Dodge Industrial

California Grain and Feed Industry 2023 Conference

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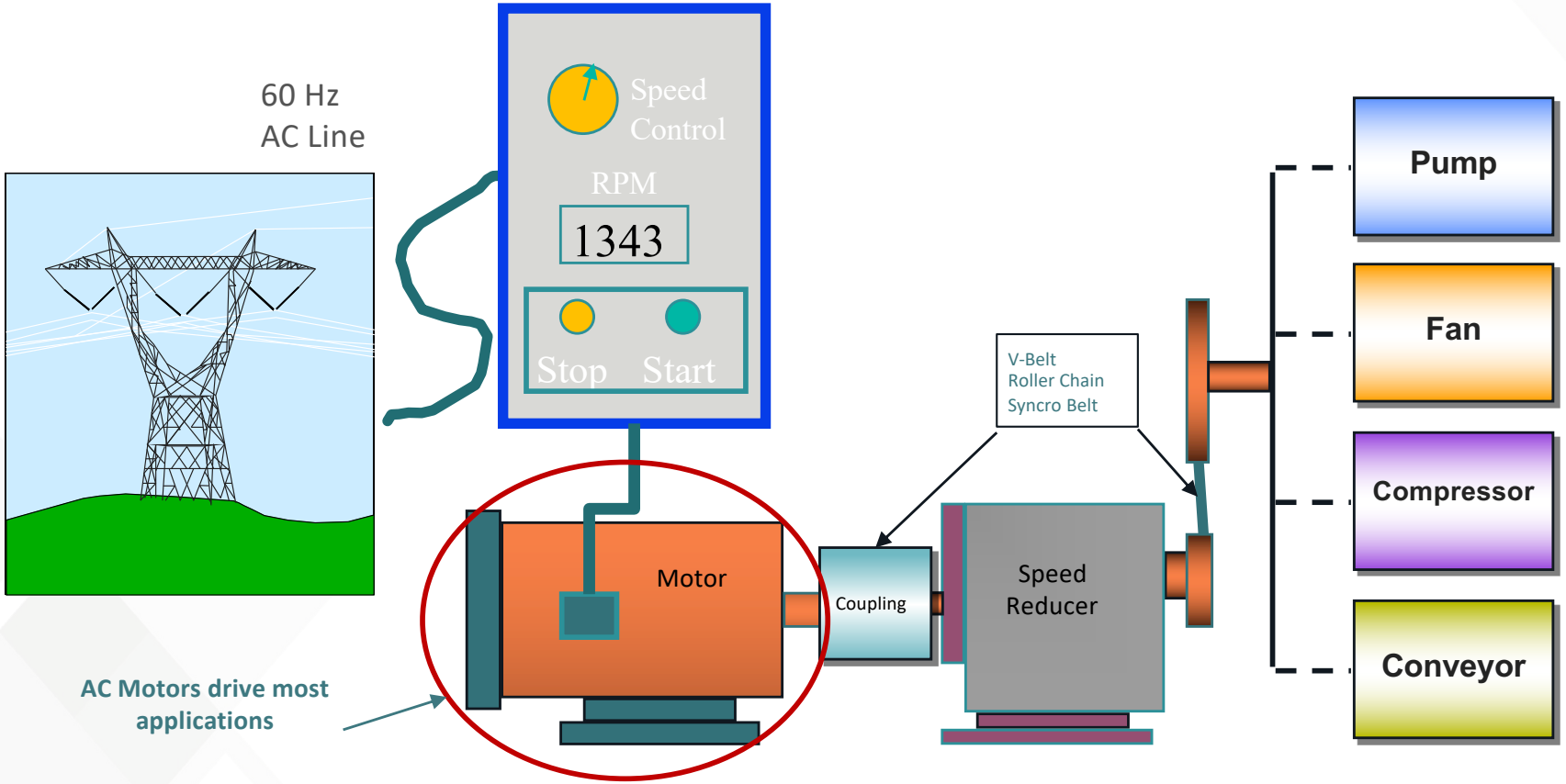
2023

80% Of Electricity used in Industry



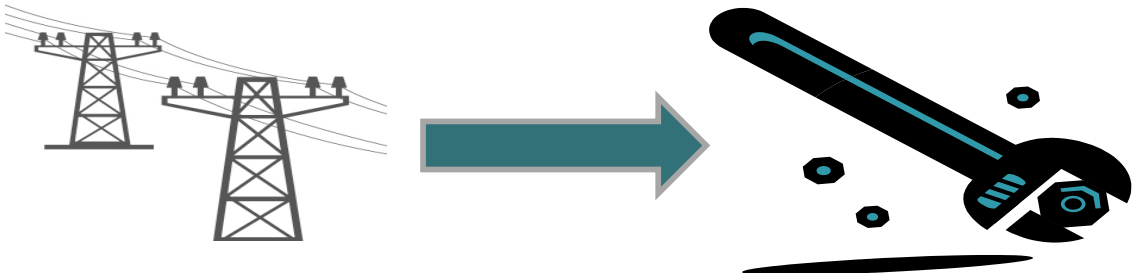
Power Transmission Systems

Typical Power Supply

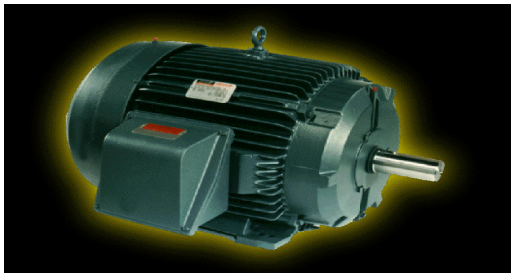
Power	Phase	Cycle Hz	Voltages
AC	Single	60	115 or 230
AC	Single	50	110, 208, 220 or 240
AC	Three	60	**208, 230**,400, 440, **460**, 575, 2300, 4160, 4600 or 6600
AC	Three	50	190, 380, 400, 415, 690 or 4000
DC	--	--	12, 24, 28, 36, 48, 72, 90, 150, 180, 240, 300 or 500

Most USA Homes

Most Common USA Industrial Activity



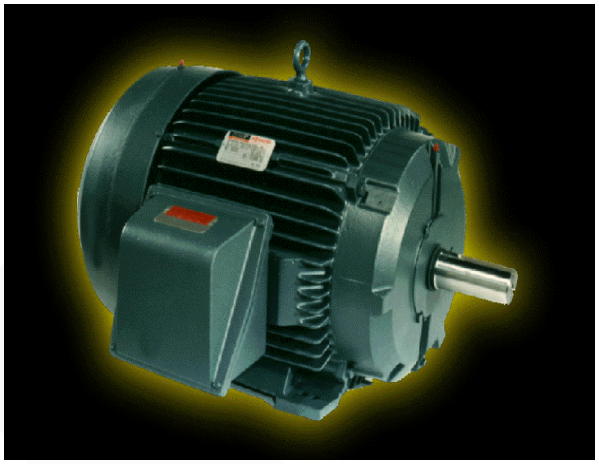
What is an Induction AC Motor?



It is a Machine that converts
Electrical Energy (watts) into
Mechanical Power
(horsepower)

Recommended Maintenance – AC Motors

Divided into two areas:



Mechanical
Electrical

AC motors require relatively little maintenance. However, what maintenance is required is "critical" towards achieving long, reliable motor life.

Storage Maintenance

Maintenance of electric motors in storage is a critical, but *often* an over-looked function.

Even those facilities that have good maintenance programs may not be taking adequate care of their stored equipment

A motor in storage on-site is there for one primary purpose:

It needs to be available for quick installation when a operating production motor goes down.

Storage Recommendations

If at all possible, electric motors should be stored in a clean, dry, low relative humidity (60% or less) environment.

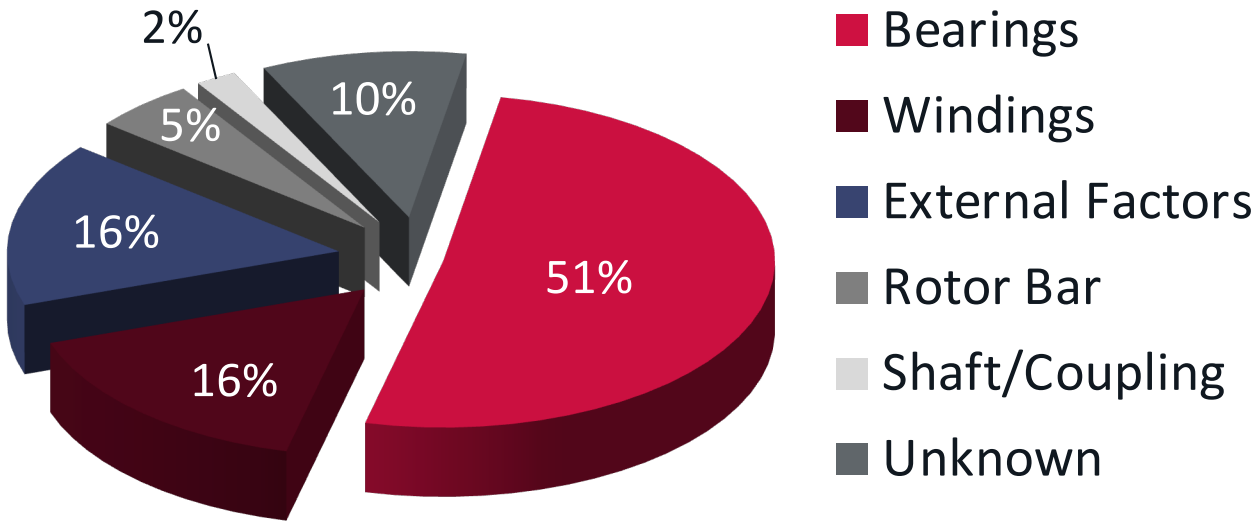
This will help prevent condensation build-up on windings and bearings

If motors are equipped with space heaters, they should be energized.

Typical motor failures

Motors fail for a variety of reasons.

But, with proper maintenance, you can reduce or eliminate most causes.



Mechanical Maintenance

Typical mechanical maintenance items are:

Bearing Lubrication
- Grease
- Oil

Cleaning
- Housing
- Enclosure
- Filters

Lubrication

Bearing life is directly proportional to lubricant life.

All bearings (except sealed) for use in small horsepower motors, require re-lubrication during their entire service life.

Proper Lubrication is the key to long bearing life.

Lubrication Consideration

Identify motor service conditions.

- Environment, temperature, operating hours, etc.

Define re-lubrication period.

- Required interval based on service conditions.

Determine amount of lubricant.

- Amount of grease to add is based on motor (bearing) size and type.

Lubricate motor per manufacturer's lubrication procedures

Service Conditions

Standard:

Eight hours per day, normal or light loading, clean, 40^0 C. maximum ambient.

Severe:

Twenty-four hours per day, or shock loading, vibration, dirt or dust @ 40 - 50^0 C. ambient.

Extreme:

Heavy shock, vibration, or dust.

Service Conditions

Service Condition	Ambient Temp	Bearing Load	Atmosphere	Operating HRS. per Day
Standard	-18C to 40C	Steady	Clean	8
Severe	-30C to 50C (1)	Medium Shock Vibration (<0.2 in/sec)	Medium Dirt Abrasives Corrosion	8 to 24
Extreme	-54C to 65C (1)	Heavy Shock Vibration (<.44 in/sec)	Heavy Dirt Abrasive Corrosion	8 to 24

(1) Motors must be specially designed for operation in ambients outside the range of -30C to 40C
(2) "Extreme" service condition are rare in actual practice. Corresponding lubrication cycles should therefore be applied with caution.

Lubrication Frequency

Speed	Frame	Standard	Severe	Extreme
=<1800	182-215	3 years	1 year	6 months
=<1800	254-365	2 years	9 months	3 months
=<1800	404-449	1 year	6 months	3 months
=>3600	All	6 months	3 months	1 month

Note: Roller bearings divide above time period by 2.

Greasing Procedure

1. Re-lubricate with the motor stopped, and warm if practical.
2. Clean grease inlet fitting!
3. Remove grease drain plug if installed.
4. Add recommended volume of fresh grease, hand operated grease gun.
5. *Run motor for 2 hours with grease drain open to allow grease purging.*
6. Replace grease drain plug.

Motor Cleaning

Dirty motors will run ***much*** hotter, due to a reduction in effective cooling properties.

Air inlet screens and passages should be kept free of obstruction.

Ventilation filters should be checked periodically and cleaned or replaced as necessary.

Build-up of contaminants on the frame surface of fan-cooled TEFC motors will greatly reduce cooling.

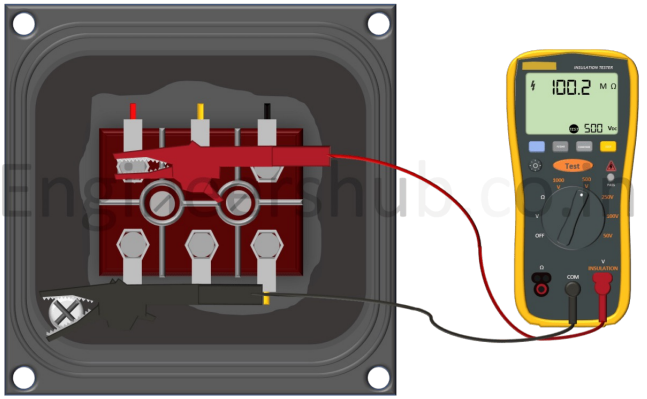
Electrical Maintenance

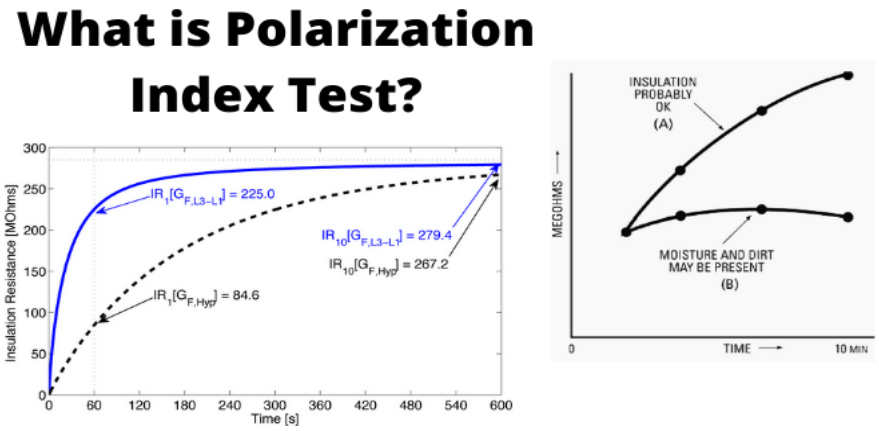
Typical electrical maintenance items are:

Insulation Resistance
- Megger
- Polarization Index

Electrical Connections
- Tightness

Winding Cleanliness
- Clean with dry compressed air





Managing Repairs

Develop a quality motor repair specification.

- Manufacturer, repair shop, industry specifications

Select the “best” repair vendor or vendors.

- *Audit shops for selection*

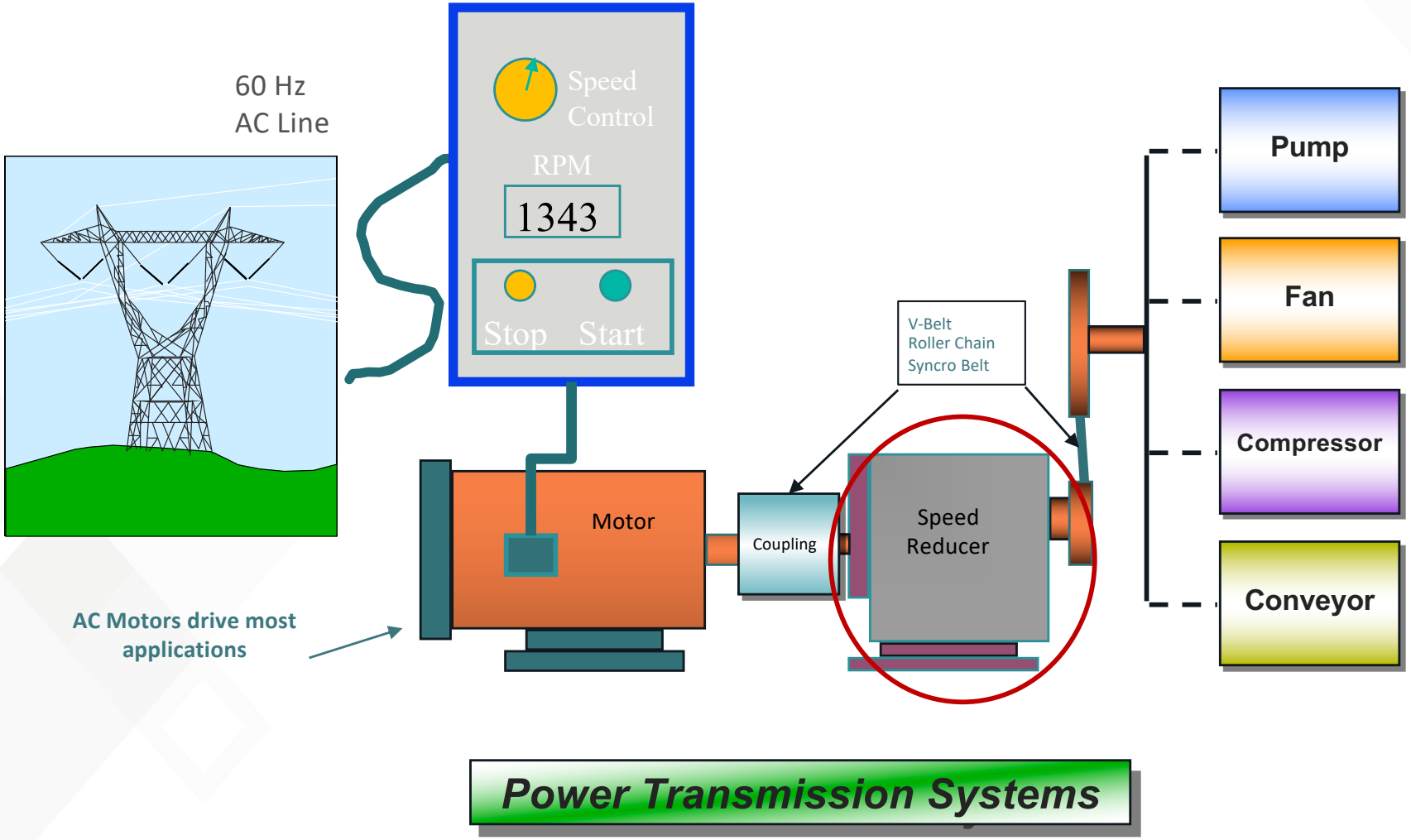
Periodically *audit repair vendors*.

- Management & personnel change affects quality

Establish good communication with you’re preferred repair vendors.

Most repair conflicts are in part due to poor communication

80% Of Electricity used in Industry



Power Transmission Systems

Dodge Industrial Gearing

Preventive Maintenance

- Arrangements/Types
- Why do we want to maintain gearboxes?
- Storage and Installation
- Lubrication
- Troubleshooting

Made in U.S.A

Greenville, SC

DODGE Bulk Material Handling

Common Gearing Types

Torque-Arm II

Drive packages up to 400 HP

Single drive assembly

Screw conveyor drive assembly

DODGE Bulk Material Handling

Common Gearing Types

Motorized Torque-Arm II

Drive packages up to 100 HP

Single drive assembly

Screw conveyor drive assembly

DODGE Bulk Material Handling

Common Gearing Types

Maxum XTR

Drive packages up to 1000 HP

Scoop mount assembly

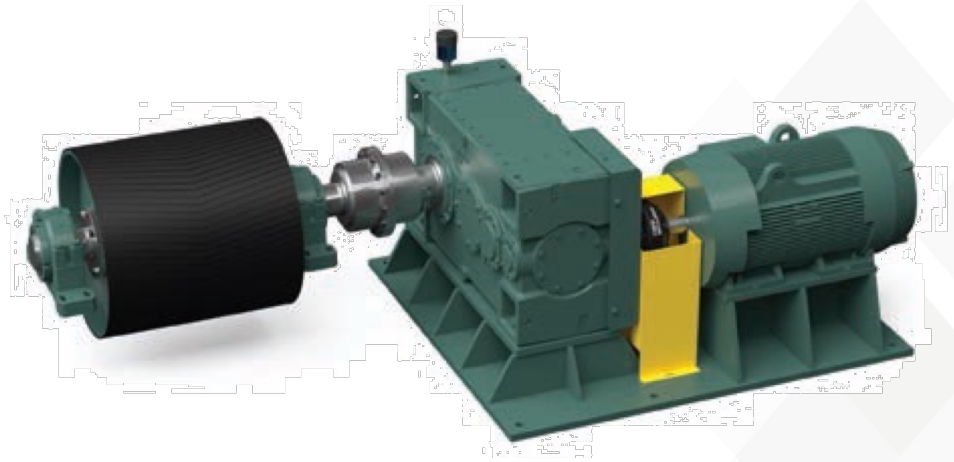
Top Motor mount assembly

DODGE Bulk Material Handling

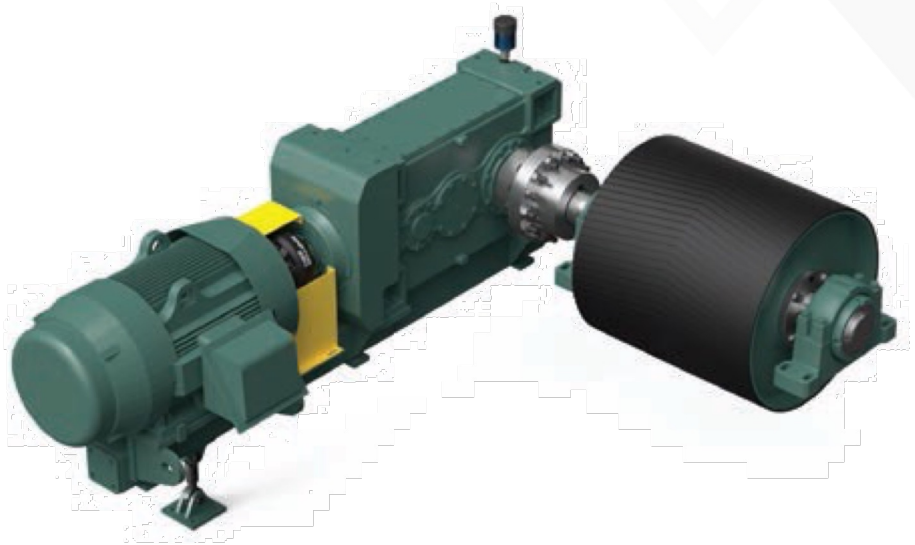
Common Gearing Types

Magnagear XTR

Drive packages up to 2500 HP



Offset parallel, base mount assembly



Right angle, swing base with moment cplg assembly

Characteristics of Good Maintenance

- **Increases machinery uptime**
- **Reduces total cost of ownership**
- **Starts before gearbox is installed**
- **Minimizes unknowns**
- **Documented procedures**
  - › Conveys importance
  - › Standardizes work

Why Do Gearboxes Fail?

- **Lubrication Issues**
- **Improper installation**
- **Overloaded conditions**
- **Manufacturing or material defect**

Long Life Starts With Proper Storage

- **General storage recommendations**
  - › Covered
  - › Indoors
  - › Humidity controlled
- **Short term storage – less than 60 days**
  - › Gearbox typically shipped with internal rust preventive
  - › Keep in shipping container until installation
- **Long term storage**
  - › Requires more corrosion protection than short term
    - Internal protection
    - External protection

- **Follow manufacturer's recommendations**

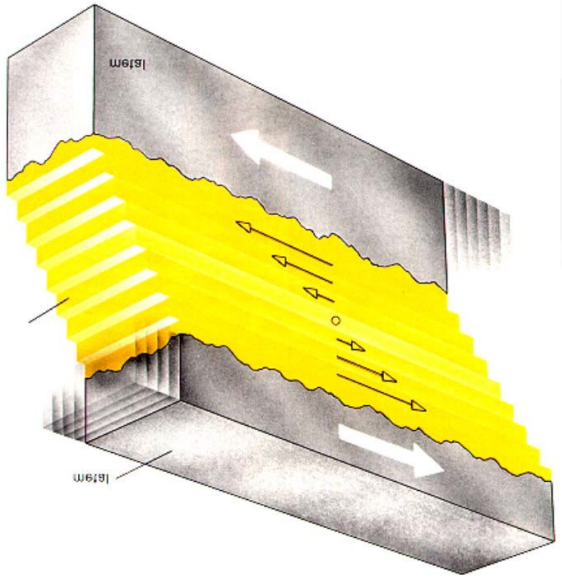
Installation

- **Foundations**
  - › Rigid
  - › Integral to driven equipment
- **Alignment**
  - › Parallel and Angular
    - Shafts
    - Belts
  - › Start with low speed shaft
  - › Work towards high speed
- **Check soft foot**
- **Shaft mount tie rod must not be bound up**
- **Install sheaves as close to reducer as possible**
- **Tension belts and chains properly**

Lubrication Basics

- **The primary function**
  - **Reduce friction**
  - **Carry off heat**

- Microscopic irregularities on each surface will create friction and resist movement.
- The function of a lubricant is to reduce friction by separating the surface irregularities with a microscopic fluid film.
- When adjoining surfaces are sufficiently separated by such a fluid film during movement, surface wear is minimized.



Friction

Lubrication

- **Improper Lubrication is a Leading Cause of Gearbox Failures**

- **Contaminated oil**
- **Incorrect oil fill level**
- **Incorrect oil**
  - › Incorrect oil viscosity
  - › Improper oil type, Mineral or Synthetic PAO or PAG

Oil Contamination

- **Types**
  - › Particles
    - Dirt
    - Process materials
    - Metal
  - › Water

Contaminants create more contaminants once in gearbox

Oil Contamination

How do they get in the gearbox?

- Manufacture
- Wear
- Breathers
- Worn seals
- Oil changes

Goal is to keep contaminants out

Oil Contamination

- **How do we keep them out of the gearbox?**
  - Identify the operating environment - Proactive
    - Is it humid?
    - Are there extreme temperature variations ?
    - Is the gearbox washed down / exposed to water ?
    - Is it dusty / dirty ?
  - Identify the contaminants – Reactive
    - Oil sampling
  - Filtration- Proactive
    - Air
    - Oil
  - Barriers -Proactive
    - Harsh Duty Seal Systems

Proactive Contamination Control - Breathers

- **Key Points:**
- **Ensure the breather is right for the environment**
- **Clogged breathers can lead to seal leaks**

- Types:
- Open – No filter, no protection
- Pressure relief – Opens at specific internal pressure
- Filtered – Mesh varies, Most standard breathers have 40 micron filter
- Desiccant – Takes out water, filters incoming air
- Hybrid desiccant – Similar to desiccant except “closes” off the system

Oil Life

When should I change the oil?

It Depends

- Additives will oxidize over time and begin to form sludge and acid
- Contaminants cause wear
- High temperatures reduce oil life

Operating Temperature vs. Oil Life

- **Useful Life of Mineral Oil at 200F is 2,000 Hrs.**
- **Useful Life of Mineral Oil at 150F is 14,000 Hrs.**
- **Decreasing Temperature by 25% will Increase Lubricant Life 700%**

Keep Oil Clean, Cool, and Dry for longest life

Lubricant Change Intervals

- **Manufacturer's recommendations**
  - › Time based - 600 hours for first
  - › Typically 2500 to 6000 hrs depending on lubricant type

- **Oil-analysis based changes**
  - › Condition based – Proactive measure
  - › Check incoming oil
  - › Monthly samples on critical equipmen
  - › Detects:
    - Contamination
    - Lubricant degradation
    - Component wear
  - › Saves money

Oil change best practices

- Clean area where oil fill takes place
- Quick connects reduce contaminant introduction
- Flush the gearbox with oil
- Check the magnetic plug
- Clean breather
- Filter incoming oil

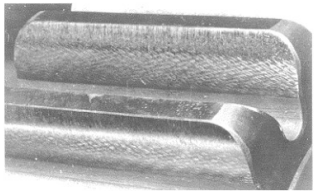
Draining alone can leave 50% of contaminants in gearbox

Source: Evolution of the gearbox oil change, Aaron Sage

Oil Levels

- **Low levels**
  - › May cause oil starvation resulting in gear and bearing wear
  - › Will create excessive heat





- **High levels**
  - › Cause churning – leading to excessive heat
  - › Entrapped air – pump cavitation and poor lube film

- **Correct level should be checked with reducer not operating and after reducer has cooled**
- **Level may be variable based on operating speed**
- **Sloped installations probably require special provisions**

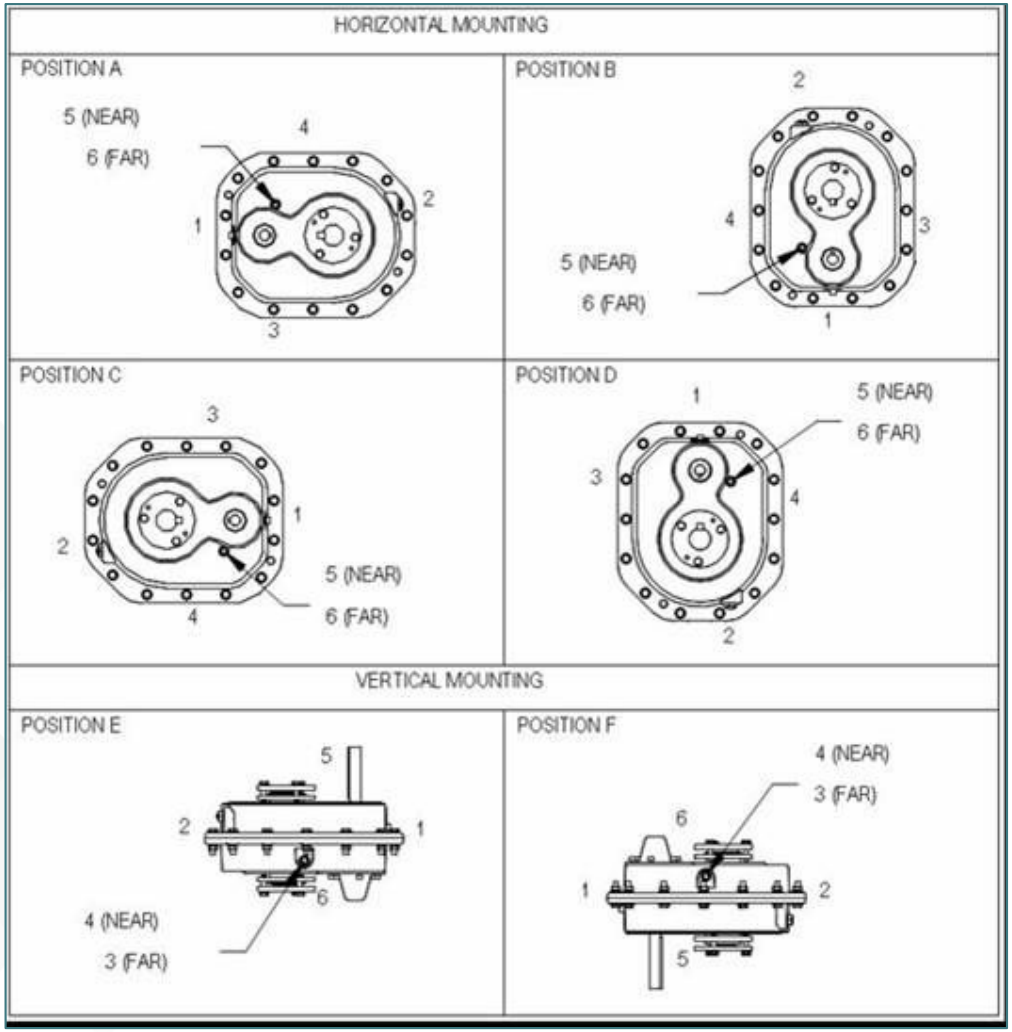
Oil Levels

Torque Arm in “B” Position

- **Location of Breather, Drain Plug, and Level Plug depend on Mounting Position**

Reducer Shown in “B” Position

Oil Levels



Position Determines:

- Location of Breather
- Location of Oil Level Plug
- Location of Drain Plug
- Location of “dead plugs”
- Oil Level (Capacity)

LUBRICATION OF TORQUE-ARM II REDUCERS (CONT'

Table 4 - Oil Volumes

Case Size	Ratios	Oil Volume in Quarts †■▲●					
		Horizontal				Vertical	
		A	B	C	D	E (Up)	F (Down)
TA0107L	Single	0.7	0.5	0.7	1.4	1.3	1.5
	Doubles	0.7	0.5	0.6	1.3	1.2	1.4
TA1107H	Single	1.3	0.7	0.7	1.7	1.5	1.9
	Doubles	1.3	0.7	0.6	1.7	1.5	1.9
TA2115H	Single	2.1	1.2	1.1	2.7	2.3	3.1
	Doubles	2.1	1.1	1.0	2.6	2.4	3.0
TA3203H	Single	2.8	1.6	1.8	4.1	3.3	4.4
	Doubles	2.8	1.5	1.7	4.0	3.4	4.2
TA4207H	Single	4.4	2.6	2.9	7.4	6.3	7.8
	Doubles	4.4	2.5	2.8	7.3	6.4	7.5
TA5215H	Single	7.4	4.9	5.8	13.2	11.6	13.1
	Doubles	7.4	4.7	5.5	12.9	11.4	12.6
TA6307H	Single	8.8	5.8	6.6	16.1	13.2	16.1
	Doubles	8.8	5.5	6.2	15.8	13.9	15.3
TA7315H	Single	8.4	11.8	13.9	22.5	22.1	25.1
	Doubles	8.4	10.8	13.2	22.0	22.4	23.1
TA8407H	Doubles	7.7	11.7	13.7	25.1	24.0	25.8
TA9415H	Doubles	17.0	16.8	18.1	33.2	33.2	38.6
TA10507H	Doubles	38.0	27.6	25.8	53.5	53.8	56.1
TA12608H	Doubles	53.0	41.5	37.1	70.7	72.2	80.4

V-Belt Drive Tensioning

- **Properly Align Sheaves & Tension V-Belts;**
- **V-Belts That are Improperly Installed Can Result In**
  - Decreased Life of Input Bearings
  - Improper Transmission of Power (Slipping)
  - Excessive Noise & Vibration
- **Check sheave grooves. If grooves are worn, belt may have to be overtightened to transmit power- uh-oh..**
- **Install sheaves as close to motor and reducer as possible to reduce overhung load stresses**

Thank you for your business, how can we help further?