.	Filled with Mobil Glygoyle 460 ⁽⁴⁾ Oil	3 ½ Pints	1.7	Below and above 32°F (0°C)	ISO 460 AGMA 7S	PAG	Fill to low level mark on the dipstick. Do not overfill. Mobil Glygoyle 460 ⁽⁴⁾ , Lubriplate PGO-460 Oil or equivalent suitable for low temperature application
				Above 32°F (0°C)	ISO 460 AGMA 7C AGMA 7S	MIN	Fill to low level mark on the dipstick. Do not overfill. Mobil 600W Super Cylinder, Shell Valvata J460, Texaco Vanguard 460 or equivalent.
Pillow Block Bearing	Filled with Timken Pillow Block Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Timken Pillow Block Grease, Lubriplate®EM, Mobilgrease®AW2, Shell alvania RL3™, SKF LGHP2™, Exxon Mobil Polyrex®EM, Conoco Phillips Polyurea™ 2. Contact North Star or Timken for other lubricants compatible with applied grease
Drive Motor (Bearings)	Filled with Exxon Polyrex EM grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Exxon PolyRex EM, Mobil PolyRex EM, Chevron SRI Grease NGLI-2 and other Polyurea based greases suitable for application.
Screw Conveyors with Gearmotor Drive							
Gearmotor SK 1282	Filled with Mobil SHC 630	0.95 Quarts	0.9	Below and above 32°F (0°C)	ISO 220	PAO	Mobil SHC 630, Chevron Hipersyn 220, Shell Omala 220 HD or equivalent
Gearmotor SK 2282	Filled with Mobil SHC 630	1.74 Quarts	1.7	Below and above 32°F (0°C)	ISO 220	PAO	Mobil SHC 630, Chevron Hipersyn 220, Shell Omala 220 HD or equivalent
Gearmotor SK 3282	Filled with Mobil SHC 630	3.3 Quarts	3.2	Below and above 32°F (0°C)	ISO 220	PAO	Mobil SHC 630, Chevron Hipersyn 220, Shell Omala 220 HD or equivalent

Bearings	Filled with Timken Pillow Block Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Timken Pillow Block Grease, Lubriplate [®] EM, Mobilgrease [®] AW2, Shell Alvania RL3 [™] , SKF LGHP2 [™] , Exxon Mobil Polyrex [®] EM, Conoco Phillips Polyurea [™] 2. Contact North Star or Timken for other lubricants compatible with applied grease
Twin Screws with Feed Reservoir							
Gearmotor SK9012	Filled with Mobil SHC 630	2.5 Quarts	2.4	Below and above 32°F (0°C)	ISO 220	PAO	Mobil SHC 630, Chevron HiPerSYN 220, Shell Omala 220 HD or equivalent
Bearings	Greased	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Lithium based grease	Bearing are greased with Lithium Complex base grease. Compatible with Lithium based greases. Chevron Multifak [®] EP, Chevron Ulti-Plex Synthetic Grease EP or equivalent.
Day Tank (Model DT2000M, DT3000M)							
Gearmotor SK9042	Filled with Mobil SHC 630	2.54 Quarts	1.7	Above 32°F (0°C)	ISO 220	PAO	Mobil SHC 630, Chevron HiPerSYN 220, Shell Omala 220 HD or equivalent
Bearings (Fafnir)	Filled with Timken Pillow Block Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Timken Pillow Block Grease, Lubriplate [®] EM, Mobilgrease [®] AW2, Shell Alvania RL3 [™] , SKF LGHP2 [™] , Exxon Mobil Polyrex [®] EM, Conoco Phillips Polyurea [™] 2 or equivalent.
Ice Maker							
Worm Gear Reducer ⁽⁵⁾ (Primary, M20 thru M90)	Filled with Mobil Glygoyle 460 Oil ⁽⁴⁾	72 Fl Oz	2.1	Above 32°F (0°C)	ISO 460 AGMA 7C AGMA 7S	PAG	Mobil Glygoyle 460 ⁽⁴⁾ , Lubriplate PGO-460 Oil or equivalent.
						MIN	Mobil 600W Super Cylinder Oil, Shell Valvata J460, Chevron Cylinder Oil W ISO 460, Texaco Vanguard 460 or equivalents. Original oil shall be drained and gear box to be flushed with new oil; See OIL CHANGE PROCEDURE in this Section
Top Center Reducer (Secondary M20-90)	Shipped Dry ⁽¹⁾	4 Quarts	3.7	Above 32°F (0°C)	SAE 80W-90	MIN	Lubriplate APG 80W-90 ⁽³⁾ , Texaco Havoline Gear Oil SAE 80W-90, Texaco Multigear EP SAE 80W-90, Delo Gear Lubricant ESI SAE 80W-90 or equivalent.
Bearing (Top and Bottom)	Bearings are specially greased and shielded for North Star ice makers. Do not remove shield and re-lubricate the bearings. Call factory 1-206-763-7300 for replacement.						
Drive and Pump Motors (Bearings)	Filled with Exxon Polyrex EM grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Exxon PolyRex EM, Mobil PolyRex EM, Chevron SRI Grease NGLI-2 and other Polyurea based greases suitable for application.

Case Ice Dispenser							
Worm Gear Reducer	Shipped Dry	3 Quarts	2.8	Above 32°F (0°C)	ISO 460 AGMA 7C AGMA 7S	MIN	Mobil 600W Super Cylinder Oil, Shell Valvata J460, Chevron Cylinder Oil W ISO 460, Texaco Vanguard 460, Lubriplate SPO-277 or equivalents.
						PAG	Mobil Glygoyle 460 ⁽⁴⁾ , Lubriplate PGO-460 Oil or equivalent.
Bearings (Fafnir)	Filled with Timken Pillow Block Grease	-	-	10°F to 100°F (-12°C to 38°C)	NGLI 2	Polyurea based grease	Timken Pillow Block Grease, Lubriplate [®] EM, Mobilgrease [®] AW2, Shell Alvania RL3 [™] , SKF LGHP2 [™] , Exxon Mobil Polyrex [®] EM, Conoco Phillips Polyurea [™] 2 or equivalent

OIL LEVEL AND OIL CHANGE PROCEDURE

The oil level should be checked prior to operation by either inspecting the oil level sight glass or removing oil level plug and looking inside. Refer to manufacturer's bulletin for correct level of oil in equipment.

North Star recommends the following oil change intervals under normal working conditions:

1. The oil in new reducers should be changed at the end of the first 250 hours of operation.
2. Mineral (petroleum) based lubricants should be changed every six months or 2500 operating hours, whichever occurs first.
3. Synthetic lubricants should be changed after 6000 – 8000 hours of operation or 18-24 months whichever occurs first, depending on operating conditions.

Under severe conditions (such as rapid temperature changes, frequent shocks and overloads, humid, dirty, and/or corrosive environments) it may be necessary to change oil more frequently than the intervals shown above.

OIL CHANGE PROCEDURE

NOTICE

NOTICE:

Do not mix different types of oil. If switching to a different type of gear reducer oil, an adequate flushing procedure will be required as described below. If switching between different types of oil, a complete oil changeover is required to be carried out.

When changing similar types of oil, the housing should be completely drained before filling it with the new lubricant type.

Special care should be taken when changing from one type of lubricant to a different type of lubricant. Generally, about 15% of the oil remains in the housing after it is drained. Therefore, just draining the old type of oil from the reducer and refilling it with the new type of oil will create an emulsion, thus preventing optimal performance of the new type of lubricant.

For optimum performance of the gear reducer, follow these steps:

1. Drain the old type of oil from the reducer while the oil is still warm. If standing oil remains in the reducer remove as much as possible with a vacuum hose.
2. Refill the reducer with the new type of oil. Run the reducer (equipment) for up to four hours.
3. Drain the oil from the reducer while the oil is still warm. If standing oil remains in the reducer, remove as much as possible with a vacuum hose.
4. Refill the reducer with fresh oil (the new type). At this time, as much as 2-3% of the initial oil may still remain in the system. Run the reducer (equipment) for at least four hours and up to 24 hours if possible. Take an oil sample for examination. If the oil is clear and bright and no emulsion is visible, it may be possible to skip the final steps and simply begin normal operation. However, if the oil is not clear or emulsion is visible, an additional flushing as described below is suggested.
5. Drain the oil again from the reducer while the oil is still warm.
6. Refill the reducer with fresh oil (the new type) and run the reducer (equipment) for at least four hours. At this point, the initial oil remaining in the system should be <0.5%. Take an oil sample and observe for any emulsion, or debris. If the oil is clear and bright (a slight haze is acceptable) then continue normal operation and top off as needed. If significant emulsion is observed, then conduct one more drain and flush.