Sumitomo Drive Technologies

MADE IN U.S.A.

Speed Reducer/Gearbox Technology

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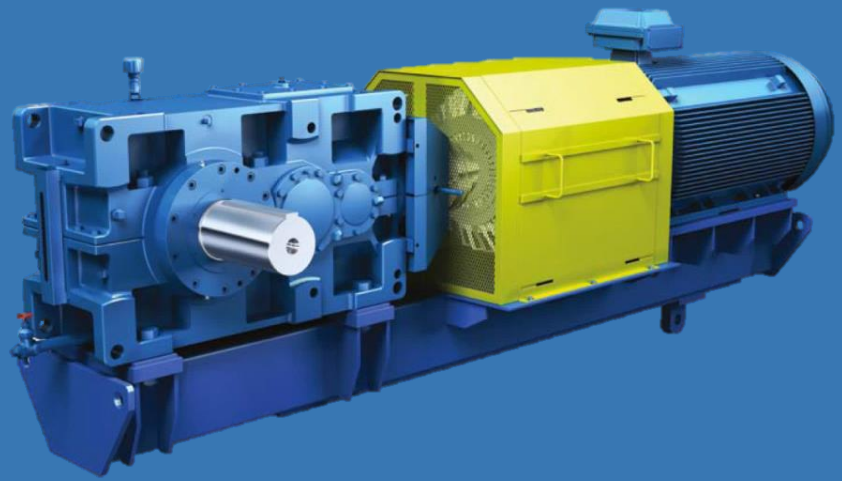
Complete Drive

Package

Engineering



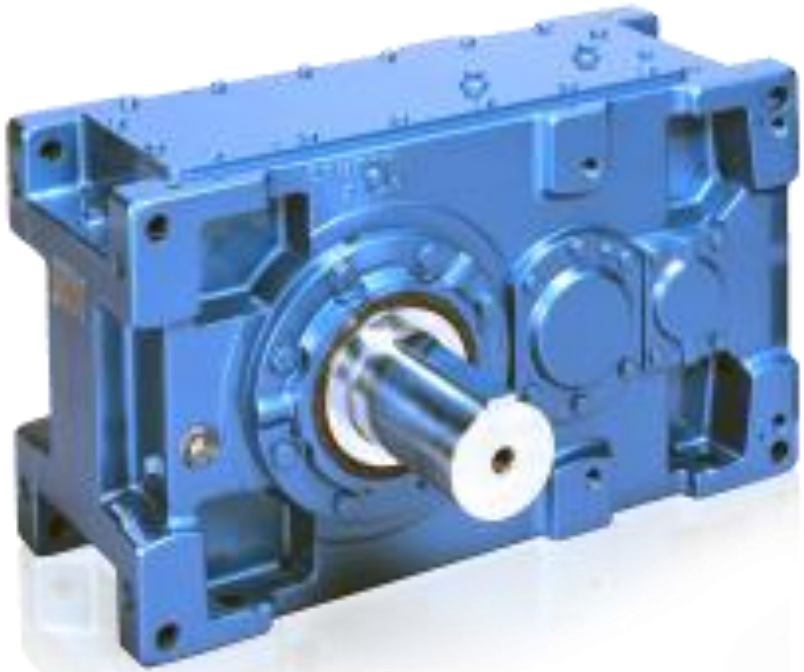
Agenda

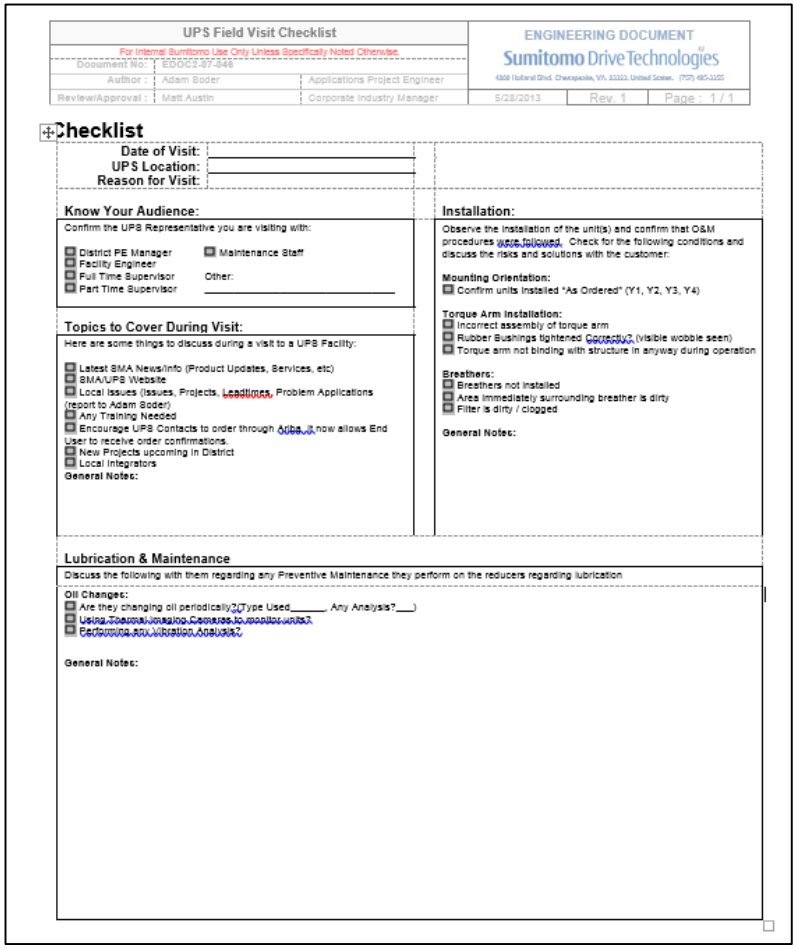
- LSS OHL Calculations
- Mechanical & Thermal Rating Calculations
- Lubrication Effects
- Maintenance Reminders
- Repair/Storage

(Griep, Ken. 13 Ways To Ruin A Perfectly Good Speed Reducer. August 3, 2017. Power Point Presentation.)

Gearbox Inspection Upon Site Arrival?

Gearbox Maintenance (PMI) Records





UPS Field Visit Checklist

For Internal Sumitomo Use Only Unless Specifically Noted Otherwise.

Document No:	EDOC2-87-948		
Author :	Adam Boder	Applications Project Engineer	
Review/Approval :	Matt Austin	Corporate Industry Manager	5/28/2013

ENGINEERING DOCUMENT

Sumitomo Drive Technologies

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Rev: 1 | Page : 1 / 1

Checklist

Date of Visit: _____

UPS Location: _____

Reason for Visit: _____

Know Your Audience:

Confirm the UPS Representative you are visiting with:

- ☐ District PE Manager
- ☐ Facility Engineer
- ☐ Full Time Supervisor
- ☐ Part Time Supervisor
- ☐ Maintenance Staff
- Other: _____

Topics to Cover During Visit:

Here are some things to discuss during a visit to a UPS Facility:

- ☐ Latest SMA News/Info (Product Updates, Services, etc)
- ☐ SMA/UPS Website
- ☐ Local Issues (Issues, Projects, Leadtimes, Problem Applications (report to Adam Boder)
- ☐ Any Training Needed
- ☐ Encourage UPS Contacts to order through Ariba, it now allows End User to receive order confirmations.
- ☐ New Projects upcoming in District
- ☐ Local Integrators

General Notes:

Installation:

Observe the installation of the unit(s) and confirm that O&M procedures were followed. Check for the following conditions and discuss the risks and solutions with the customer:

Mounting Orientation:

- ☐ Confirm units installed "As Ordered" (Y1, Y2, Y3, Y4)

Torque Arm Installation:

- ☐ Incorrect assembly of torque arm
- ☐ Rubber Bushings tightened Correctly? (visible wobble seen)
- ☐ Torque arm not binding with structure in anyway during operation

Breathers:

- ☐ Breathers not installed
- ☐ Area immediately surrounding breather is dirty
- ☐ Filter is dirty / clogged

General Notes:

Lubrication & Maintenance

Discuss the following with them regarding any Preventive Maintenance they perform on the reducers regarding lubrication

Oil Changes:

- ☐ Are they changing oil periodically?(Type Used_____, Any Analysis?___)
- ☐ Using Thermal Imaging Cameras to monitor units?
- ☐ Performing any Vibration Analysis?

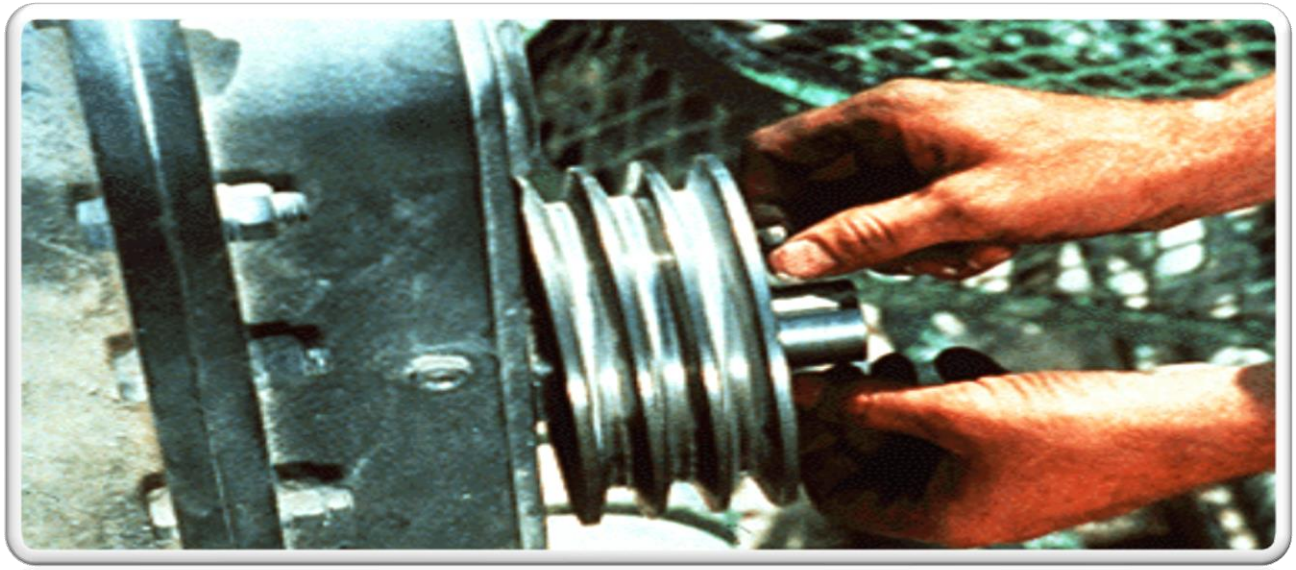
General Notes:

Healthy Gearbox Maintenance Reminders

Mount Sheaves/Sprockets Close To Seal Cages/Gearbox Collars…

Reduces Overhung Loads & Shaft Bending Stresses

- Increases Bearing & Seal Life
- Reduces Equipment Downtime



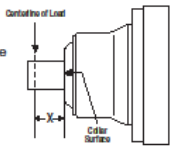
Overhung Load (OHL) – lbs.

CYCLO® 6000 Gearmotors

Overhung Loads • Slow Speed Shaft

Overhung Loads are loads that act perpendicular to the gearmotor shaft. Each gearmotor has a maximum allowable overhung load (OHL) capacity, which is shown in the Frame Size Selection Tables for each gearmotor. In applications with an OHL, it is critical that the OHL is calculated and that the chosen gearmotor is adequately sized for the maximum OHL.

How to Calculate Overhung Load (OHL)



Step 1. **Measure distance X** from gearmotor collar surface to the centerline of the OHL.

Step 2. **Determine Lf (Load Location Factor)** for your chosen Frame Size, using **Load Location Factor Table** on the next page.

Step 3. **Determine Cf (Connection Factor) and Sf (Shock Factor)** from the tables below:

Load Connection Factor (Cf)

CONNECTION TYPE	FACTOR
General Purpose Chain	1.0
Machined Gear or Synchronous Belt	1.25
V-Belt	1.5
Flat Belt	2.5

Service Factor (Sf)

DEGREE OF SHOCK	FACTOR
Steady Loads	1.0
Moderate Shock	1.3
Heavy Shock	1.6

Step 4. **Apply Lf, Cf and Sf to the formula** to calculate the OHL.

EXAMPLE: Known HP – Power Transmitted by shaft (HP)
Known D – Pitch Diameter of sprocket (inches)
Known N – Shaft Speed (RPM)

$$\frac{126{,}000 \times HP \times Lf \times Cf \times Sf}{D \times N} = \text{Calculated OHL}$$

Step 5. **Refer back to the Frame Size Selection Tables** (pp. 3.1–3.32) to determine maximum allowable OHL capacity for the selected Frame Size.

If the calculated OHL **does not** exceed the OHL capacity (from Selection Table), the selected Frame Size is acceptable.

If the calculated OHL exceeds the OHL capacity, there are two standard options that can increase the OHL capacity of a reducer:
- High Capacity Bearings Option–R1 (Table on pg. 5.8)
- Ductile Iron Housing & High Capacity Bearings Option–R2 (Table on pg. 5.9)

If neither of these options adequately increase the OHL capacity:
1. Choose the next larger Frame Size, or
2. Move the OHL closer to the collar surface, or
3. Decrease the OHL by increasing the pitch diameter of the connecting drive.

Be sure to recalculate and verify the OHL capacity for the new frame size.

Overhung Loads

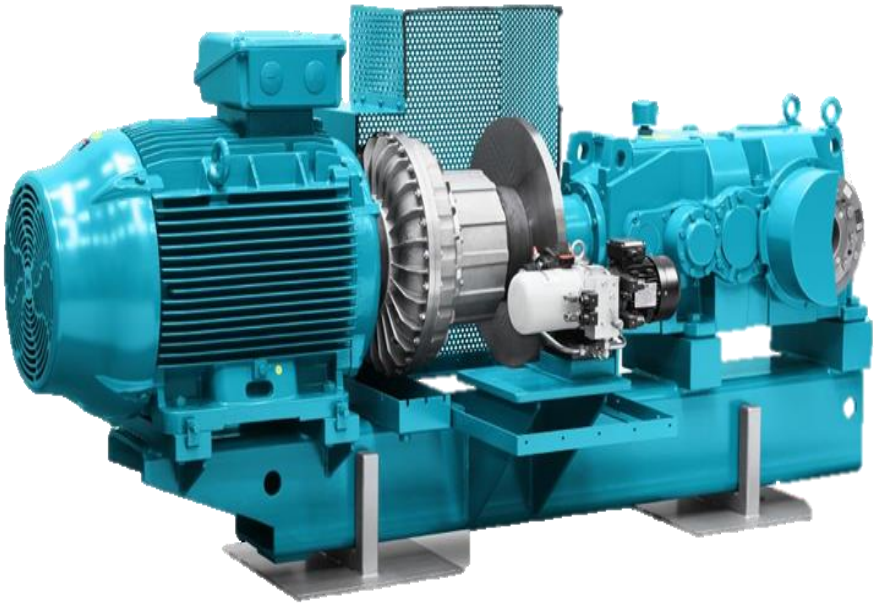
Overhung Load Calculation:

Scenario Example:
100HP/1750RPM
15:1 Ratio/116.66 Output RPM
25” Pitch Diameter Sprocket On LSS
General Purpose Chain
Heavy Shock

$$\frac{126{,}000 \times 100(HP) \times 1.02(LF) \times 1.0(CF) \times 1.6(SF)}{25”(P/D) \times 116(RPM\ Output/N)}$$

=7,091lbs.

Lubrication

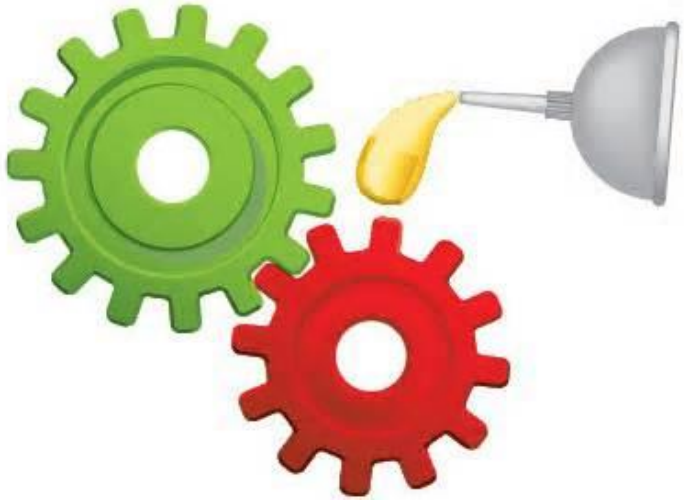


Reduces friction

- Gears
- Bearings
- Seals

Removes heat from gears

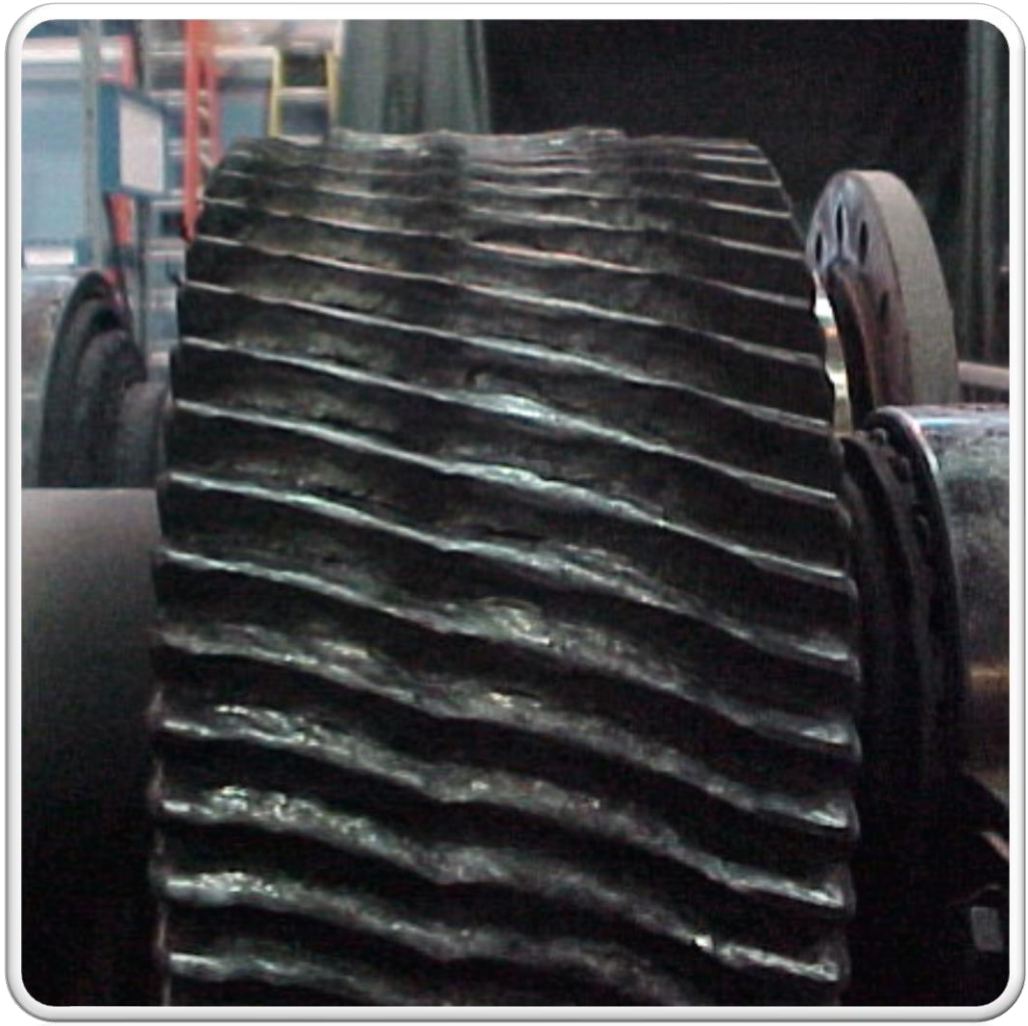
- Transfers heat to housing



Healthy Gearbox Maintenance Reminders

Lubrication is a major reason speed reducers fail…

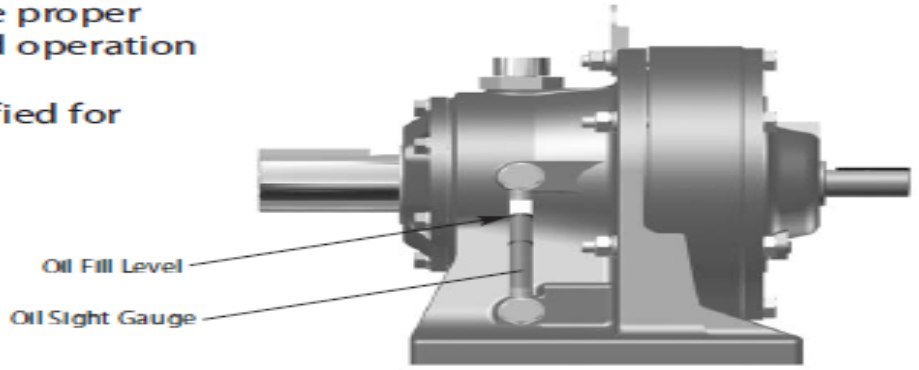
- Too Little… Damages Bearings & Gearing
- Too Much… Reducer Will Overheat
- Not The Proper Type… Will Affect Both of the Above
- Change Oil As Often As Recommended By Manufacturer



Lubrication

Cyclo® Reducers are either Grease lubricated or Oil lubricated.
Refer to pages 5.3 and 5.4 to determine the unit lubrication type.

- **Grease lubricated** reducers are filled with grease prior to shipment and are ready for installation and operation
- **Oil lubricated** reducers must be filled with the proper amount of approved oil before installation and operation
- **Lubrication methods** (grease or oil) are specified for Cyclo® driven at standard input speed.



Approved Greases

Grease lubricated reducers are filled with grease prior to shipment and are ready for installation and operation. This information is provided for maintenance purposes.

Ambient Temperature		Cyclo	Planetary
°F	°C	ExxonMobil	Shell Oil
14 to 122	-10 to 50	Exxon Unirex N2 Grease (NLGI Grade #2)	Shell Alvania® EP (NLGI Grade #0)

When the Cyclo® reducer will be used underwidely fluctuating temperatures or ambient temperatures (other than those listed here) or any other special conditions, consult the factory.

Approved Oils

Oil lubricated reducers must be filled with oil prior to operation. Fill the reducer to the correct level with the recommended oil.

Ambient Temperature		ChevronTexaco	Exxon Oil	Mobil Oil	Shell Oil	BP Oil
°F	°C					
14 to 41°	-10 to 5	EP Gear Compound 68	Spartan EP 68	Mobilgear 600 XP 68 (ISO VG 68)	Omala S2 G 68	Energol GR-XP 68
32 to 95°	0 to 35	EP Gear Compound 100, 150	Spartan EP100 EP150	Mobilgear 600 XP 100, 150 (ISO VG 100, 150)	Omala S2 G 100, 150	Energol GR-XP 100 GR-XP 150
86 to 122°	30 to 5	EP Gear Compound 220, 320, 460	Spartan EP 220 EP320 EP 460	Mobilgear 600 XP 220, 320, 460 (ISO VG 220, 460)	Omala S2 G 220, 320 460	Energol GR-XP 220 GR-XP 320 GR-XP 460

For use in winter or relatively low ambient temperatures, use the lower viscosity oil specified for each ambient temperature range.

For consistent use in ambient temperatures outside of the range 32°F to 104°F (0°C to 40°C), consult factory.

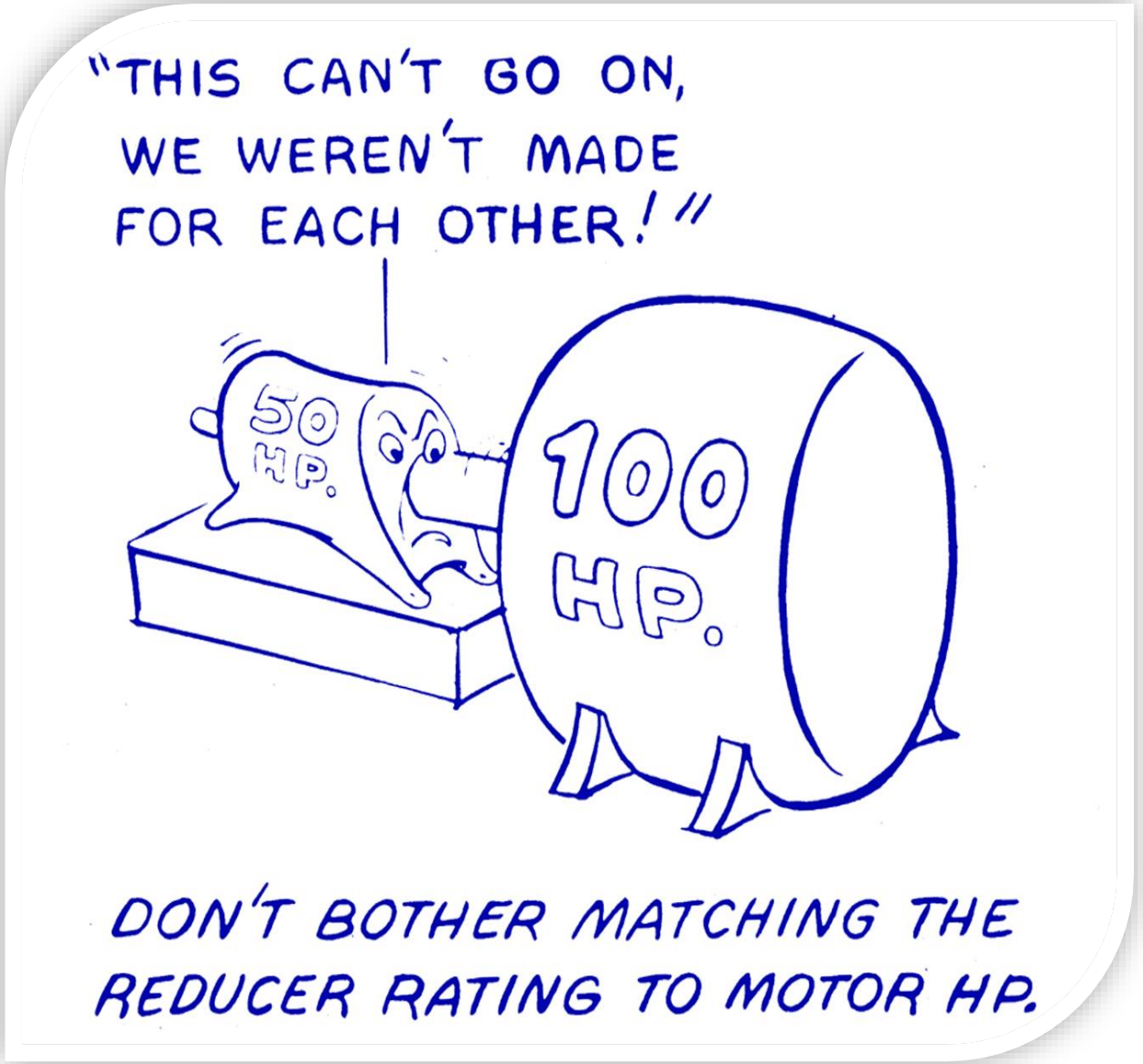
Healthy Gearbox Maintenance Reminders

Lubrication: The Wrong Viscosity…

- Lubricant Too Light… Damages Gearing
- Lubricant Too Heavy… Starves Bearings & Causes Cavitation In Lube Pumps
- Change Seasonally As Instructed In Manual

Healthy Gearbox Maintenance Reminders

3



What Is Service Factor?

AGMA states that to achieve normal service life of reducer (5000 hours L_{10}):

Normal application – (electric motor)

8 hours/day, uniform load

➔1.0 service factor

Moderate application

24 hours/day, uniform load, or

8 hours/day, moderate shock load

➔1.5 service factor

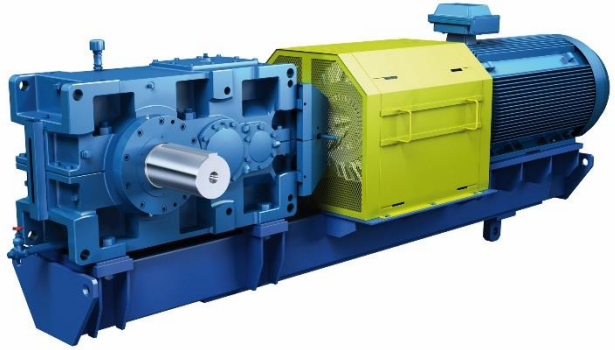
What Is Service Factor?

$HP_R = HP_M$ X Service Factor

Where:

HP_R = rating of reducer

HP_M = rating of motor



Why Is This Important?

Gearboxes in operation that are undersized will fatigue or fail much faster!

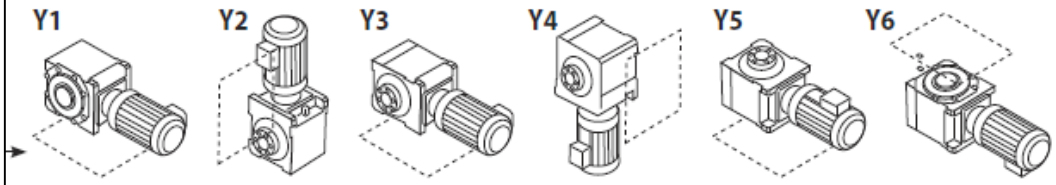
Increases gearbox replacement intervals!

Is your gearbox correctly sized?

Healthy Gearbox Maintenance Reminders

Review Application Service Factors, Duty Cycles & Mounting

Mounting Positions



Recommended Reducer Service Factors

		AGMA Load Classifications		
		Uniform (U)	**Moderate Shock (M)**	**Heavy Shock (H)**
Duration of Service	**1/2 hr. per day** (Occasional)	0.50[1]	0.80[1]	1.25
	3 hrs. per day (Intermittent)	0.80 [1]	1.00	1.50
	Up to 10 hrs. per day	1.00	1.25	1.75
	24 hrs. per day	1.20	1.50	2.00

Note: [1] Maximum momentary or starting load must not exceed 200% of gear reducer rating (rating meaning service factor of 1.0). Time specified for occasional and intermittent service refers to total operating time per day.

Recommended Supplemental Service Factors for Frequent Start–Stop Applications

For **frequent start-stop applications**, use the table below to determine the recommended service factor, and check the Motor Thermal Rating (Table 5.29) in Section 5.

Number of starts (Times/hour)	**~10 hours/day**			**~24 hours/day**		
	Uniform	**Moderate Shock**	**Heavy Shock**	**Uniform**	**Moderate Shock**	**Heavy Shock**
~10	1.00	1.15	1.50	1.20	1.30	1.65
~200	1.10	1.35	1.65	1.30	1.50	1.85
~500	1.15	1.50	1.80	1.40	1.65	2.00

$$\text{The Moment of Inertia (ratio of Inertia } WR^2) = \frac{\text{Total Moment of Inertia } (WR^2) \text{ as seen from motor shaft}}{\text{Moment of Inertia } (WR^2) \text{ of motor}}$$

U = Allowable ratio of Moment of Inertia (WR^2) ≤ 0.3
M = Allowable ratio of Moment of Inertia (WR^2) $0.3 < WR^2 \leq 3.0$
H = Allowable ratio of Moment of Inertia (WR^2) $3.0 < WR^2 \leq 10$

What Is Service Factor?

HP X SF = Gearbox Input HP Rating
(Cataloged Selection)

Service Factor = 1.5
Design HP = 10 X 1.5 = 15HP
10HP motor connected to 15HP rated gear reducer.

- Normal service life (5000 hours L_{10})
- 100,000 hour L_{10} specification?
  - Use service factor = 2.2 or higher (depending on shock load) to increase dynamic bearing capability

Healthy Gearbox Maintenance Reminders

Make Sure Speed Reducers Have Adequate Service Factors for the Application…

- Check With Manufacturer Before Using Larger HP Motors

What Is A Thermal Rating?

"The thermal rating of a gearbox determines the power that can be continuously transmitted at a predetermined ambient temperature without resulting in damage to the inner workings, or degradation of the lubricant." (All Torque, 15)

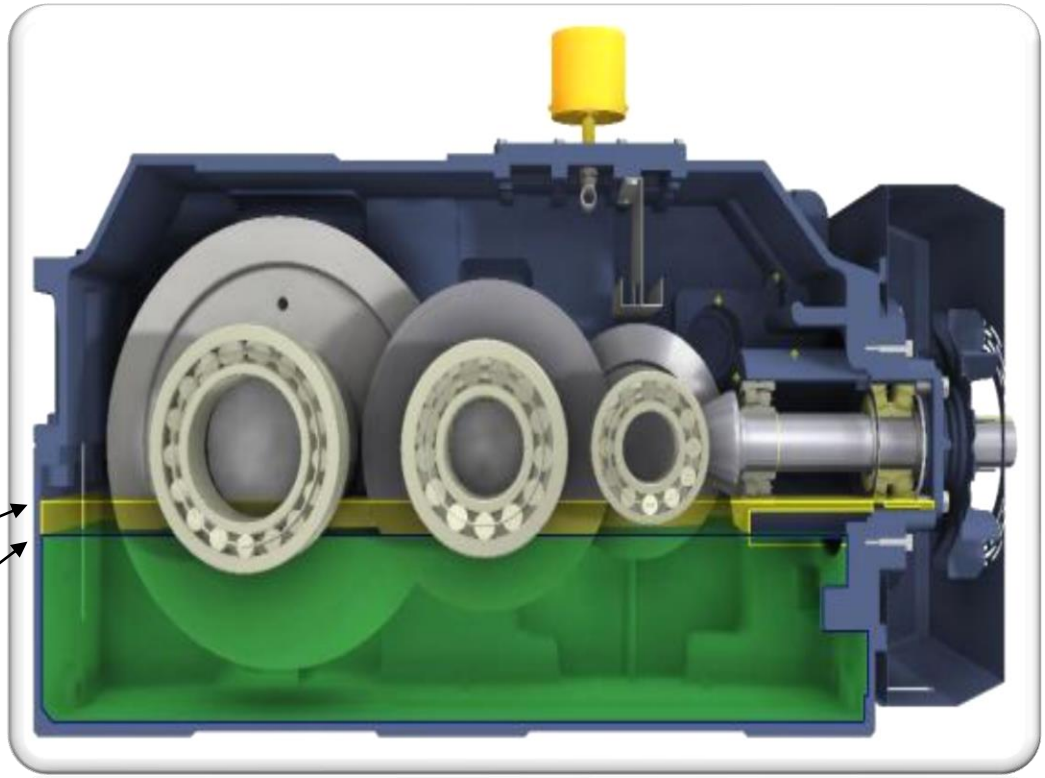
Catalog HP/Kw X Correction Factor = Thermal Rating
(Must be at or above HP of connected motor)

Standard Drives Are For Horizontal Operation

(Usually Within 3 to 5 degrees of Horizontal Plane)

Lubrication Modifications Are Usually Required

- Oil Level Adjustments
- Oil Inclusion and/or Exclusion Pans
- Sometimes Oil Lube Pumps Are Required



10
Screw bolts into Taper-Grip® bushing

- Lightly oil each bolt before inserting.
- Finger tighten to secure in place.

11
Tighten bolts on Taper-Grip® bushing

- Using a torque wrench, tighten each bolt in a star pattern to the specified torque level listed in Table 2 below. Tighten the bolts in 20% torque increments to minimize the possibility of shaft misalignment.

Table 2. Bushing Bolt Torque

Cyclo® BBB Size	Screw Quantity & Size	Screw Torque (foot pounds)
A	6 x M12	56
B	6 x M12	104
C	6 x M16	185
D	6 x M16	223
E	8 x M16	223
F	10 x M16	223

- After tightening is complete, apply grease or an anti- corrosion product to the exposed shafting.

12
Reinstall bushing guard over Taper-Grip® bushing

13
Verify lubrication and install air vents.

- Sumitomo supplies air breathers for all Cyclo Bevel Buddybox 4 units sold
- An air breather must be installed on the bevel gear housing (output portion) for Y1, Y3 and Y4.
- An air breather must be installed on the fill cup (plumbing) for Y2.
- If the lubrication is grease, no breather is required.

Installation Date Sticker

14
Finished installation

- Check the following items:
  - Oil Levels
  - Temp Strips
  - Pre-wiring
  - Breather installed in Cyclo® BBB4 sizes mounted in positions Y1 and Y3.
  - Breather installed in Cyclo® BBB4 only for all sizes mounted in position Y4.
- Punch-out the **installation date** on the preforated yellow sticker at the end of the unit.
- Install torque arm assembly; refer to page 6.
- Check the Taper-Grip bushing screw torques after 20 - 30 hours of operation. If necessary, tighten the screws according to the torque chart in step 11. Check the screw torques every 6 months thereafter.

Torque Arm Mounting Bracket
Installation Options

As shown below, there are three torque arm options available for the Cyclo BBB: 1. UPS Preferred Banjo Torque Arm Bracket, 2. T-type Torque Arm Bracket, 3. Retrofit for Turnbuckle Torque Arm Brackets. Correct mounting procedures for each are outlined on the pages that follow.

1

Name: Flange Mount T-Type (Banjo)
UPS Preferred Banjo Torque Arm Bracket

Available Cyclo BBB Sizes: A – D

Mounting Instructions: Pages 8-9

2

Name: T-Type Torque Arm Bracket

Available Cyclo BBB Sizes: All, A – E

Mounting Instructions: Pages 11-12

3

Name: Transverse Type

Retro design for applications that used Turnbuckle torque arms.

Available Cyclo BBB Sizes: A and B

Mounting Instructions: Page 14

Flange Mount T-Type (BLO-07 with Banjo) Torque Arm Bracket
Assembly and Part Numbers

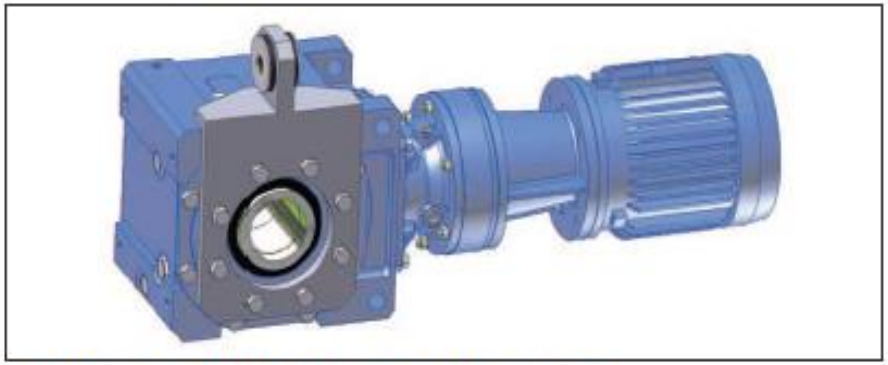
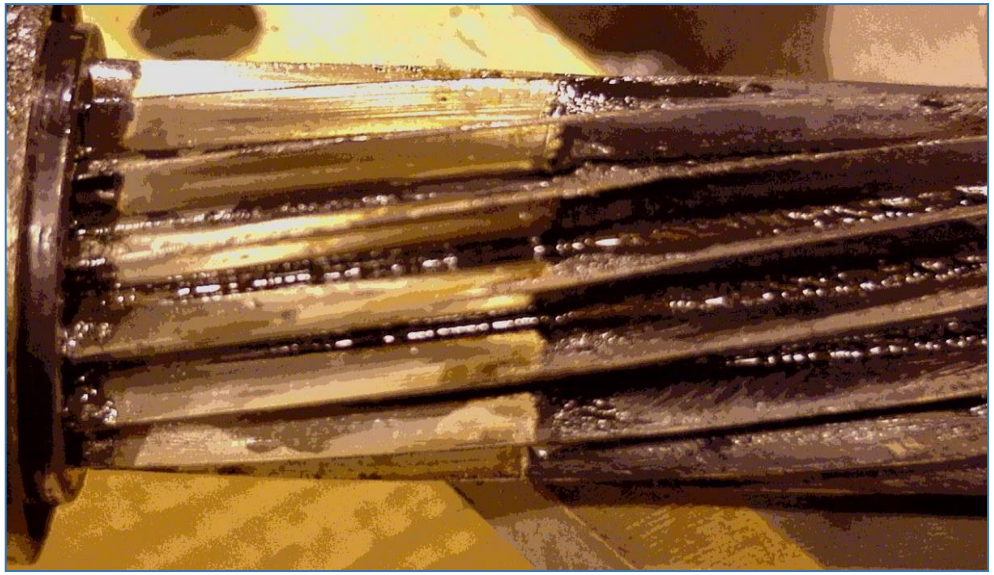


Table 3. Flange Mount T-Type (BLO-07 with Banjo) Torque Arm Bracket Part Numbers

			Cyclo® BBB Model Number Item Part Number			
Item	Qty.	Supplier	3A	3B	3C	3D
Torque Arm Assembly (Includes Torque Arm & Hardware Set)	1	SMA	SSCY9847-3A-LHYM	SSCY9847-3B-LHYM	SSCY9847-3C-LHYM	SSCY9847-3D-LHYM
Torque Arm	1	SMA	TKMC9346	TKMC9349	TKMC9345	TKMC9350
Hardware Set - Includes: Rubber Bushing, 3 Washer, 4 Mounting Hardware, 1 set	1	SMA	998TABPART3AG	998TABPART3BG	998TABPART3CG	998TABPART3DG
Replacement Parts						
Rubber Bushing	3	SMA	NKPA6379-4	NKPA6379-3	NKPA6379-2	NKPA6379-1
Washer	4	SMA	NKPA6391-4	NKPA6391-3	NKPA6391-2	NKPA6391-1
Bolt, Nut	1, 2	Customer	M16	M20	M24	M30
Mounting Hardware	8	SMA	M10 x 30 Hex Bolt M10 Spring Washer	M12 x 40 Hex Bolt M12 Spring Washer	M16 x 40 Hex Bolt M16 Spring Washer	M20 x 50 Hex Bolt M20 Spring Washer
Mounting Bracket Hole Diameter (mm)	1	Customer	Ø20	Ø24	Ø28	Ø35

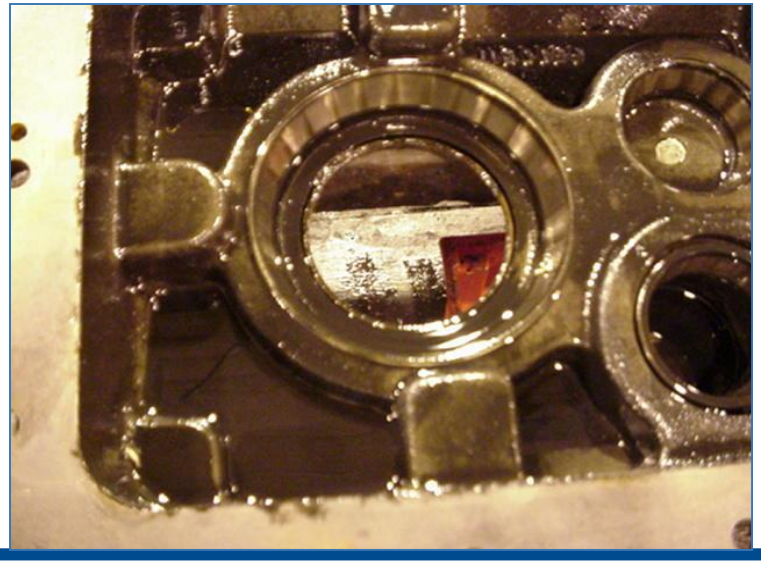
Healthy Gearbox Maintenance Reminders



Rust Stalactites

Lead To Gear Wear

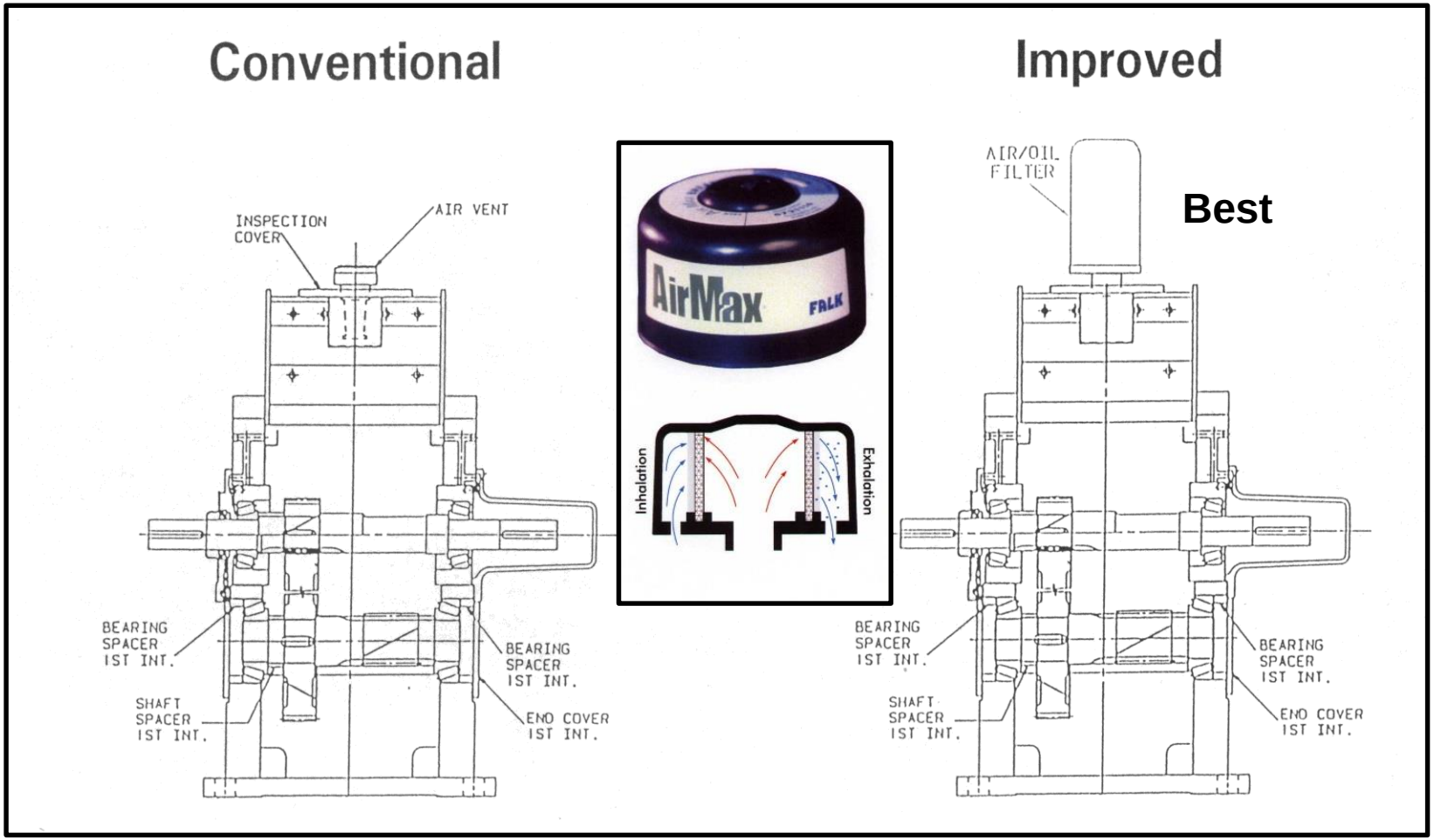
H2O
In Oil



Keep the Water Out
With Proper Ventilation
Systems/Breathers…

Healthy Gearbox Maintenance Reminders

Check & Clean Air Vent Filters At Least Twice A Year



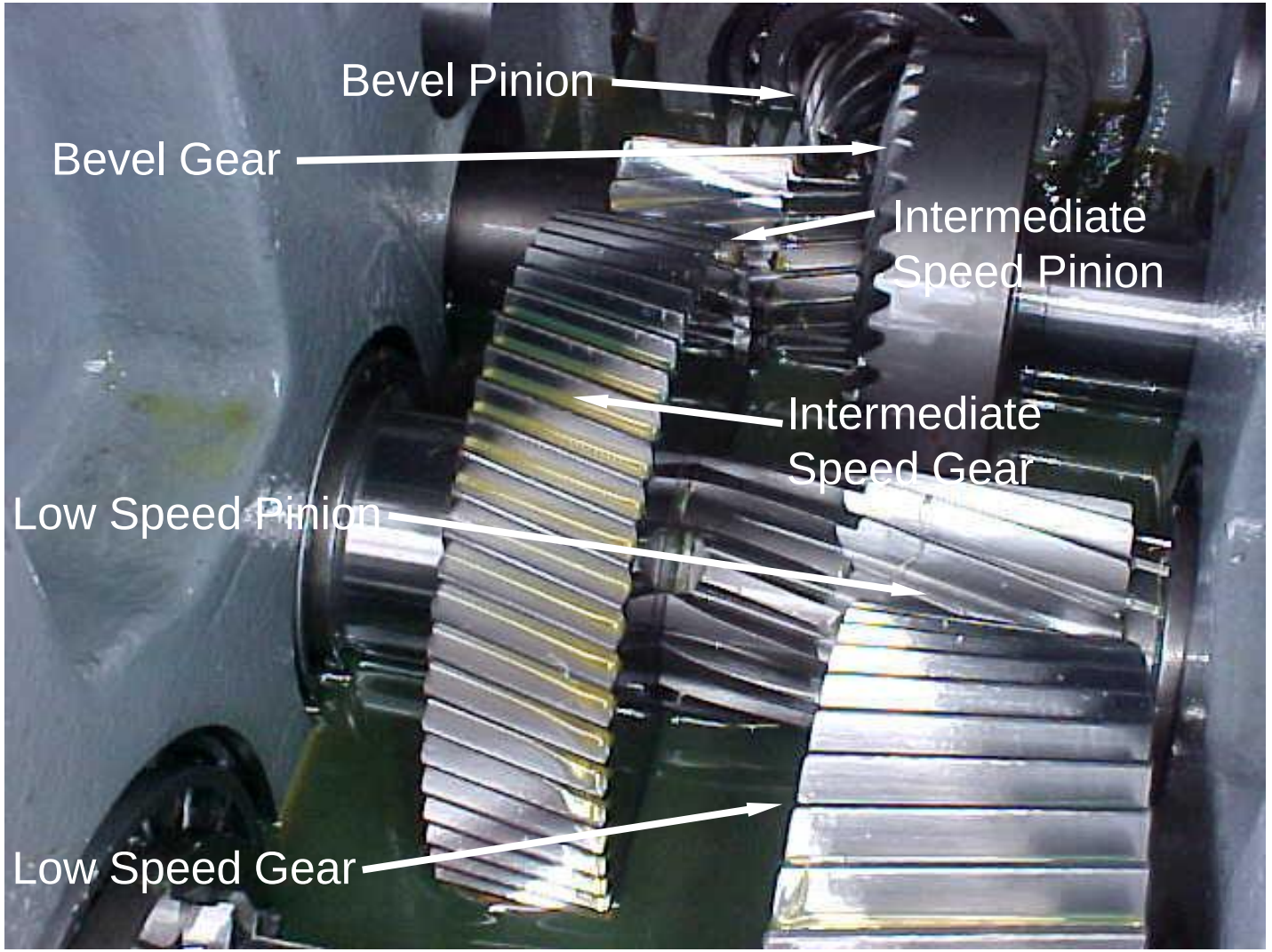
Healthy Gearbox Maintenance Reminders

Store Inside Or Away From The Elements…

- Store Properly Per Manufacturer's Recommendations

Spare Ring Gears

Understanding Gearbox Clearances, Tolerances & Settings

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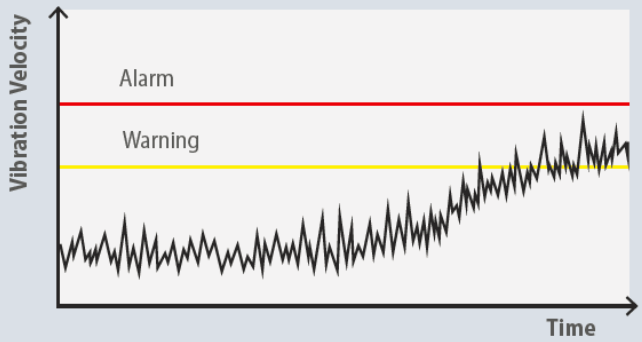
Healthy Gearbox Maintenance Reminders

CycloSmart™

Sumitomo Machinery Corporation of America (SMA), part of Sumitomo Drive Technologies, releases CycloSmart™. This vibration monitoring system provides predictive maintenance by notifying customers—via local ethernet or broadcast—if the machine needs attention. It minimizes the risk to the customer, while avoiding catastrophic failures. CycloSmart™ increases machine uptime, enabling customers to schedule convenient maintenance for their facility.

Predictive Data:



Machine vibration trend according to ISO 10816

Simulated real time data

Reliable Power
Transmission Drives for your Industry Applications

SPECIAL AND DROP-IN UNITS

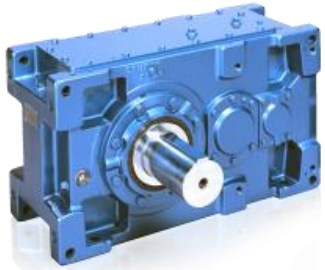
Drop-in Units
Customized Units
Premier Performance
Engineered Excellence
Reliable Quality
Global Network

Sumitomo Machinery Corporation of America

07.001.51.001

Thomas Hill Power, Clifton Hills, MO


Hansen P4




THANK YOU
GRACIAS
ARIGATO
SHUKURIA
DANKSCHEEN
TASHAKKUR ATU
YAQHANYELAY
BÏYAN
SHUKRIA
TINGKI
SUKSAMA
EKHMET
MEHRBANI
GRAZIE
MAAKE
SUMNIDA
KOMAPSUMNIDA
GOZAIMASHITA
EFCHARISTO
JUSPAXAR
PALDIES
BOLZÏN
MERCI