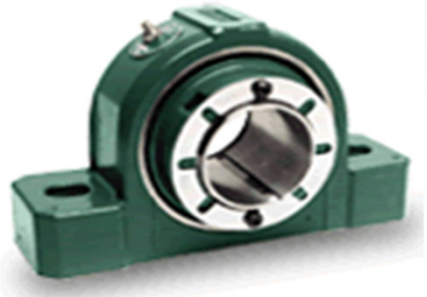
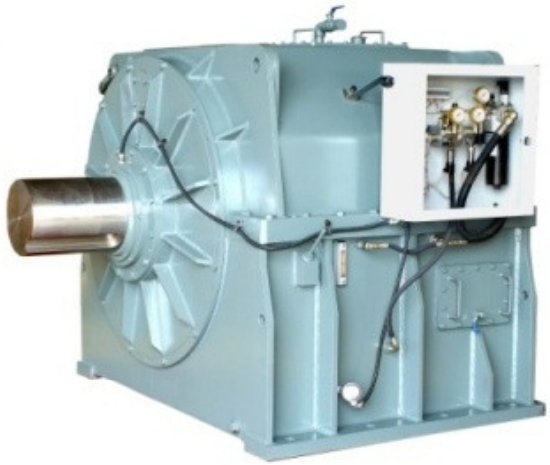
High Value Bearing Products

- **Mounted Bearings**
- **Enclosed Gearing**
- **PT Components**
- Offering mechanical power transmission products for more than 140 years
- High quality, high value, long-lasting, feature-rich
- Complete line of mounted bearings, gear reducers and power transmission components
- Innovative and globally compatible product solutions
- Leading U.S. manufacturer of bearings and gearing products

DODGE





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DODGE High Value Products

- Lower overall cost over the total product lifecycle
- Higher uptime and reliability
- Longer life
  - Higher ratings
  - State of the Art Sealing
  - Higher speed
  - Advanced lubrication
  - Enhanced corrosion resistance
- Faster installation and removal
- Higher efficiency
- Low or no maintenance
- Predictive maintenance
- Improved serviceability

Dodge Mounted Bearings

Bearing Comparisons

Mounted Ball Bearing

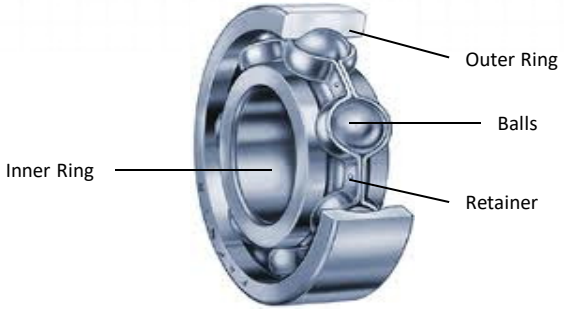
Exploded View

Assembled Unit

A self-contained system with it's own sealing package, lubrication system, & misalignment capability

- **Used in cooperation with other equipment to deliver performance**
- **Superior sealing systems mean that the life of a mounted ball bearing is prolonged in an application by prevention of contamination and retention of lubrication**
- **Quick and easy installation**
- **Significant value afforded to the user because of the capability to maintain productivity & uptime and reduce maintenance**
- **Consists of:**
  - **Housing**
  - **Spherical outer ring**
  - **Wide inner ring**
  - **Mechanical shaft attachment**
  - **Robust sealing system**
  - **Cage**
  - **Balls**
  - Grease Fitting
  - Anti-Rotation Pin
  - **Lubrication**

Standard "Naked" Ball Bearing



A component part of a larger piece of equipment, like a motor, an axle, or a conveyor roller

- **Life and performance of a "naked" ball bearing are a function of the capabilities of the parent equipment**
- **Installation / replacement may be difficult within parent equipment; no misalignment capability**
- **Little value afforded to the user solely by a naked bearing alone**
- **Consists of:**
  - Cylindrical outer ring
  - Narrow inner ring
  - Limited sealing system
  - Loose or press fit shaft attachment
  - Balls
  - Retainer

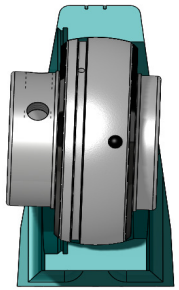
A "naked" ball bearing is made up of components similar, but dimensionally different, to the components of the assembled mounted ball bearing system. Manufacturing processing is similar, but tooling packages and capital requirements are different.

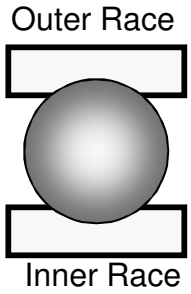
General Bearing Comparisons
DODGE Products

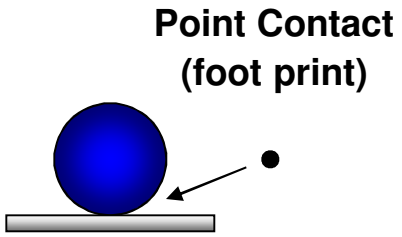
	Ball	Tapered	Spherical
Speeds	High	Med (~70% of B.B. Speeds)	Med – High
Typical Load Capacity	1X	3X	3.5X
Radial Loads	Low	Med – High	High
Thrust Loads	Low - Med	Med	Low – Med ($F_r > F_a$)
Static Misalignment	+/- 2° (Insert Relative to Housing)	Insert Relative to Housing	+/- 2° (Less with Seal Considerations)
Dynamic Misalignment	None	None	+/- 2°
Temperature Range	-40° F to 225°F (High temp available to 400° F)		
Expansion Capability	Select PB Only	Yes, Except Type E	Yes
Mounting Methods	Setscrew, Eccentric, D-Lok, Adapter	Setscrew, Clamp Collar, Adapter	Setscrew, Adapter, Direct
Shaft Size Range	1/2" – 3 1/2"	1 3/8" – 12"	1 3/8" – 15 ¾"
Roller Shape	Ball	Tapered (Conical)	Spherical (Crowned Barrel)
Raceway Contact Shape	Point 	Line	Elliptical 

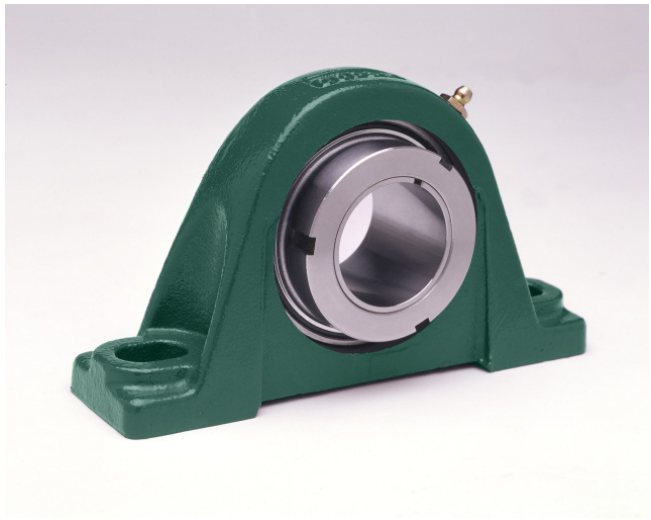
Ball Bearings

- Loads - Light to Medium
- Speeds – High
- Combination Loads
- No Minimum Load
- Static Misalignment



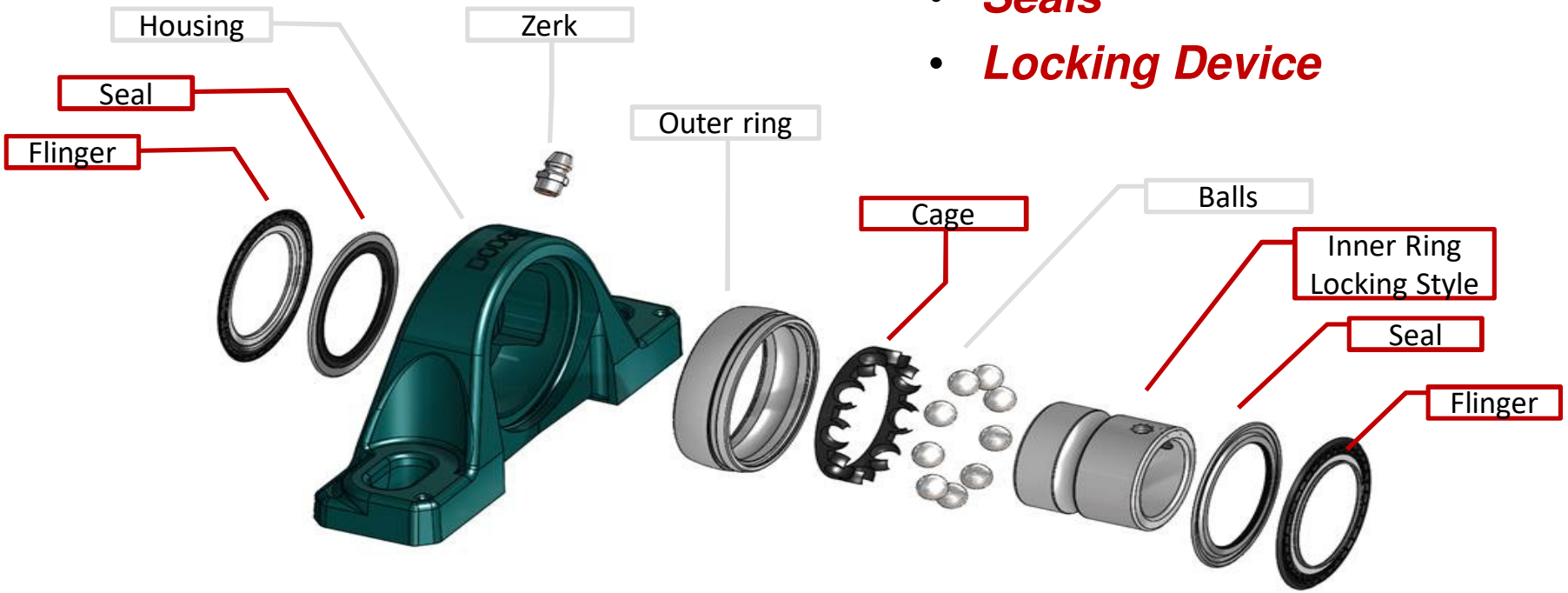






What makes up a Ball Bearing?

- **Mounted ball bearings consist of:**
  - **Housing**
  - **Bearing insert**
    - **Rings,Balls,*Cage***
  - ***Seals***
  - ***Locking Device***



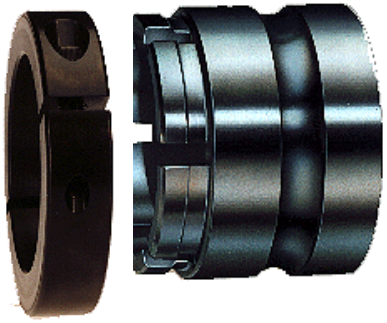
Locking Mechanisms

Shaft Attachments

Set Screw

Eccentric Locking Collar

Concentric Lock



Tapered Adapter Sleeve

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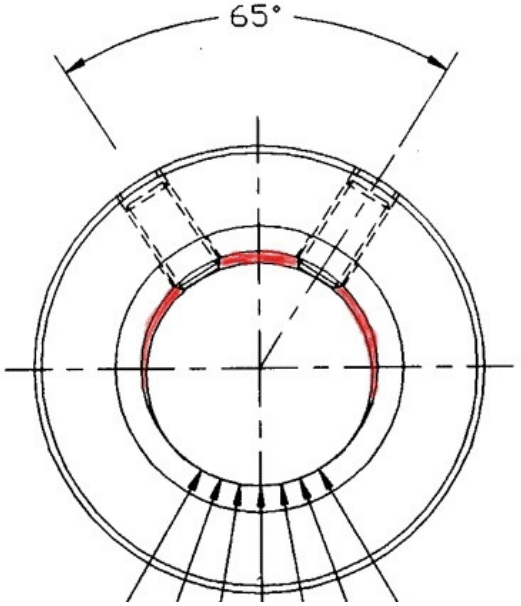
Set Screw

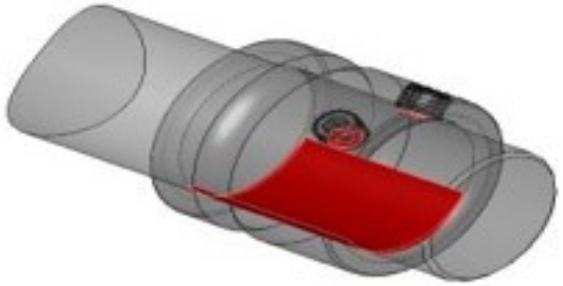
Advantages

- High axial holding power
- Quick, easy installation
- Few tools for installation
- Widely accepted

Disadvantages

- Mars shaft surface
- Fretting corrosion
- Difficult to remove
- Speed limitations
- Tight shaft tolerances



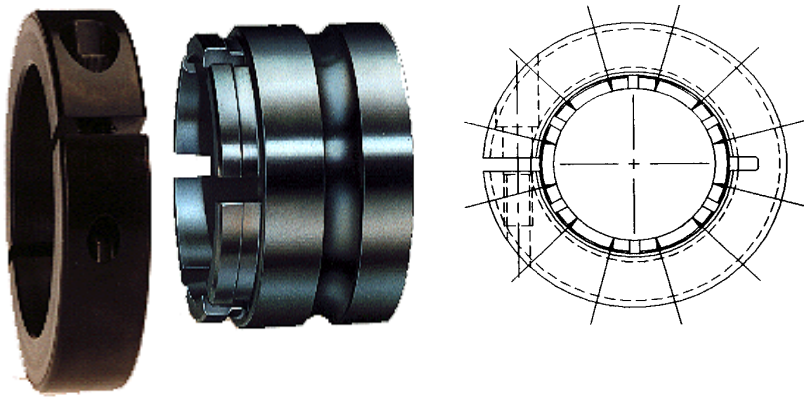


Concentric Lock

D-Lok

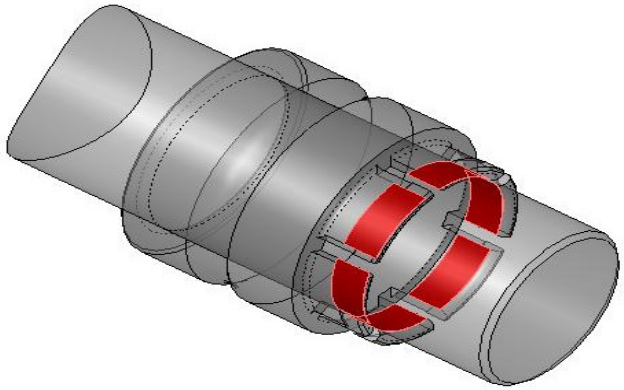
Advantages

- 360° Concentric fit to shaft
- Quick, easy installation
- Less vibration at higher speeds
- No setscrew damage to shaft



Disadvantages

- Fretting corrosion
- Less speed capability than direct/adapter mount
- Tight shaft tolerances
- Less hold than Set Screw



Tapered Adapter Sleeve

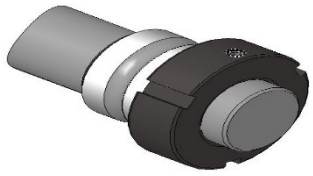
Grip-Tight

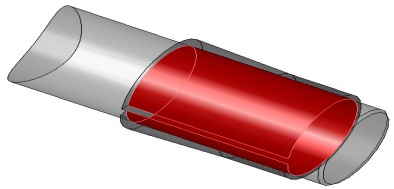
Advantages

- 360° Concentric locking thru total length of bearing
- Low vibration
- High speed capability
- No shaft damage
- Removal

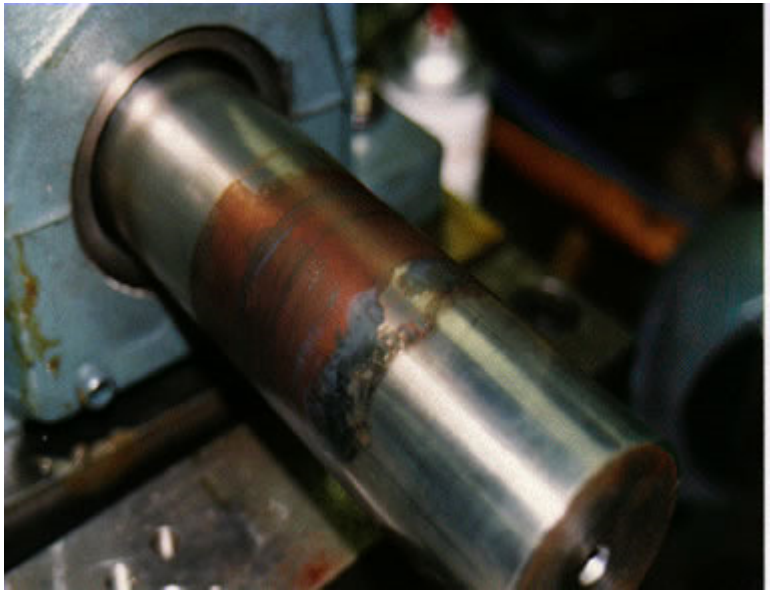
Disadvantages

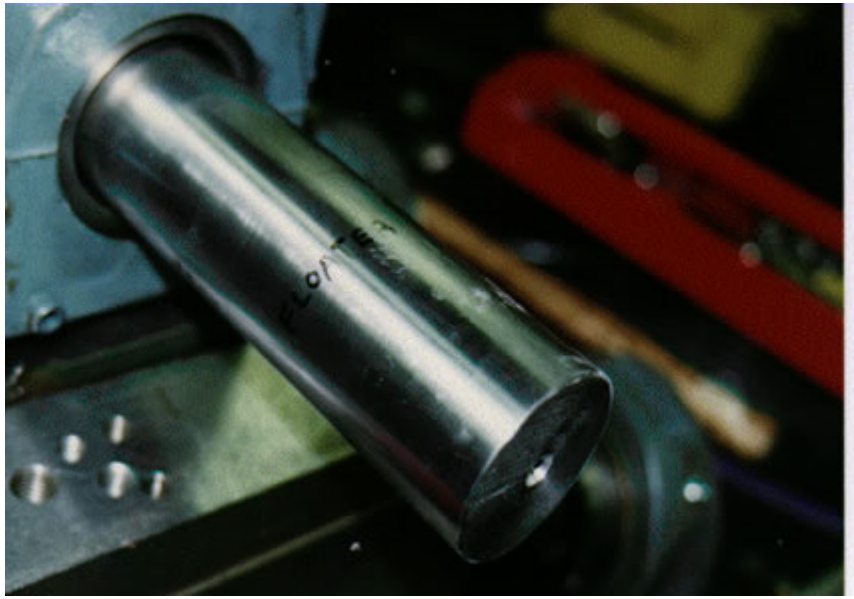
- Installation time





The Adapter Locking Method Eliminates Fretting





After only 500 hours in service, a setscrew mounted bearing will leave shaft corrosion and scarring

After 2500 hours in service the Grip-Tight Bearing demounts quickly and reveals no shaft fretting corrosion or scarring from setscrews

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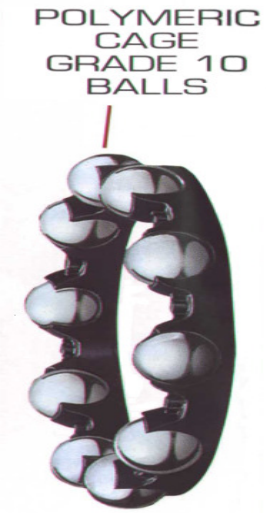
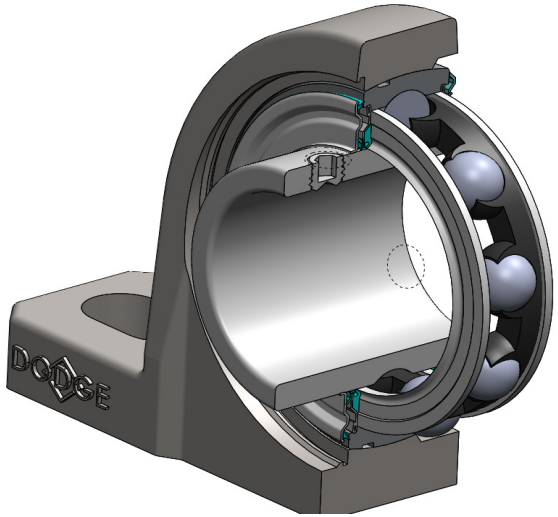
Inserts

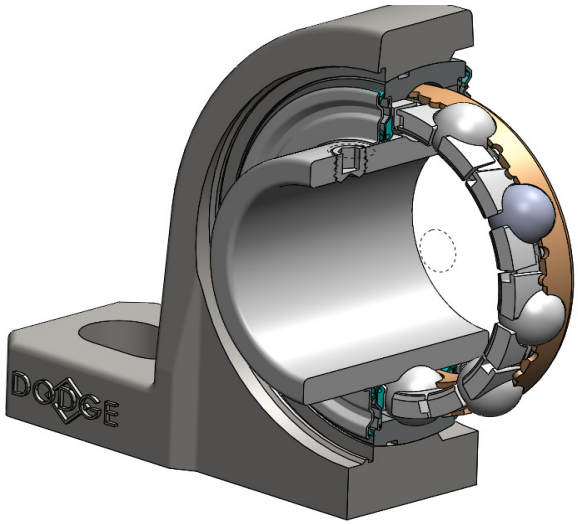
Rolling Element



Retainer or Cage

- Distributes balls evenly around the inner ring
- Tighter tolerances, Quieter operation





Dodge Patented Maxlife Cage

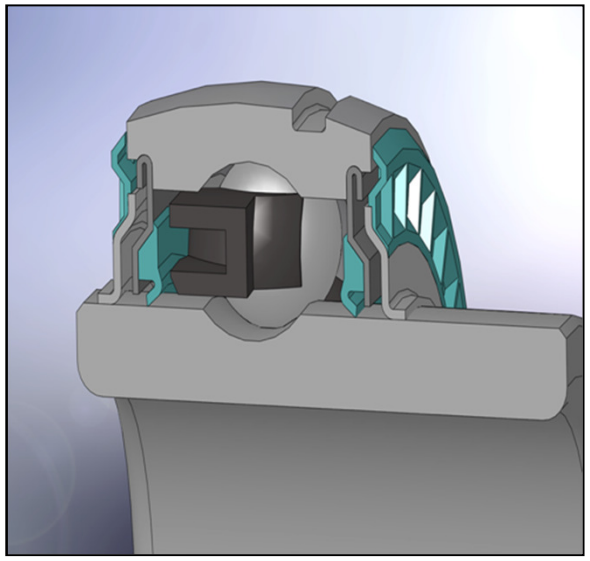
- Two piece design creates compartments that keep grease in close contact with balls
- Compartments help prevent grease from being washed out during high pressure cleaning
- Allows extended lubrication intervals
- Cooler operating temperatures extend grease life

Ball Bearing Seal Systems

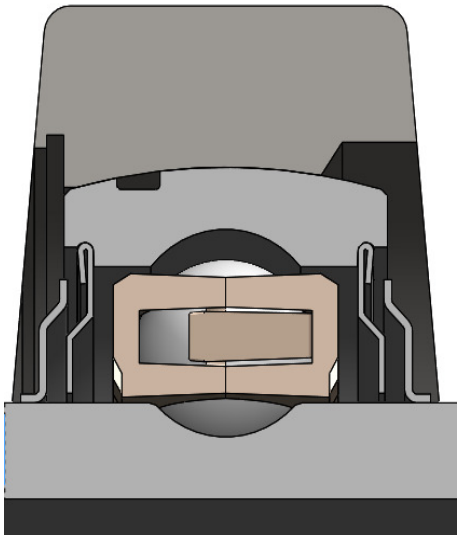
- Keep lubrication in
- Keep contamination out
- Allows contaminated lubricant to purge

Three Main Types

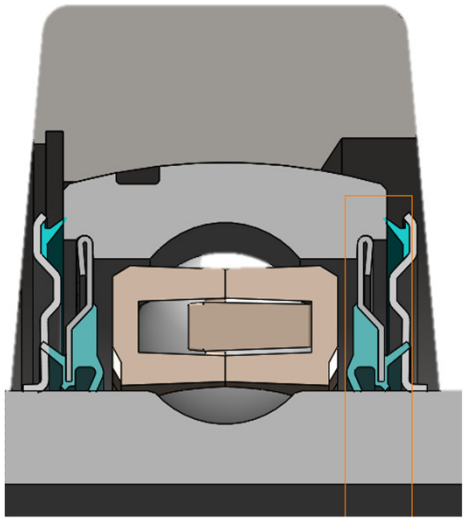
Contact Seals



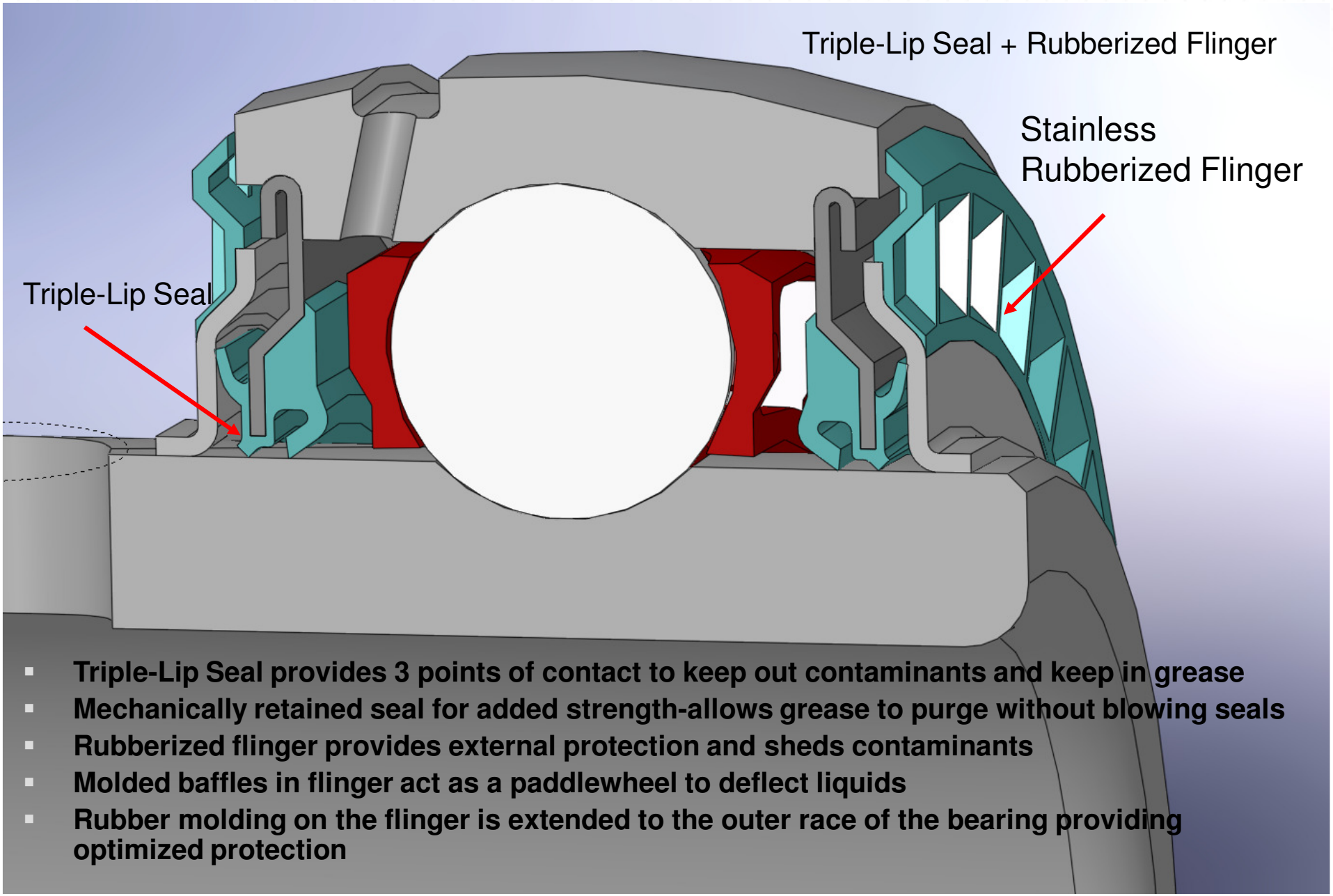
Labyrinth Seals



Combination Seals



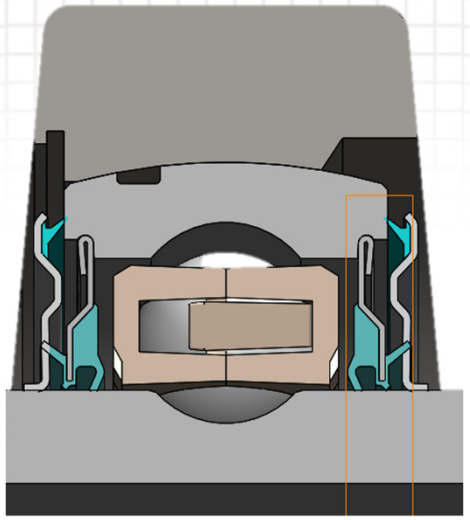
QuadGuard Sealing System

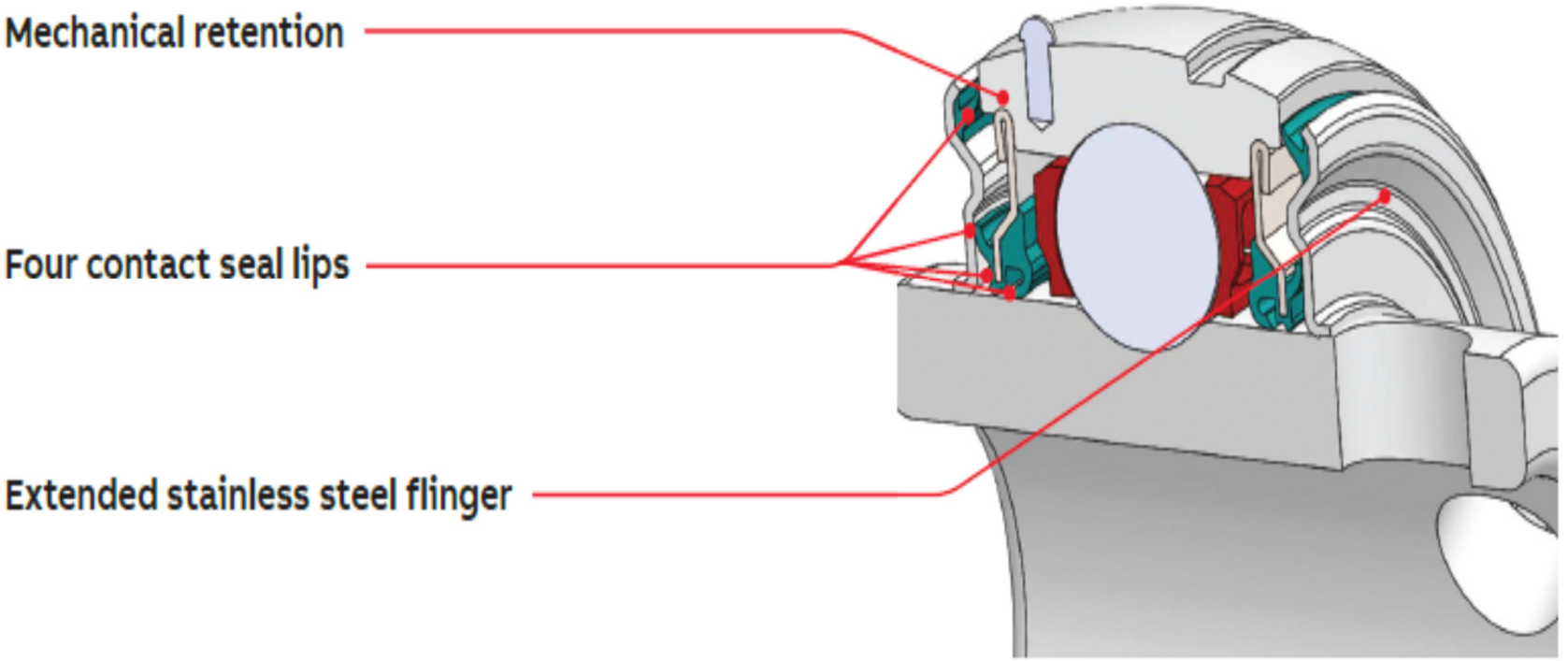


- **Triple-Lip Seal provides 3 points of contact to keep out contaminants and keep in grease**
- **Mechanically retained seal for added strength-allows grease to purge without blowing seals**
- **Rubberized flinger provides external protection and sheds contaminants**
- **Molded baffles in flinger act as a paddlewheel to deflect liquids**
- **Rubber molding on the flinger is extended to the outer race of the bearing providing optimized protection**

Hydro Armor Sealing System

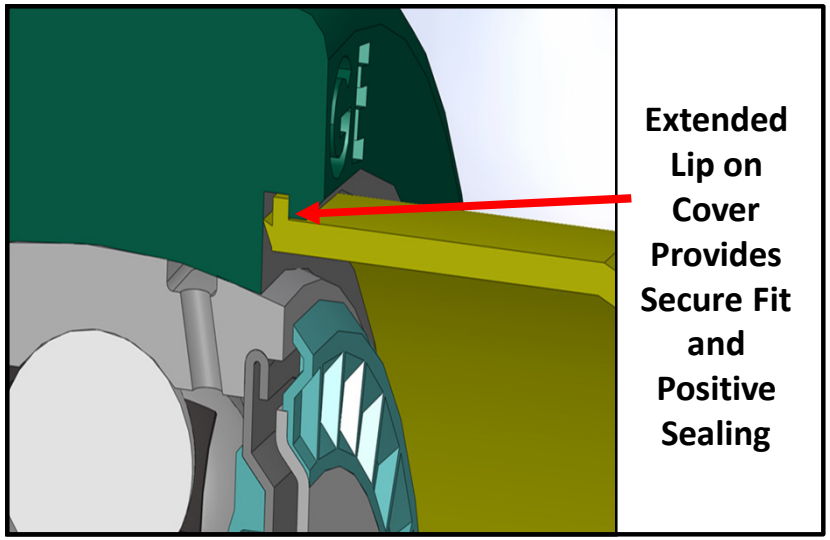
- Designed with four contact lip seals and an extended metal flinger for maximum protection
- Protects lubrication from contamination and washout
- Eliminates seal blowout due to mechanically retained design.





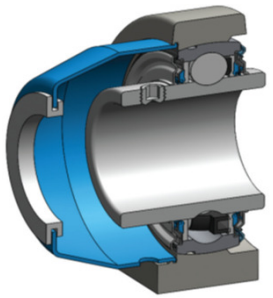
DODGE Ball Bearing End Covers

Extra Protection from Contamination and Lubrication



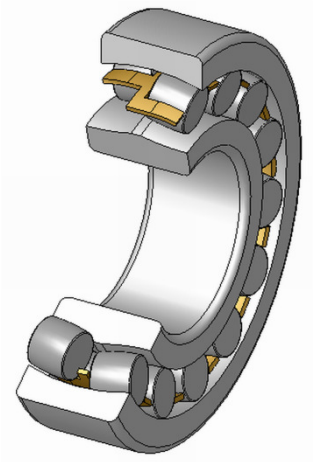
Snap-On End Covers: Machined groove in the housing accepts cover; secure fit to prevent spinning; keeps contaminants away from seal; creates safer work environment; OSHA-approved yellow; closed and open covers available.

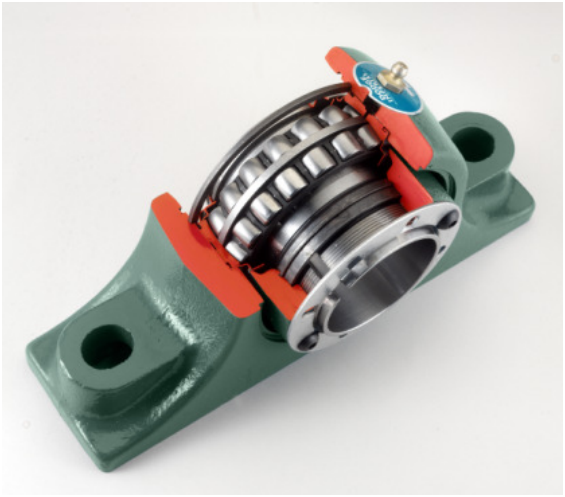
- **Standard feature on P2B, F2B & F4B housing styles, 204-212 Series**
- **New 214-218 Series availability pending**
- **Nomenclature:**
  - **ECC-205-Y, Closed 205 Series**
  - **ECO-100-Y, Open 1” Bore Size**



Spherical Roller Bearing

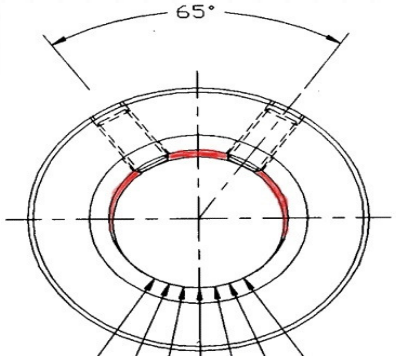
- **Designed for moderate to heavy loads**
- **Minimum load requirement**
  - Handles thrust loads as long as the radial load exceeds the thrust load
- **Cages: steel; sometimes nylon, brass**

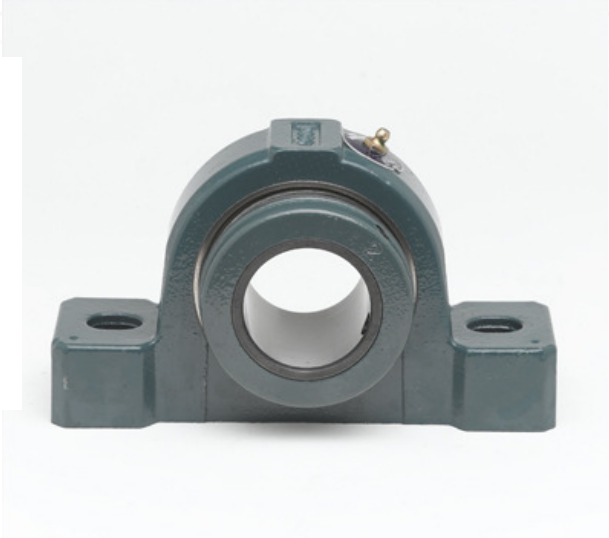


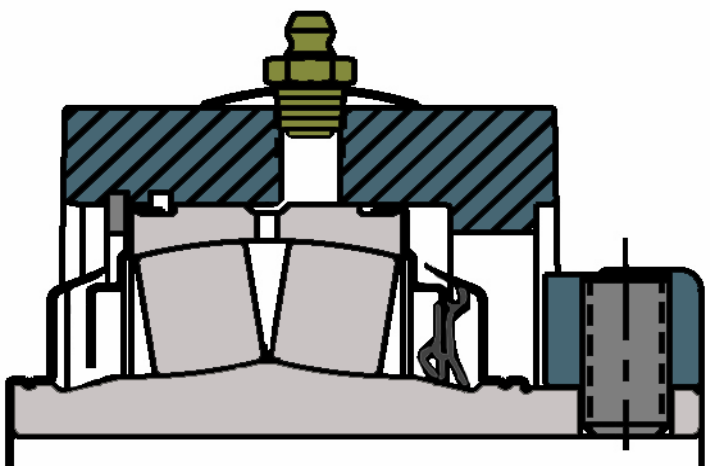


S2000: *Overview*

- Set screw shaft mount
- Replaceable insert
- Triple lip or labyrinth seals
- Expansion / Non Exp. convertible







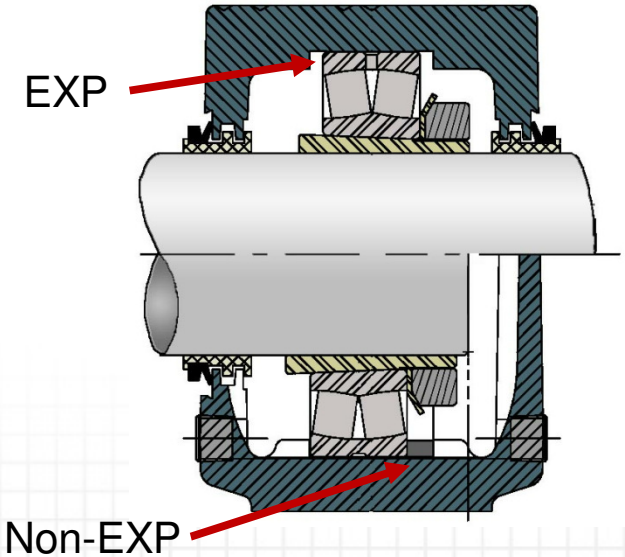
Benefits

- **Quick & simple installation**
- **Economical**
- **Easy insert replacement**
- **Application versatility**

USAF *Adapter Mount*

Features

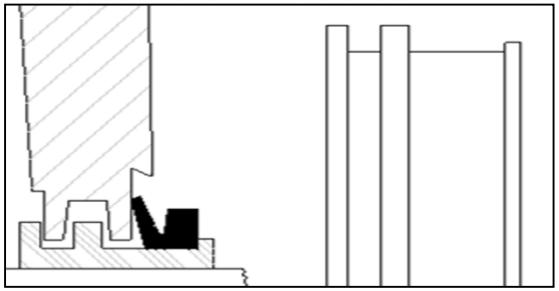
- Multiple bearing series
- ABMA adapter mounting system
- Large size range 1-7/16 – 15-3/4”
- USAF housings oil lube ready
- Wide choice seals
- Expansion / Non Exp convertible



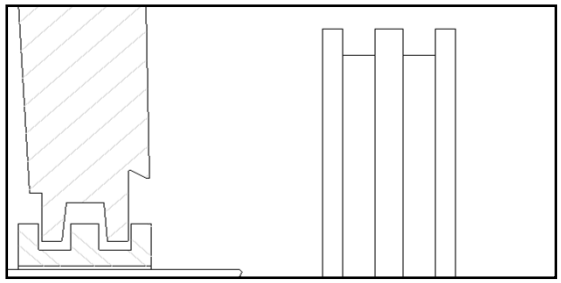
Benefits

- **Common bearings & mounting hardware**
- **Application versatility with multiple bearing series, seals and optional oil lube**
- **Split bearing & seals available**
- **Metric shaft sizes available**
- **Steel housings available on USAF**
- **Air Handling versions available**

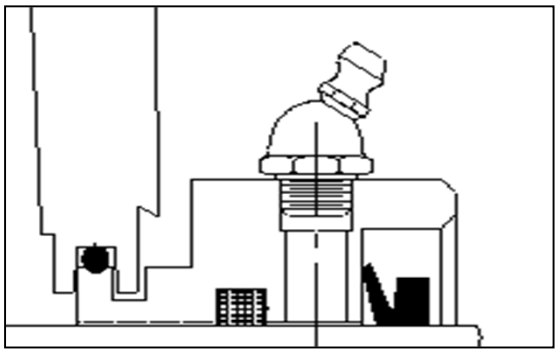
USAF Labyrinth/Clearance Seals



SAF Triple-Tect Seal
- General purpose seal for wet or dirty environments
- Limited misalignment capability
- Requires field installation



SAF LER Seal
- High speed for relatively clean or hot environments
- Provides metal labyrinth protection and easy installation
- Limited misalignment capability
- Requires field installation



SAF Auxiliary Taconite Seal
- For dusty environments
- Extremely limited misalignment capability
- Requires field installation

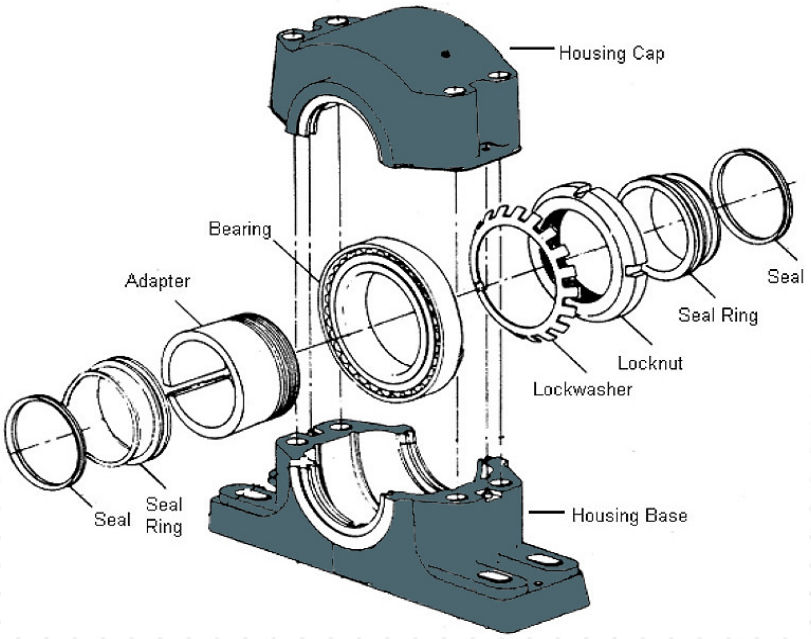
USAF *Adapter Mount*

Assembly

- **17 Step Process 2+ hours average**
- **Measurement Challenges**
  - Shaft/Journal Tolerance
  - Internal Clearance
    - EVERY Bearing is different
  - Reduction Table Chart
    - Math must be done correctly
    - Over/Under tightening
  - Location on shaft must be accurate
    - Wrong location must start over from the beginning
- **Lubrication**
  - Proper amount (size/speed)
  - Dual use oil/grease require 2x
  - Contaminants collect in sump
- **Cap to Base**
  - Ensure seals not pinched
  - Safety of fingers
  - Proper Cap Bolt Torque

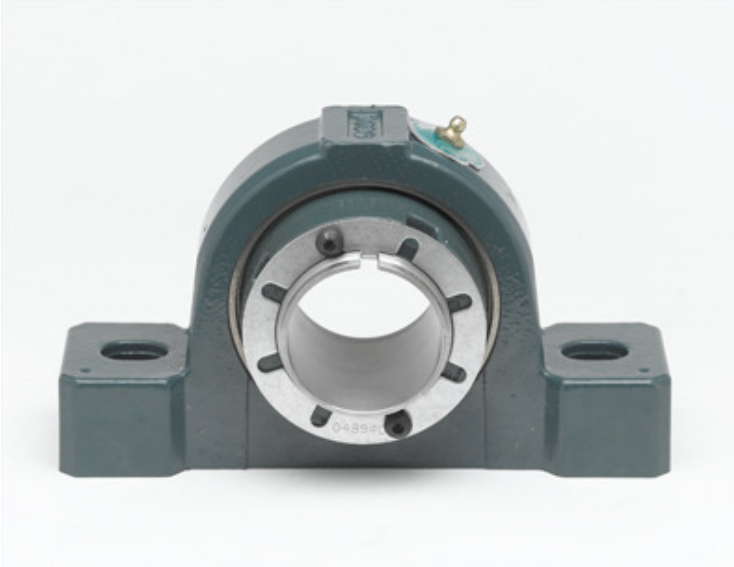
RADIAL CLEARANCE REDUCTION OF DODGE SPHERICAL ROLLER BEARINGS WITH TAPERED BORE

Nominal Bore		Basic* Bearing Description	Reduction in Radial Clearance (in.)		Radial Clearance Prior to Mounting (in)		Axial Displacement of Bearing Relative to Sleeve (in.)		Smallest Permissible Radial Clearance After Mounting (in)
From	To		Min.	Max.	Min.	Max.	Min.	Max.	
1-7/16	/	22209K	.0010	.0012	.0024	.0031	.018	.020	.0014
1-11/16	/	22210K	.0010	.0012	.0024	.0031	.018	.020	.0014
1-15/16	/	22211K	.0012	.0015	.0030	.0037	.020	.028	.0015

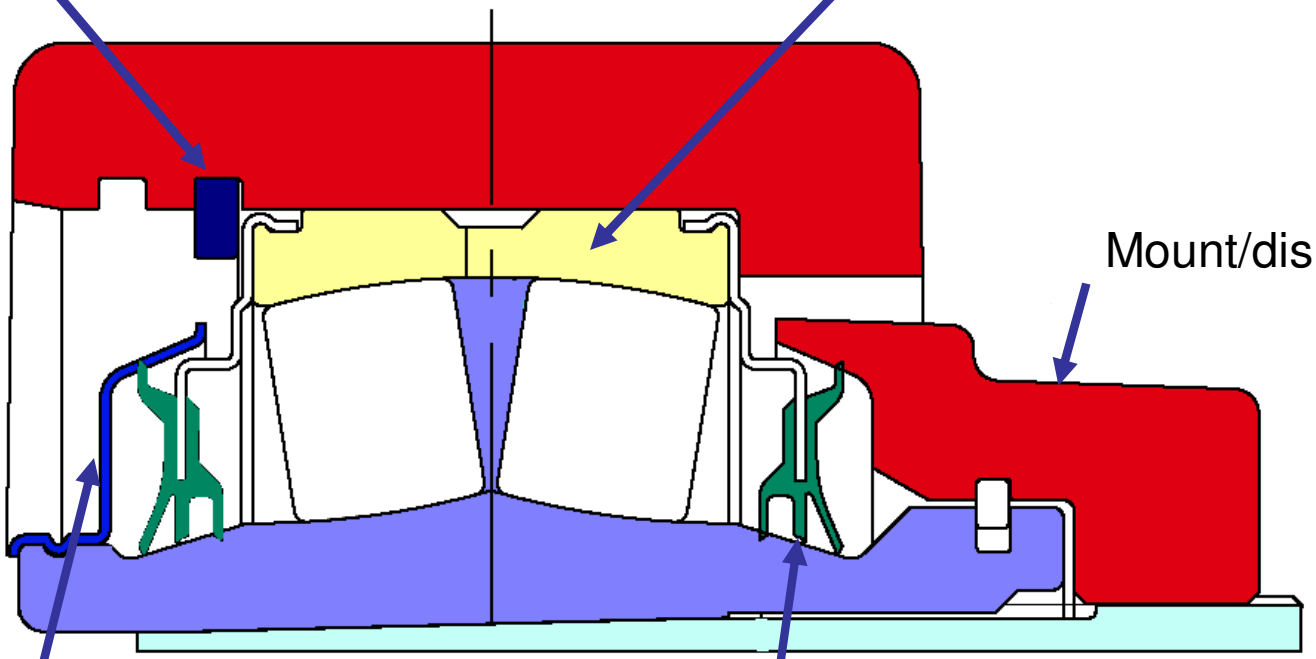


DODGE IMPERIAL & ISAF

- External nut install/remove adapter mounting system
- Fully assembled and greased
- Fast installation or removal
- Easy clearance setting without the use of feeler gauges
- Built-in bearing puller
- Advanced constant pressure, harsh-duty, multi-lip seal with flinger
- No fretting corrosion and no setscrew shaft damage
- Improved concentricity, less vibration
- Accepts commercial shafting
- High temperature and high speed capability
- ISAF replaces traditional SAF dimensions
- Cast Steel housing available

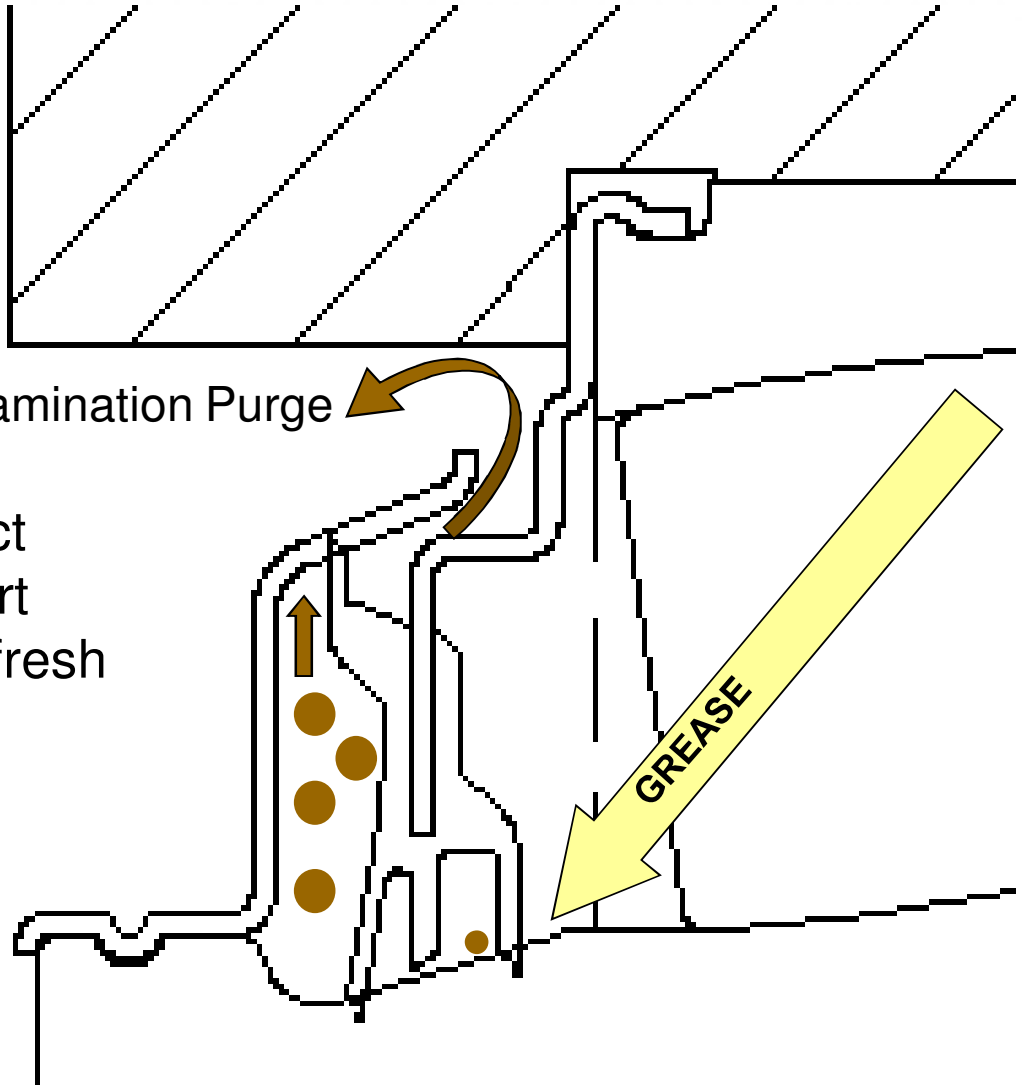


DODGE IMPERIAL & ISAF



IMPERIAL & ISAF Trident Seal

The Trident triple lip contact seal is designed to eject dirt and moisture and provide fresh grease to the bearing at all times.



DODGE ISAF and IMPERIAL or SAF Style
Which would you choose???

One part number in one box, assembled and lubed, shaft ready, easy to install, reposition or remove?

O

R

Four part numbers in four boxes, you assemble and grease, use feeler gauges to install, and shock or burn to remove?

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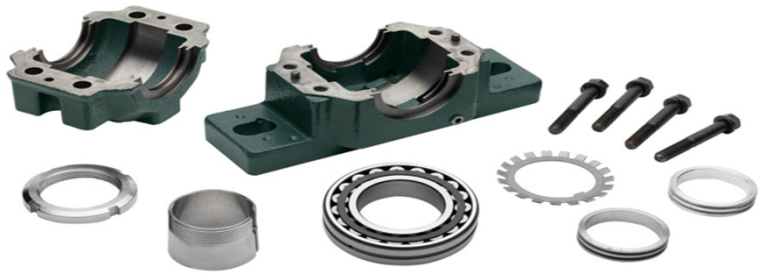
SAF versus ISAF / Head to Head



SAF – Cutting Edge
(once upon a time)

ISAF – New Technology

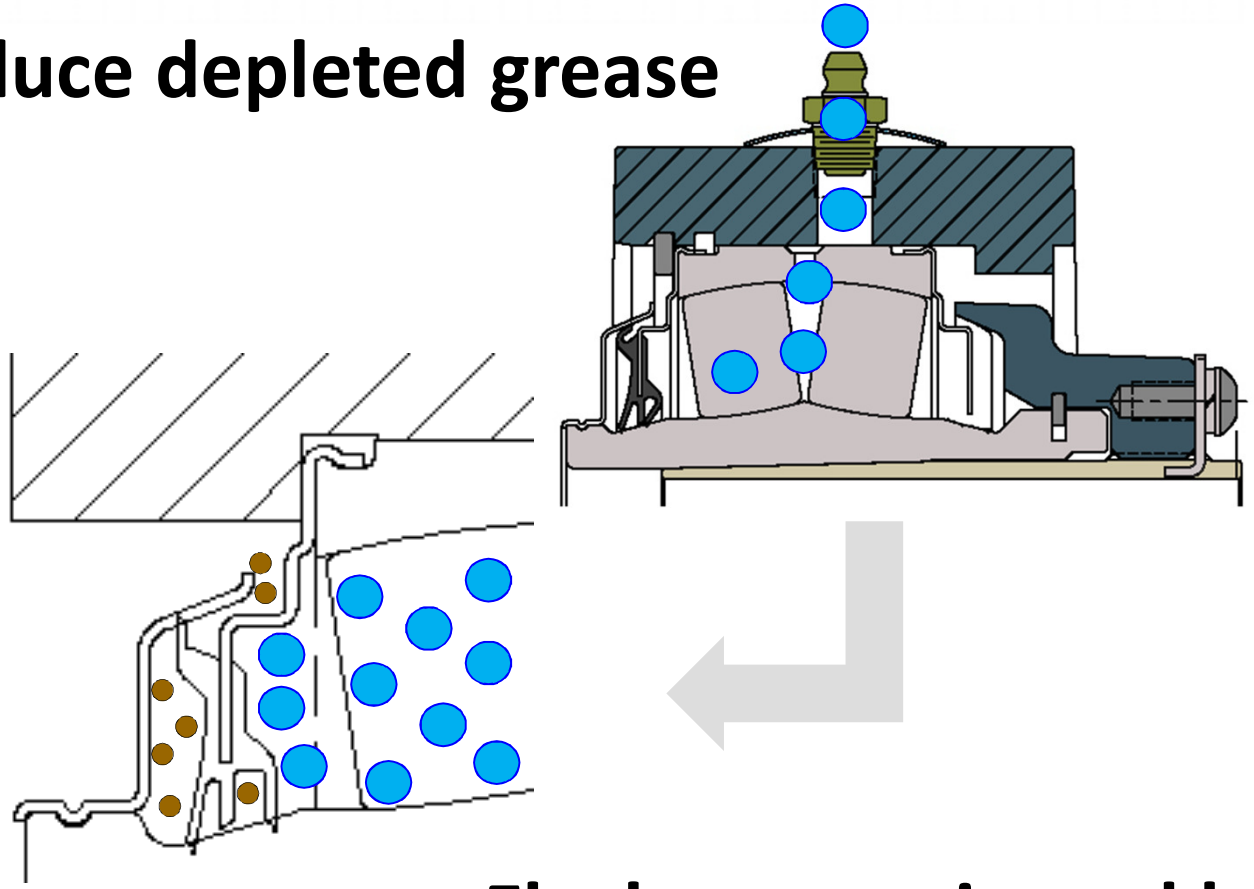
Bearing Lubrication

- **Purpose of Lubrication**
  - Primary function:
    - Reduce friction between contact areas by separating contact surface irregularities
  - Secondary function:
    - Reduce wear of the two moving surfaces
    - Prevents metal-to-metal contact between rollers and raceways
    - Helps prevent loss of total mass of softer material
  - Third function:
    - Remove heat generated by friction and wear activity
  - Fourth function:
    - Protect bearing components from contamination

Effective lubrication is critical to bearing performance and service life expectancy

Bearing Lubrication Process

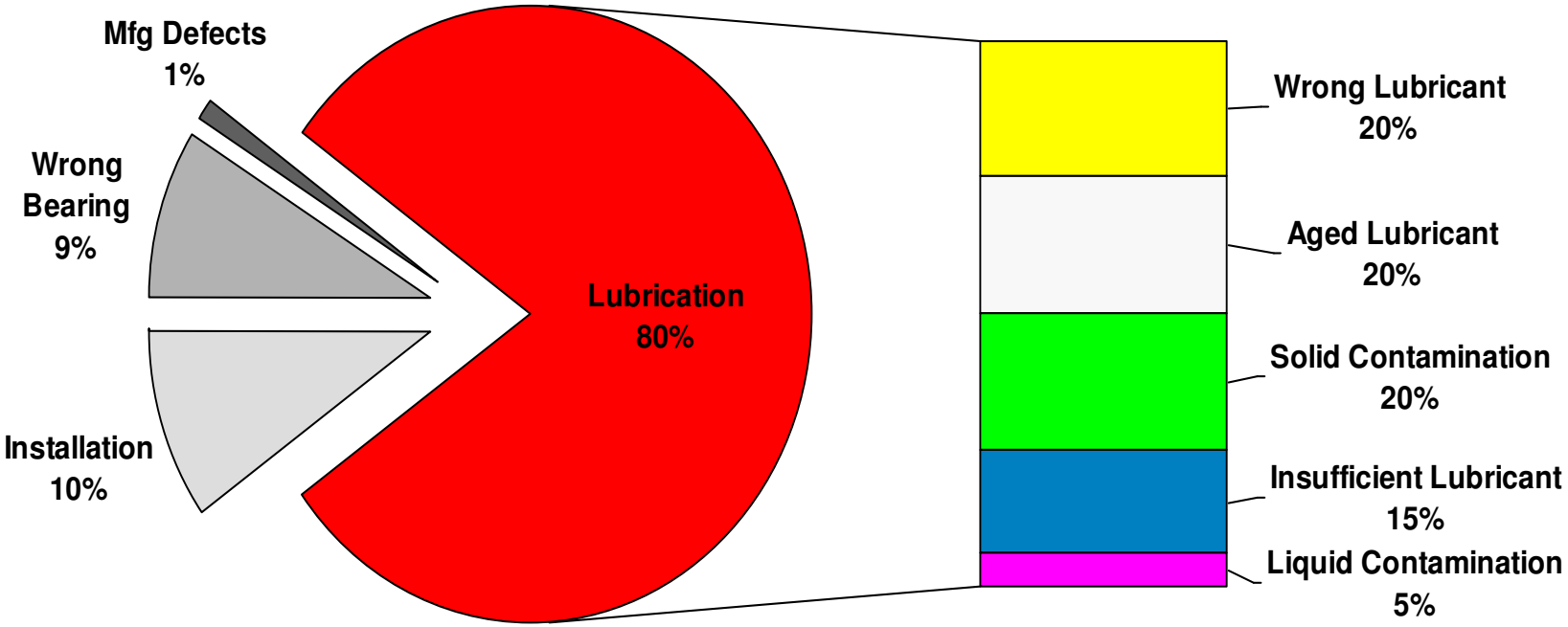
Introduce depleted grease



Flush contaminated lubricant
Recharge seal with clean lube

Failure Modes

(80% of all premature bearing failures are lubricant related)



Preventative Maintenance

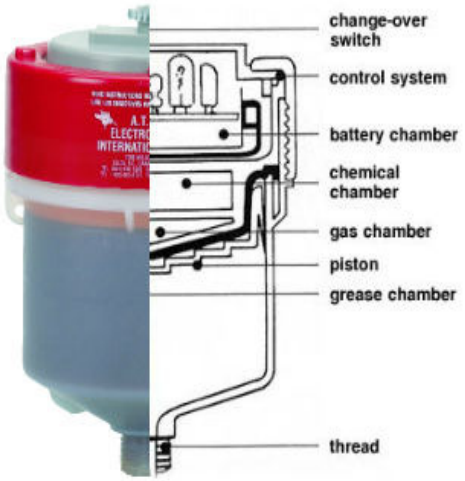
- **Time-based (scheduled) maintenance activities**
  - Bearing cleanliness
  - Bearing re-lubrication
  - Bearing corrosion prevention
  - Checking shaft attachment devices
- **Designed to correct causes of failures expected to occur based on failure history of like machinery components**
- **Advantage: simple planning of maintenance resource allocation**
- **Disadvantage: does not accommodate changes to operational variables if used alone**

Lubrication Delivery

Oil Circulation

Conventional Grease Gun

Auto Lubrication Device



Power Luber

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Condition Based Monitoring

- **Tool that predicts maintenance needs by tracking specified operating parameters and comparing them to a standard set of parameters**
- **Simple machine inspection by experienced operator/technician**
  - Reads performance indicators
  - Recommends a specific maintenance activity to restore machine to acceptable performance level
- **More complex machines/systems use technology to collect and transmit info**
- **Basic data elements collected for mounted bearings:**
  - Bearing temperature
    - Bearing operating speed
    - Bearing vibration

ABB Ability™ Smart Sensor for Mounted Bearings

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ABB Ability™ Smart Sensor for mounted bearings

- Wireless communication – Bluetooth
- Measures vibration and temperature
- Advanced algorithms for bearing diagnostics
- On board storage: 30 days data storage
- Connection to ABB Ability™ platform
- Software: Android & iOS

ABB Ability™ Smart Sensor for mounted bearings

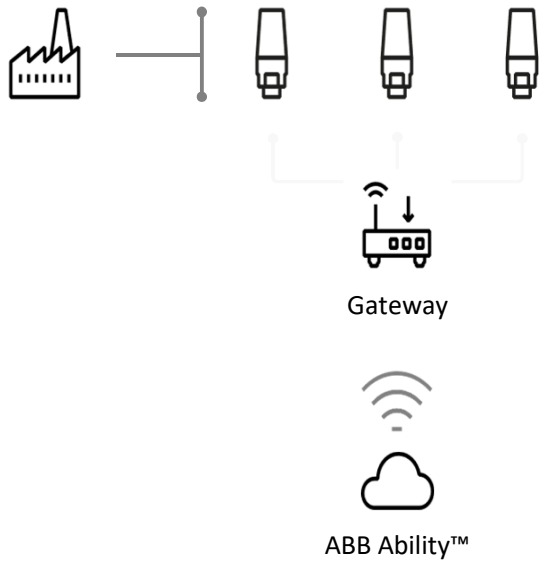
Customer benefits

- Quick health indication on assets during maintenance round:
  - Get an idea what is wrong
- Able to monitor bearings without physically looking at it
- Warnings on decreasing assets health status
- Learning about assets normal limits
- Ability to properly analyze why a bearing failed
- Continuously collect reliable data to central storage
- Ability to reduce downtime
- Ability to reduce unplanned, unscheduled maintenance
- Easy installation for selected group of bearings

ABB Ability™ Smart Sensor for mounted bearings

Gateway connection for remote accessibility

- Cloud-based data trend storage and backup
- Smooth data transfer to the ABB Ability™ cloud
- Increased sensor battery life time
- Perfect solution for location where H&S rules do not allow using hand held devices
- On-line monitoring several sensors in gateway range
- Remote access to a single or multiple sites
- Continuous monitoring of critical applications
- Remotely adjust alarms based on data trends
- Quick overview of the site assets health status
- Easy assets performance comparison



DODGE Sales Engineer Support

- Application engineering support
- Technical product selection
- Specification development
- Training
  - Product features and function
  - Installation
  - Maintenance
- Failure analysis
- Competitive conversions
- Cost savings
- Documenting value

TCO WORKSHEET - DODGE GEARING

DODGE FSE	Larson
DODGE REGION	North Central
COMPANY	Acme Paper
MILL NAME / LOCATION	Anytown
APPLICATION	Re-Pulp Mixer
DODGE/RELIANCE PRODUCT	Magna
REPLACED PRODUCT	V Belt/Foote Bros.
DATE	10/20/2012

SAVINGS CATEGORY	DATA	NOTES
DOWNTIME (UNPLANNED)		
Cost of Unplanned Downtime ($/hr) or ($/min)	$2,000.00	Approximate costs as they can be variable
Number of Unplanned Downtime Failures (X/yr)	0.25	
Time Spent on Failure Replacement (hr) or (min)	24	Only if there is a complete catastrophic issue
Number of Dodge/Reliance Downtime Failures (X/yr)	0	
Time Spent on Dodge/Reliance Replacement (hr or min)	24	Time to change reducer
DOWNTIME SAVINGS SUB-TOTAL	**$12,000.00**	
LABOR		
Labor Rate ($/hr) or ($/min)	$100.00	
Number of Total Failures (X/yr)	2	Total = unplanned + planned downtime.
Time Spent on Failure Replacement (hr) or (min)	24	
Number of Total Dodge/Reliance Failures (X/yr)	0	
Time Spent on Dodge/Reliance Replacement (hr or min)	24	
LABOR SAVINGS SUB-TOTAL	**$4,800.00**	
MATERIALS		
Cost of Replaced Product ($ each)	$20,000.00	Complete rebuild of reducer only
Number of Total Failures/Replacements (X/yr)	0.5	Average yearly failure frequency.
Cost of Dodge/Reliance Product ($ each)	$16,000.00	Cost includes coupling and Motor
Number of Dodge/Reliance Failures/Replacements (X/yr)	0	To account for initial purchase of TCO product.
Cost of Other Materials - Shafting, etc. ($ each)	$2,000.00	Transition Base plate, machined by customer
Shafting, etc.	1	$1,000 for shaft if using Stocked Hollow bore
Replacements of Other Materials - Dodge/Reliance (X/yr)	0	
MATERIALS SAVINGS SUB-TOTAL	**$12,000.00**	
EFFICIENCY		
Existing System (Motor/Gearbox) Efficiency (%)	82.9	Motor 90% Belt 95% Reducer 97%
Dodge System (Motor/Gearbox) Efficiency (%)	90.5	Motor 95.8% Reducer 94.5%
Horsepower (HP)	125	
Number of Units	1	7 Repulp tanks in 2 buildings All to be replaced
Cost of Energy ($ / kW Hr)	0.08	
Annual Hours of Operation (Hrs)	8000	
EFFICIENCY SUB-TOTAL	**$6,045.60**	

TOTAL ANNUAL TCO SAVINGS	**$34,845.60**

DODGE

BALDOR
BALDOR · DODGE · RELIANCE

ABB

DODGE

DODGE

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