

NEW CUMBERLAND L/D OHIO RIVER

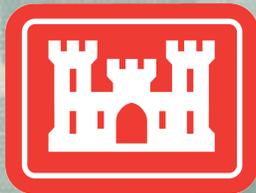
Dam Gate #10

-Line Shaft Replacement

-Quick-Disconnect Couplers

Greg Turko

412-395-7640

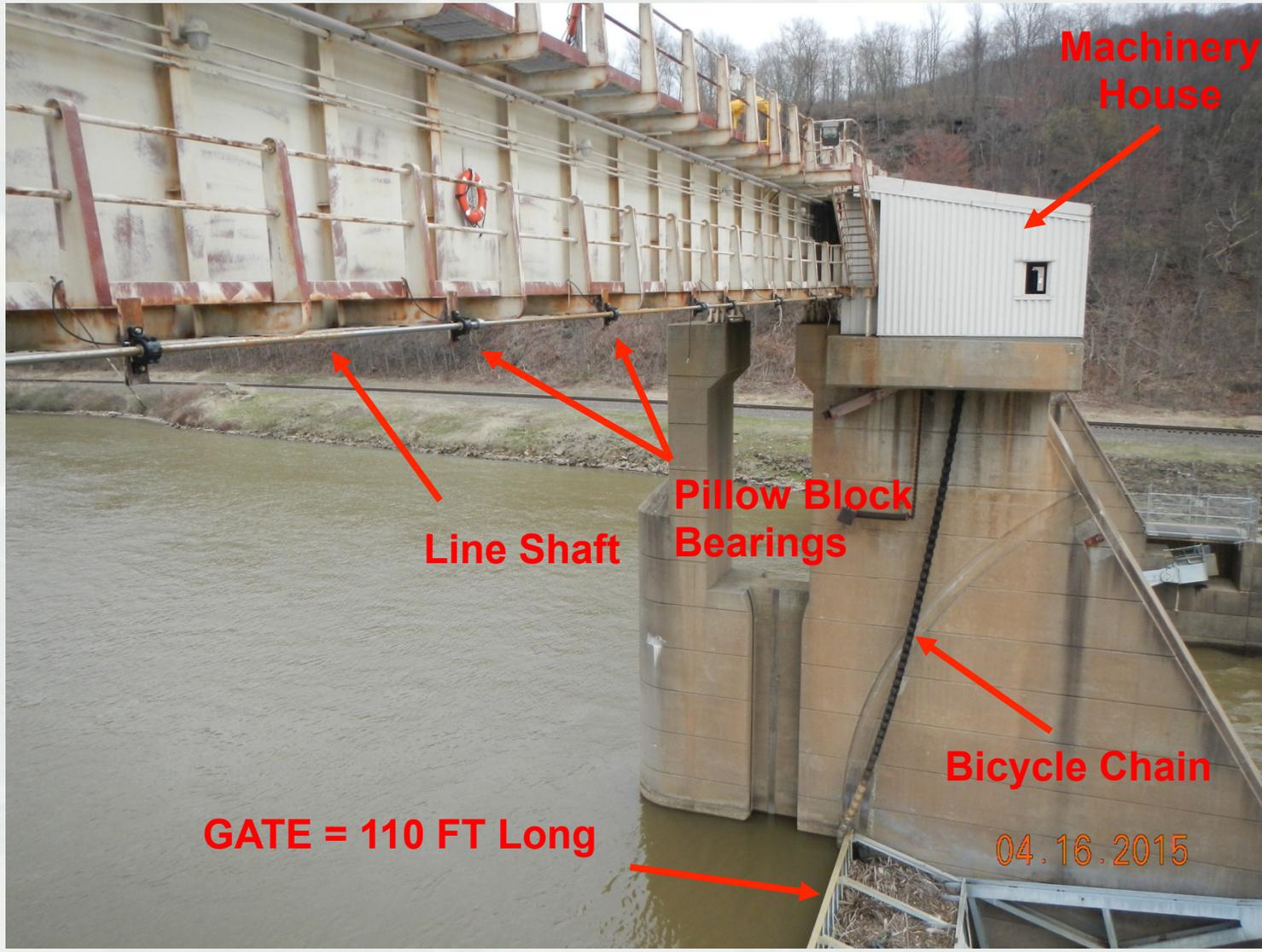


®

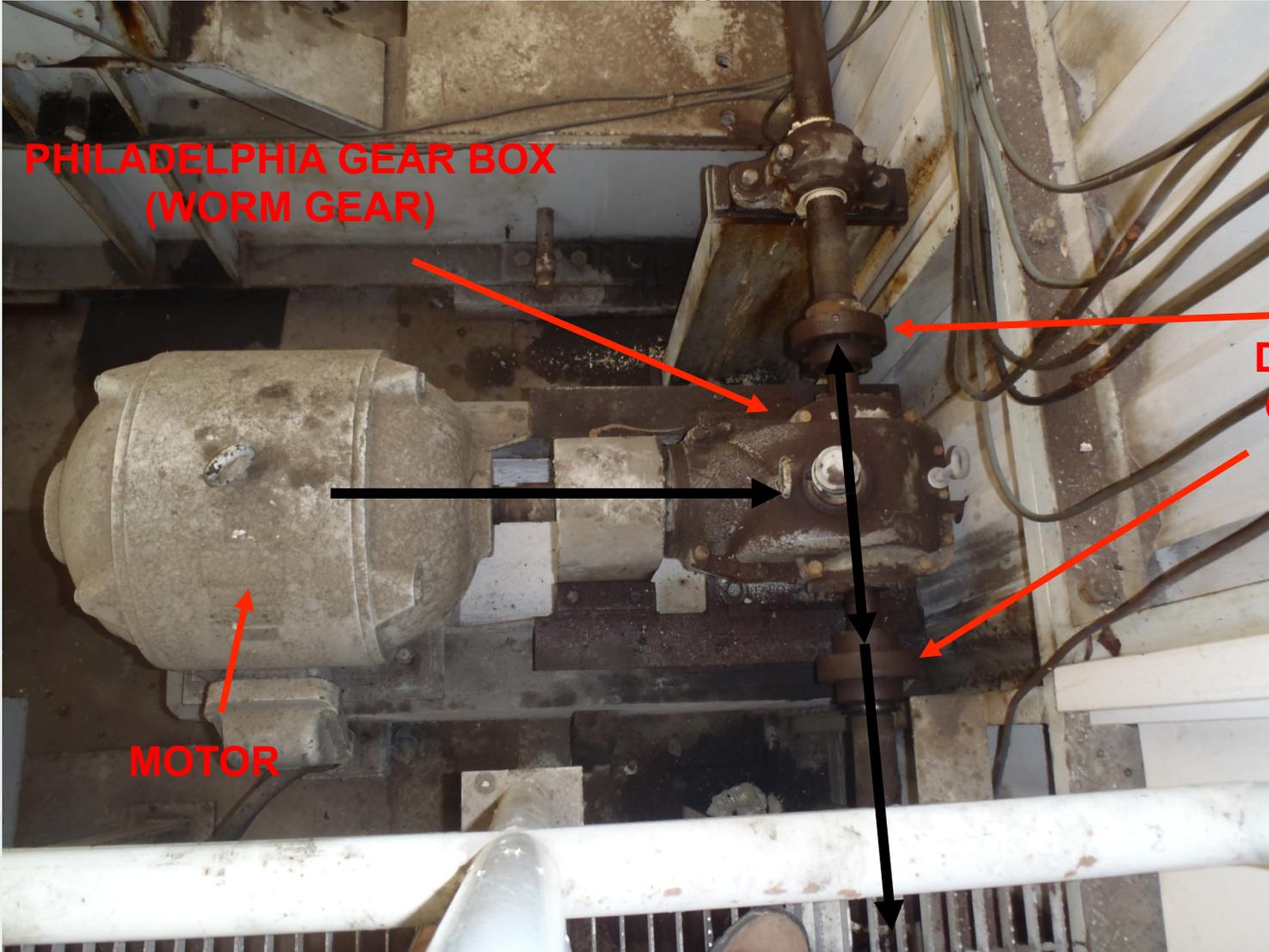
US Army Corps of Engineers
BUILDING STRONG®



Dam Gate #10



Machinery House



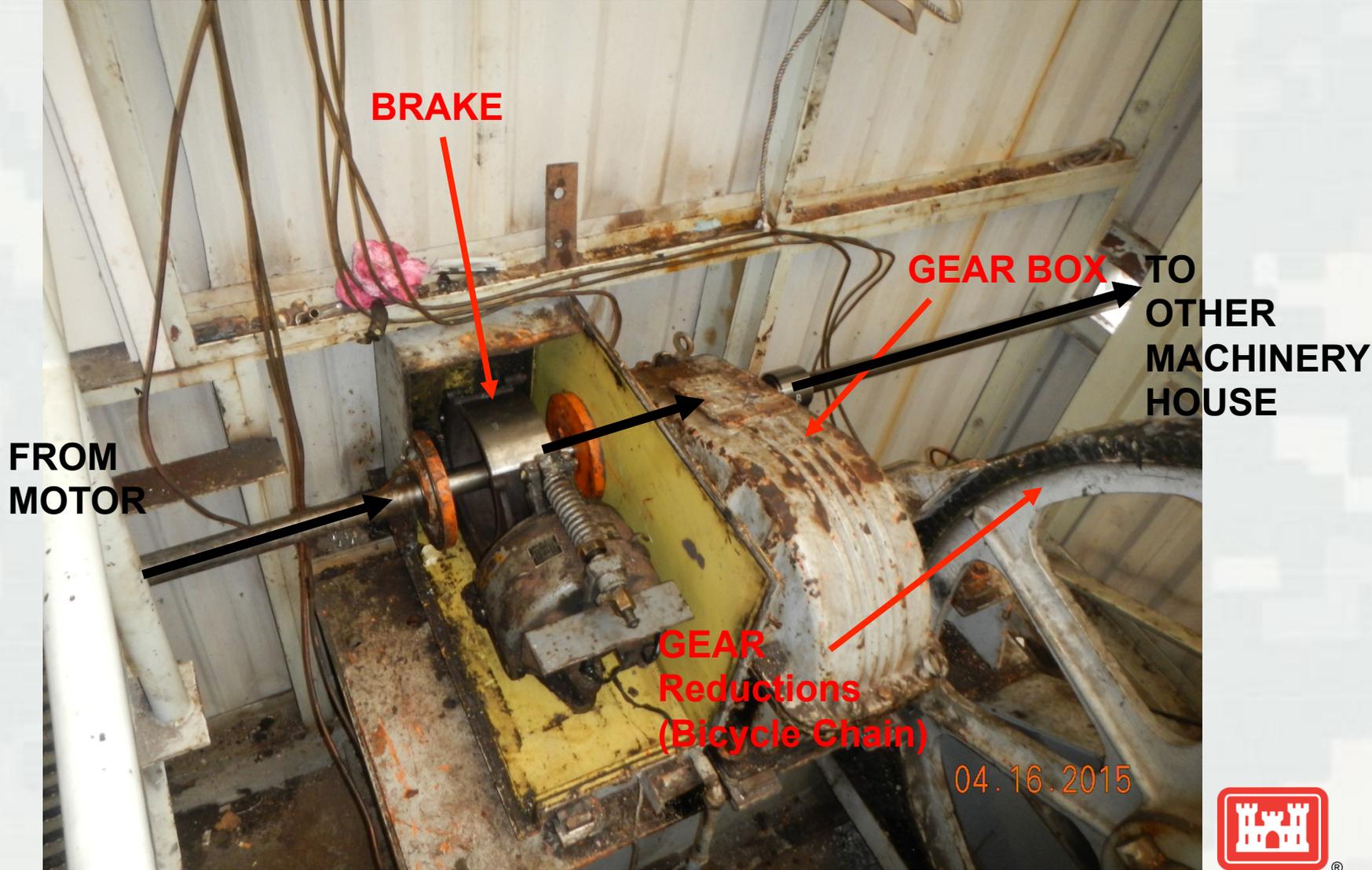
**PHILADELPHIA GEAR BOX
(WORM GEAR)**

**Quick
Disconnect
Couplings**

MOTOR



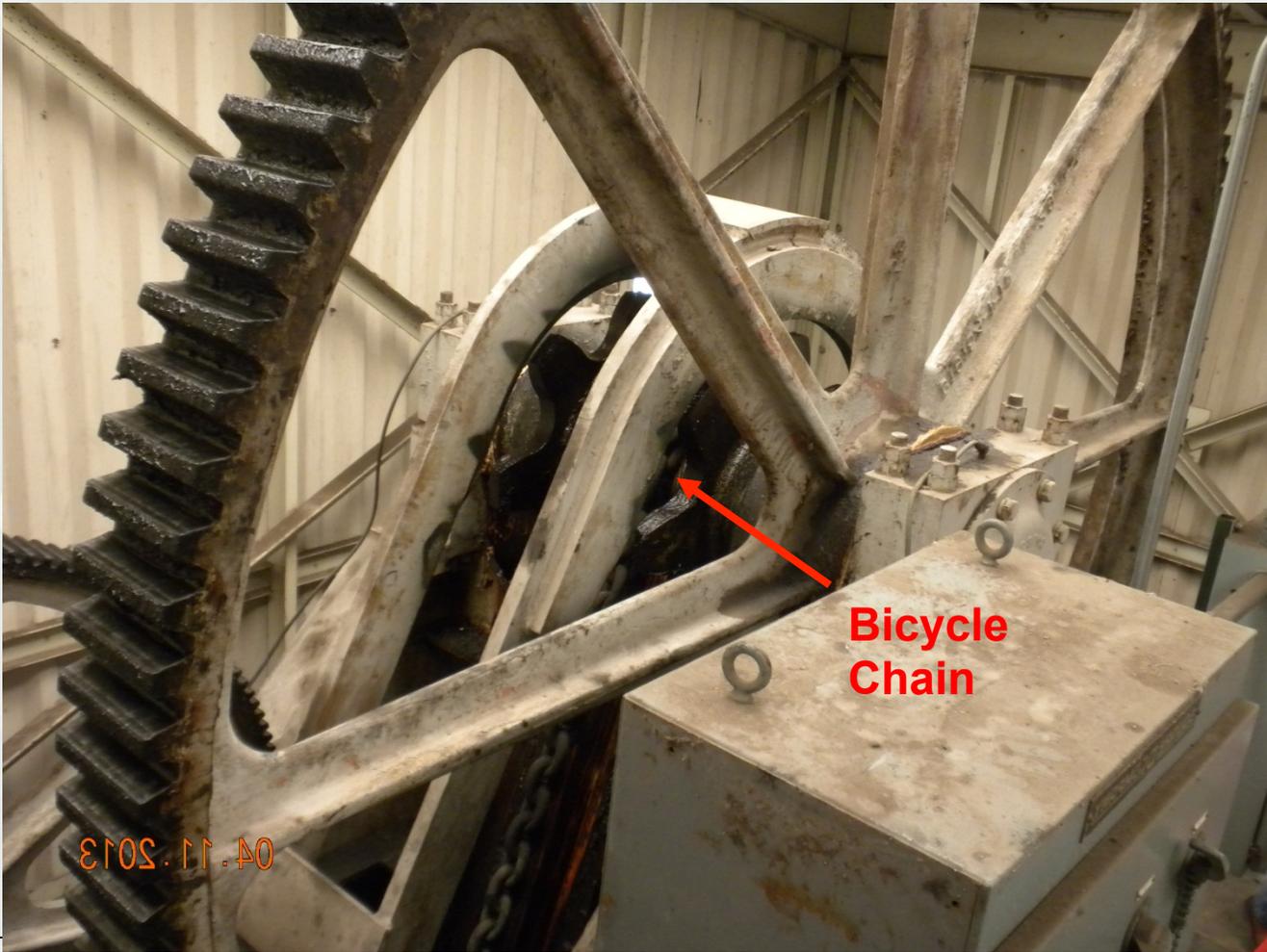
Dam Gate #10 Machinery



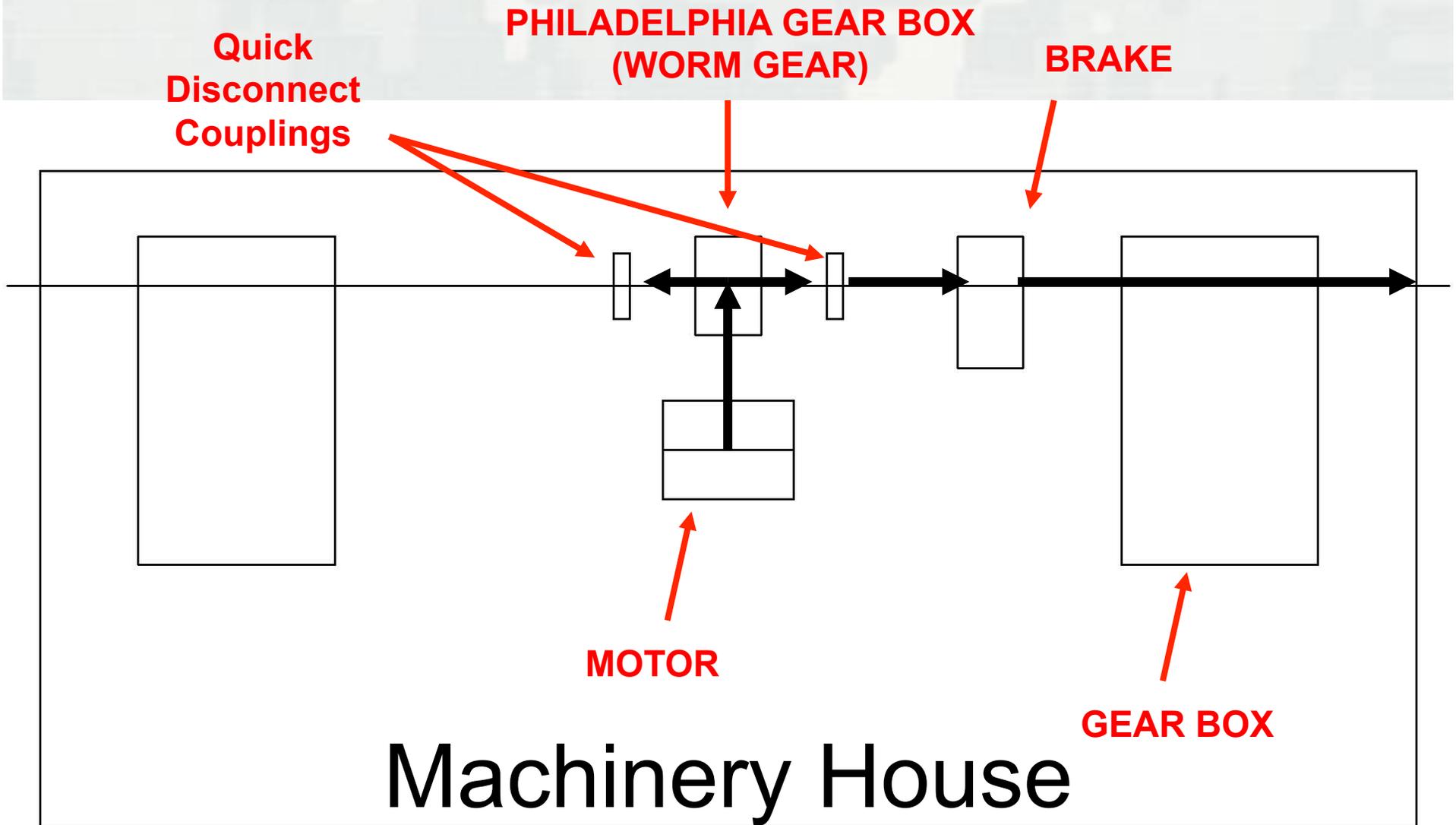
Dam Gate #10 Machinery



Dam Gate #10 Machinery



Dam Gate #10 Machinery



GATE FALLS – April 2013



**No More
Line Shaft**



GATE FALLS – April 2013



GATE FALLS – Damage



04/05/2013 14:09



GATE FALLS – Damage



GATE FALLS – Damage



GATE FALLS – Damage



GATE FALLS – Damage



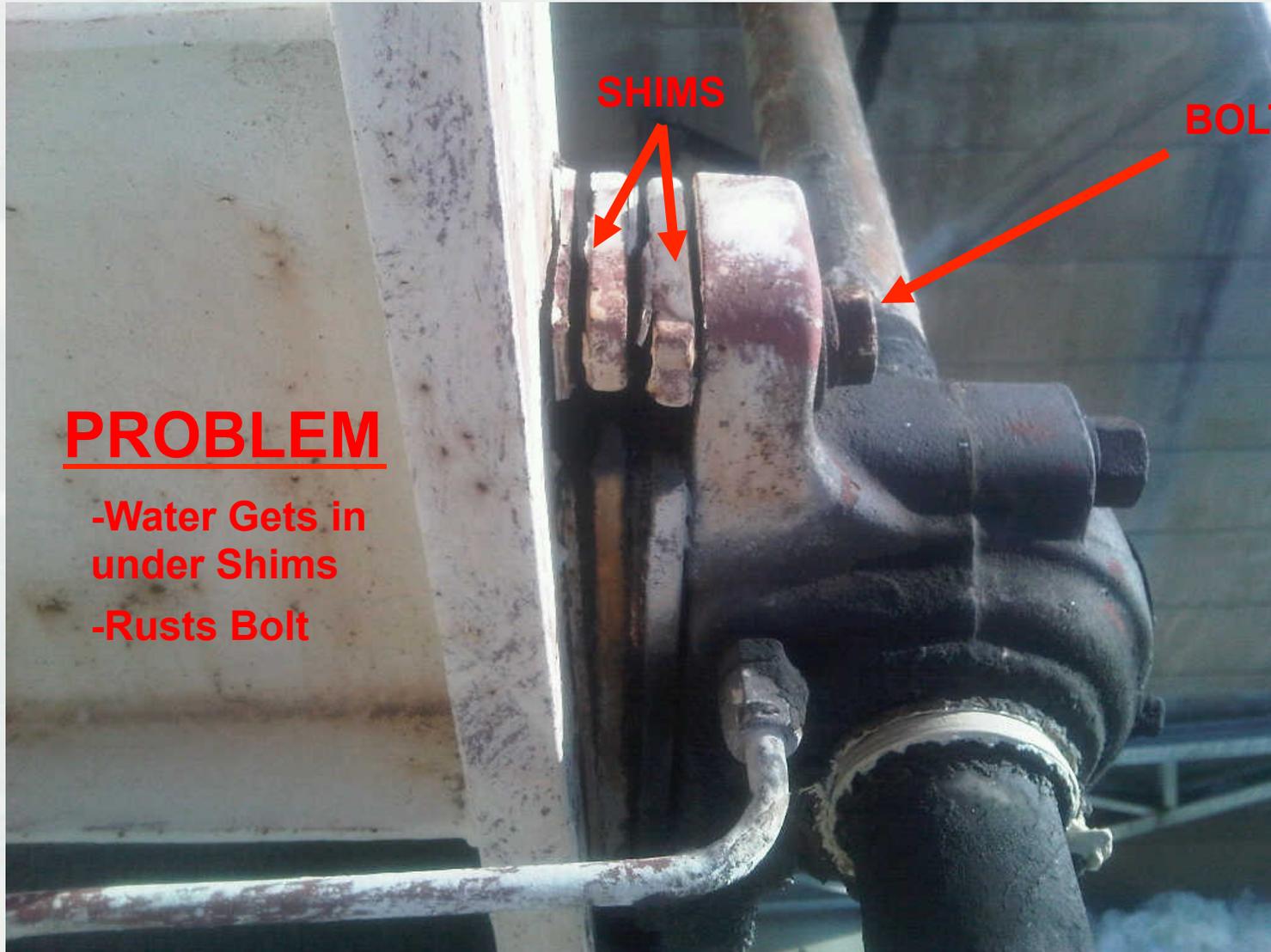
GATE FALLS – Damage



04.11.2013



GATE FALLS – Reason??



PROBLEM

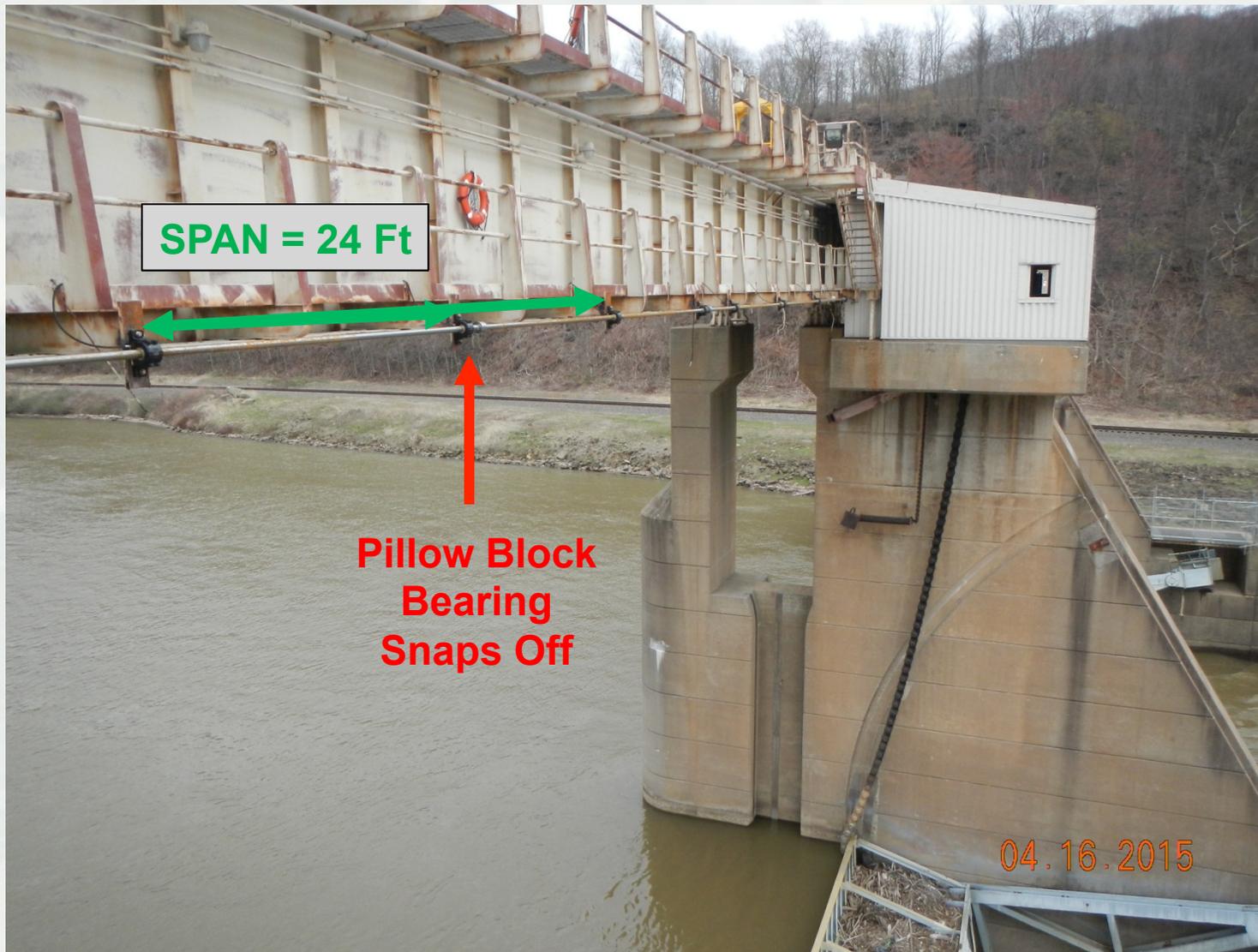
- Water Gets in under Shims
- Rusts Bolt



GATE FALLS – Reason



GATE FALLS – Reason



REBUILD

- 1. Inspect and Refurbish Gear Box
- 2. Install Line Shaft
 - Align Pillow Block Bearings
 - Pillow Blocks
 - Couplings



REBUILD

- 1. Inspect and Refurbish Gear Box



REBUILD – Gear Boxes



REBUILD – Gear Boxes

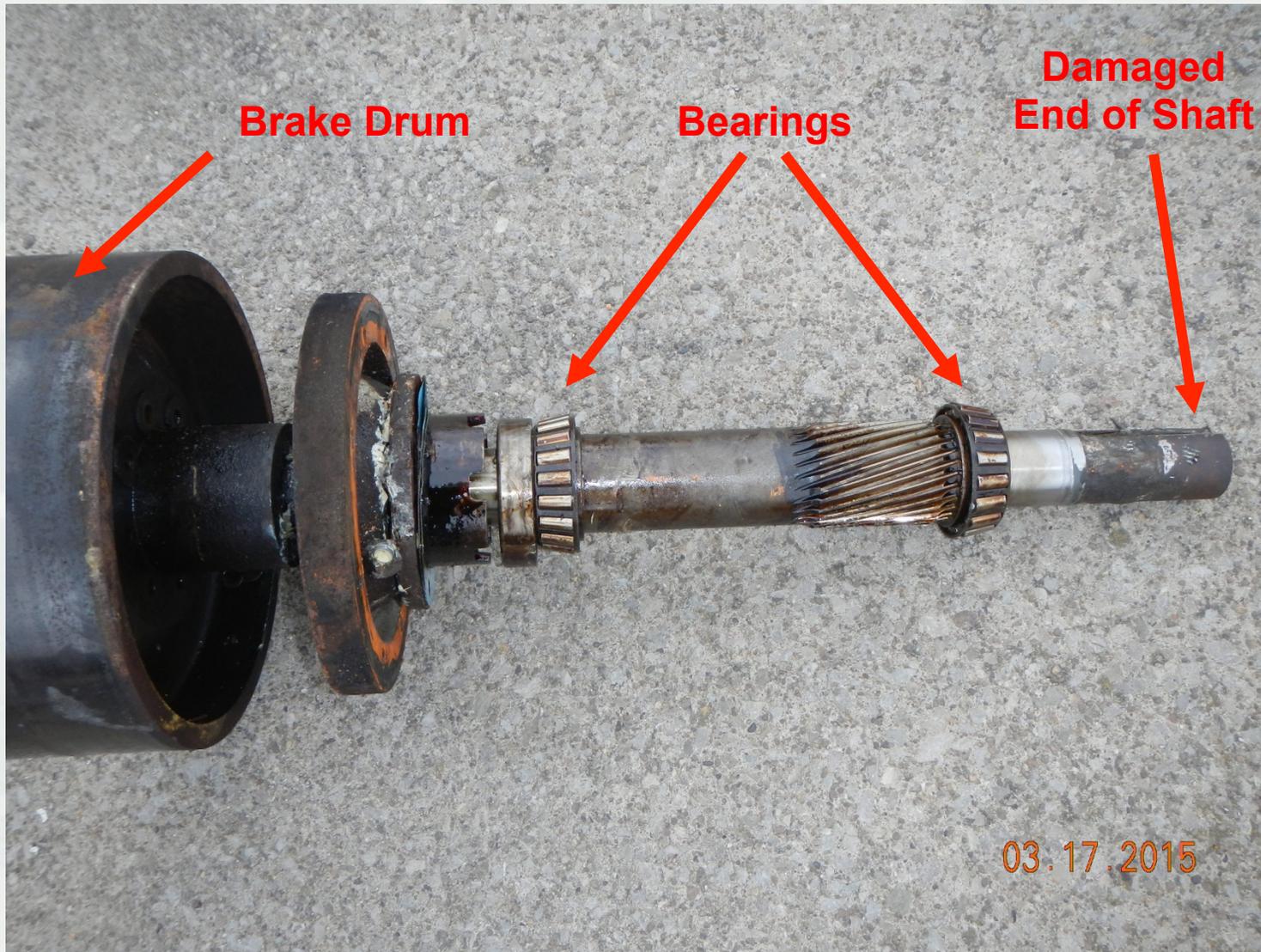


**Damaged
Shaft**

03.16.2015



REBUILD – Gear/Brake Drum



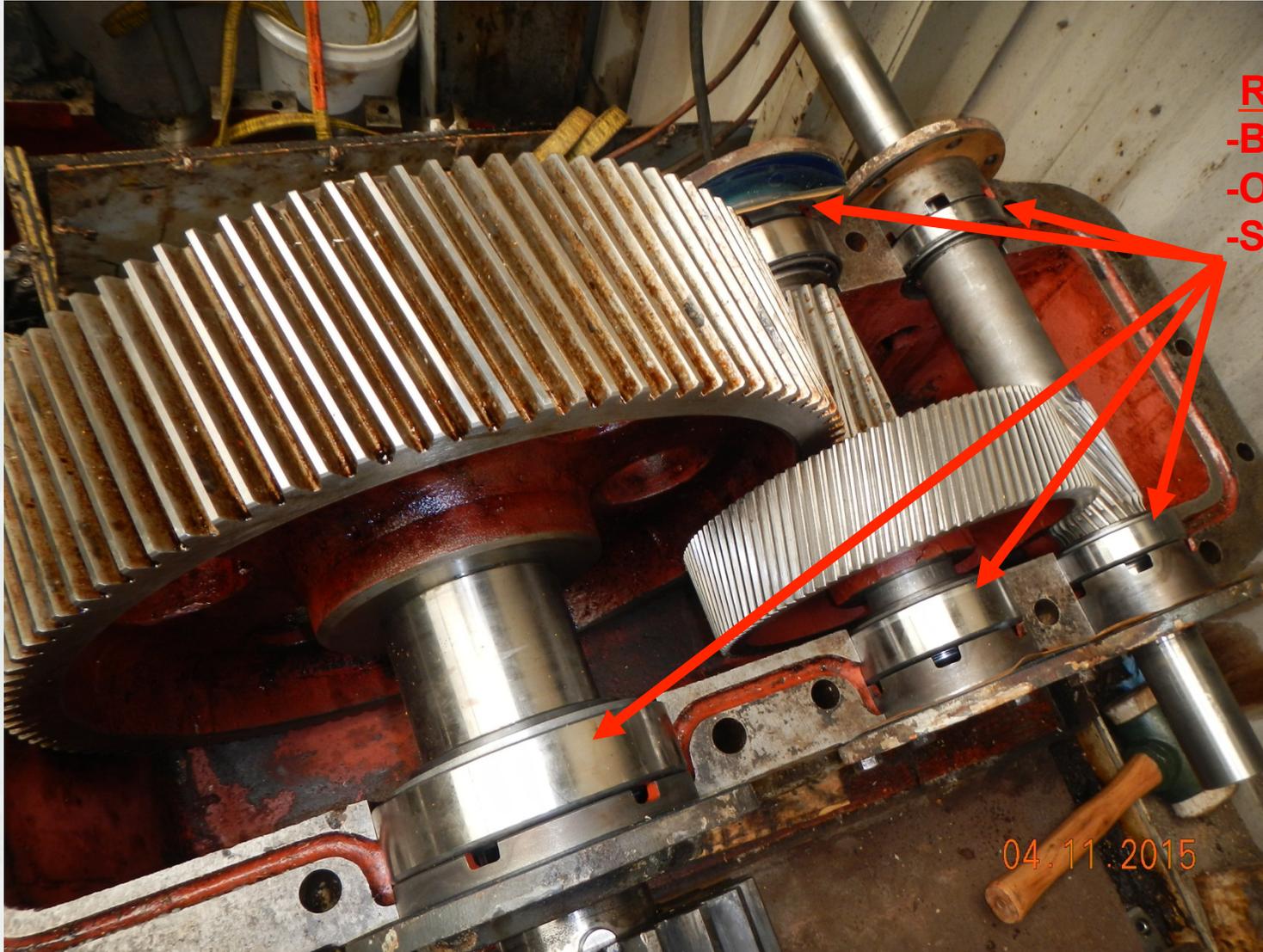
REBUILD – Gear/Brake Drum



REBUILD – Bull Gear



REBUILD – Gear/Brake Drum



REPLACED

- Bearings
- Oil Seals
- Shims

04.11.2015



REBUILD – Gear/Brake Drum



REBUILD

- 2. Install Line Shaft
 - Align Pillow Block Bearings
 - Pillow Blocks
 - Couplings



How-To: PILLOW BLOCKS



How-To: PILLOW BLOCKS



How-To: PILLOW BLOCKS



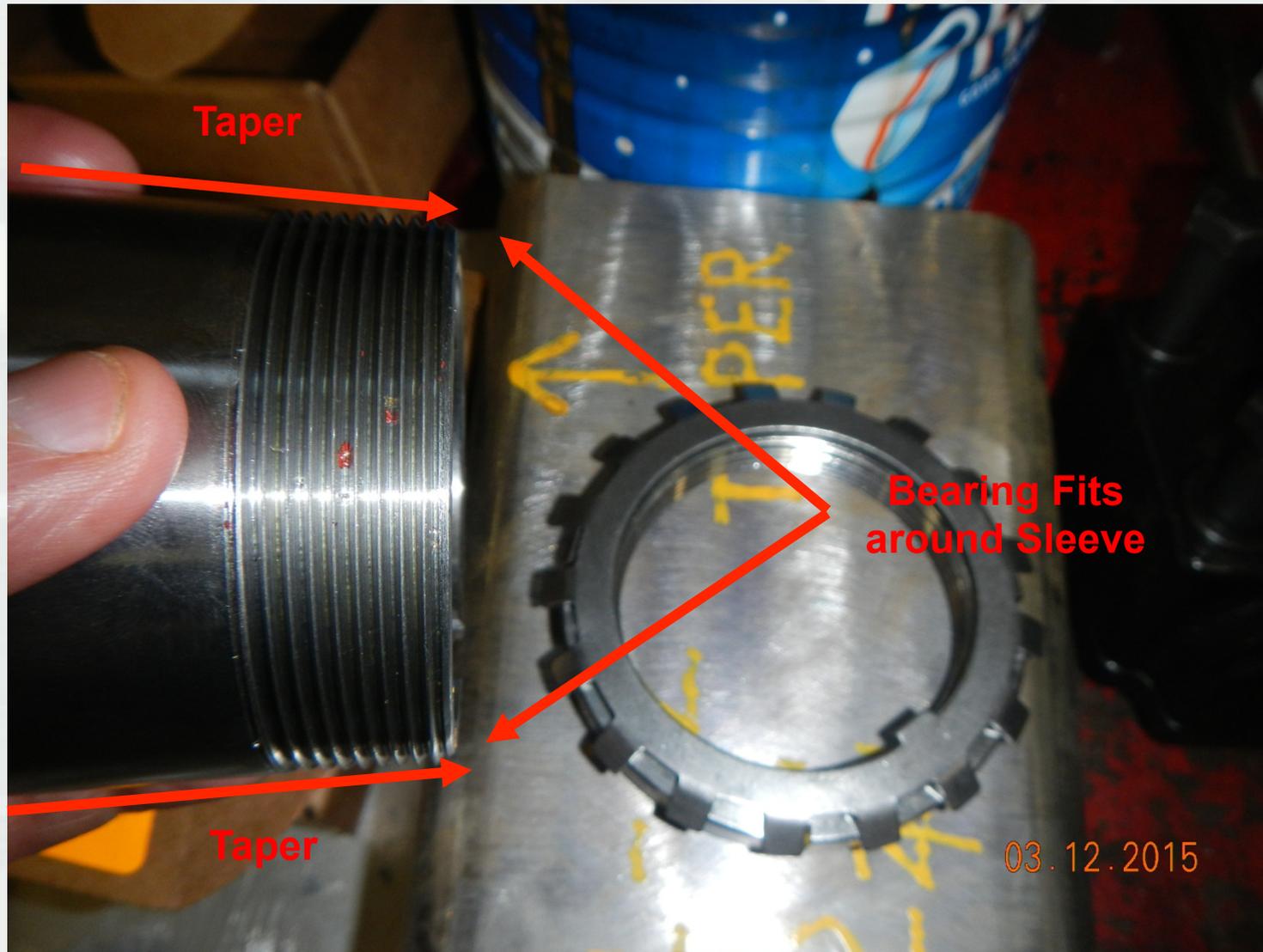
Tapered Sleeve
with Locking
Nut

Bearing

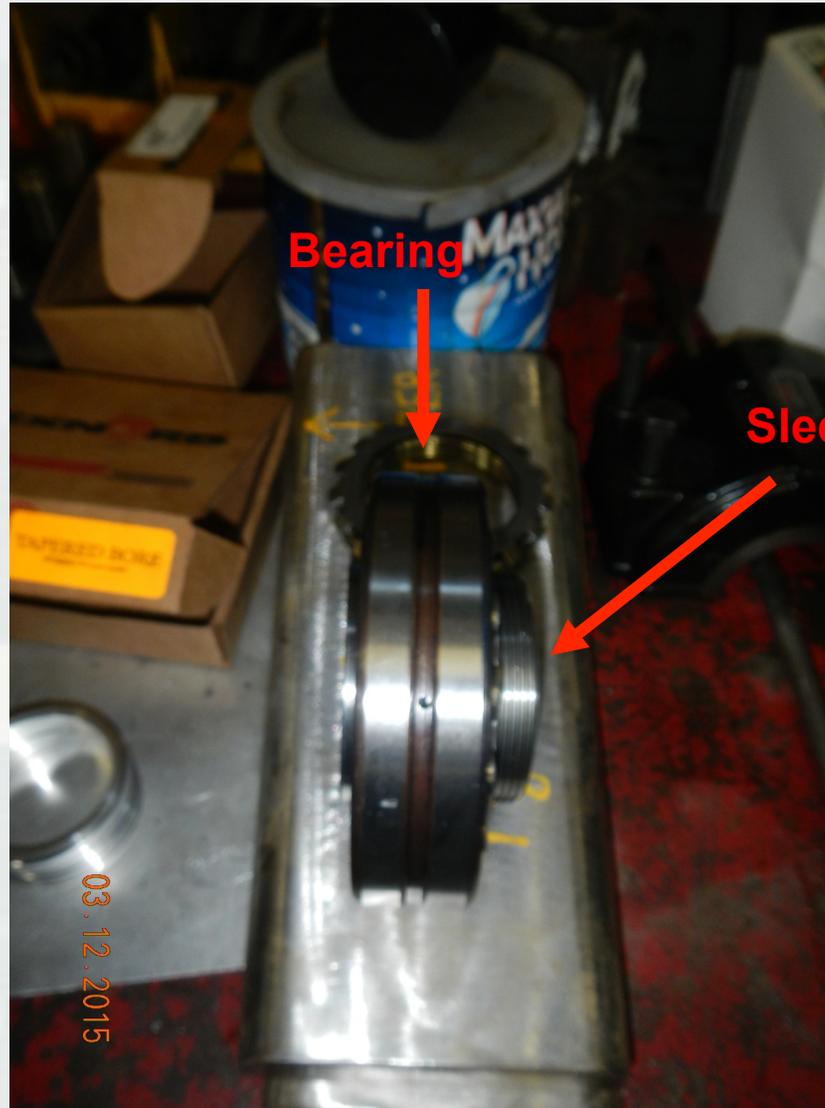
03.12.2015



How-To: PILLOW BLOCKS



How-To: PILLOW BLOCKS



How-To: PILLOW BLOCKS

As the Nut Tightens, It moves the Bearing up the taper of the sleeve

This tightens the whole assembly onto the line shaft and locks it into place



Locking Nut



How-To: PILLOW BLOCKS



How-To: PILLOW BLOCKS



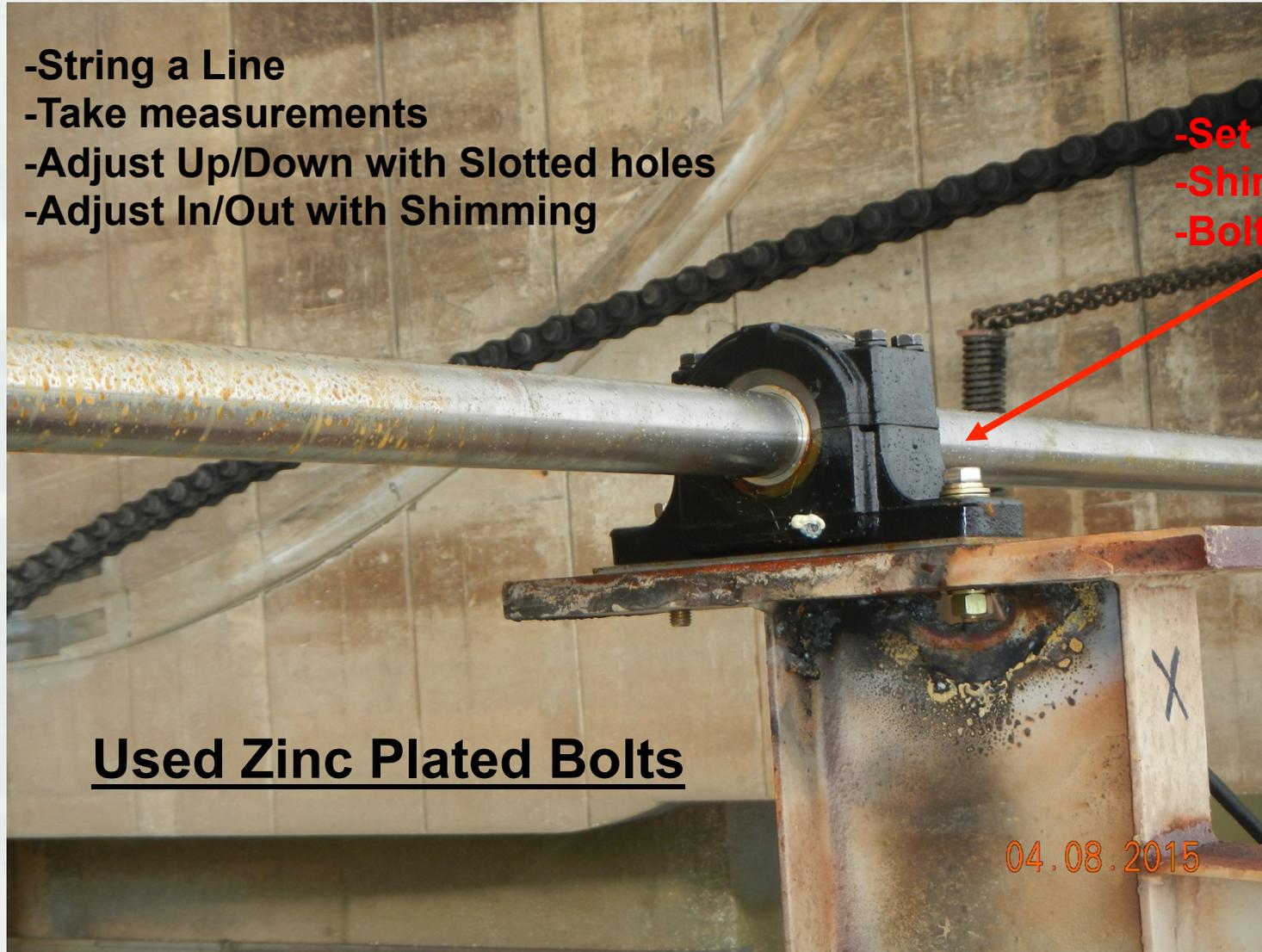
How-To: PILLOW BLOCKS



ALIGN NEW PILLOW BLOCKS

- String a Line
- Take measurements
- Adjust Up/Down with Slotted holes
- Adjust In/Out with Shimming

- Set the base
- Shim as needed
- Bolt it in place

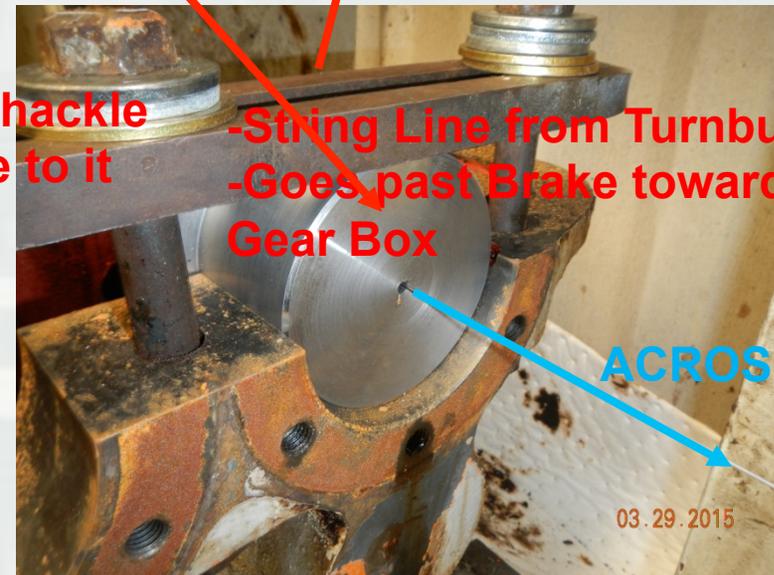
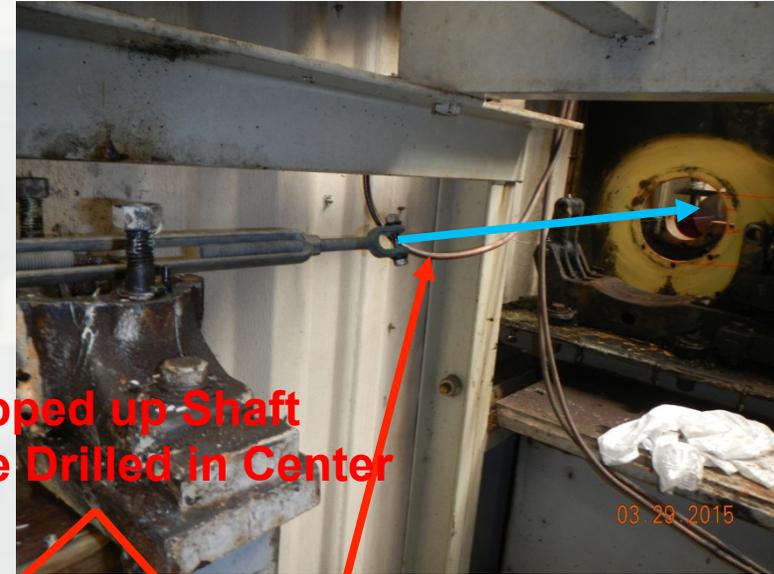


Used Zinc Plated Bolts

04.08.2015



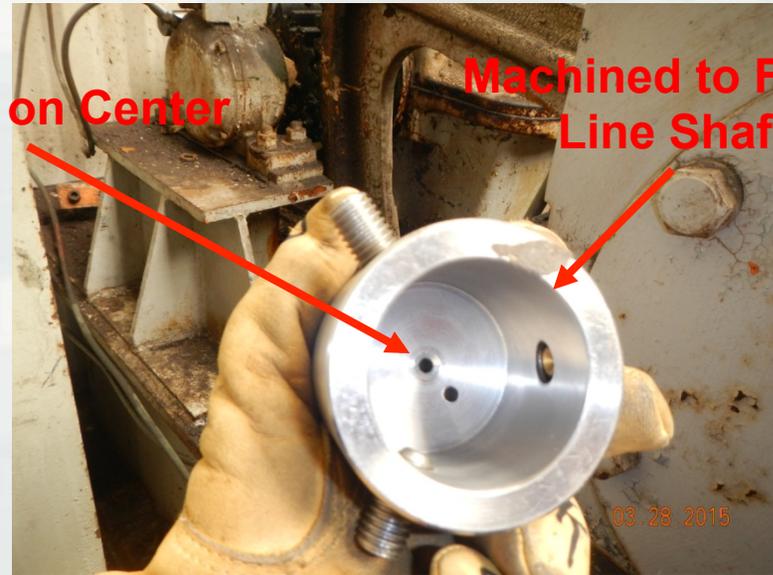
STRINGING THE LINE



OTHER MACHINERY HOUSE – GEAR BOX



Drilled Hole on Center

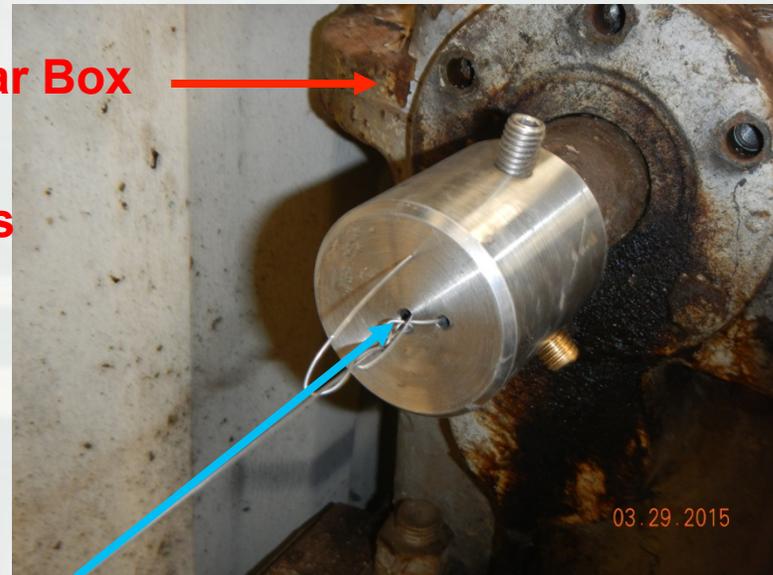


Machined to Fit on Line Shaft



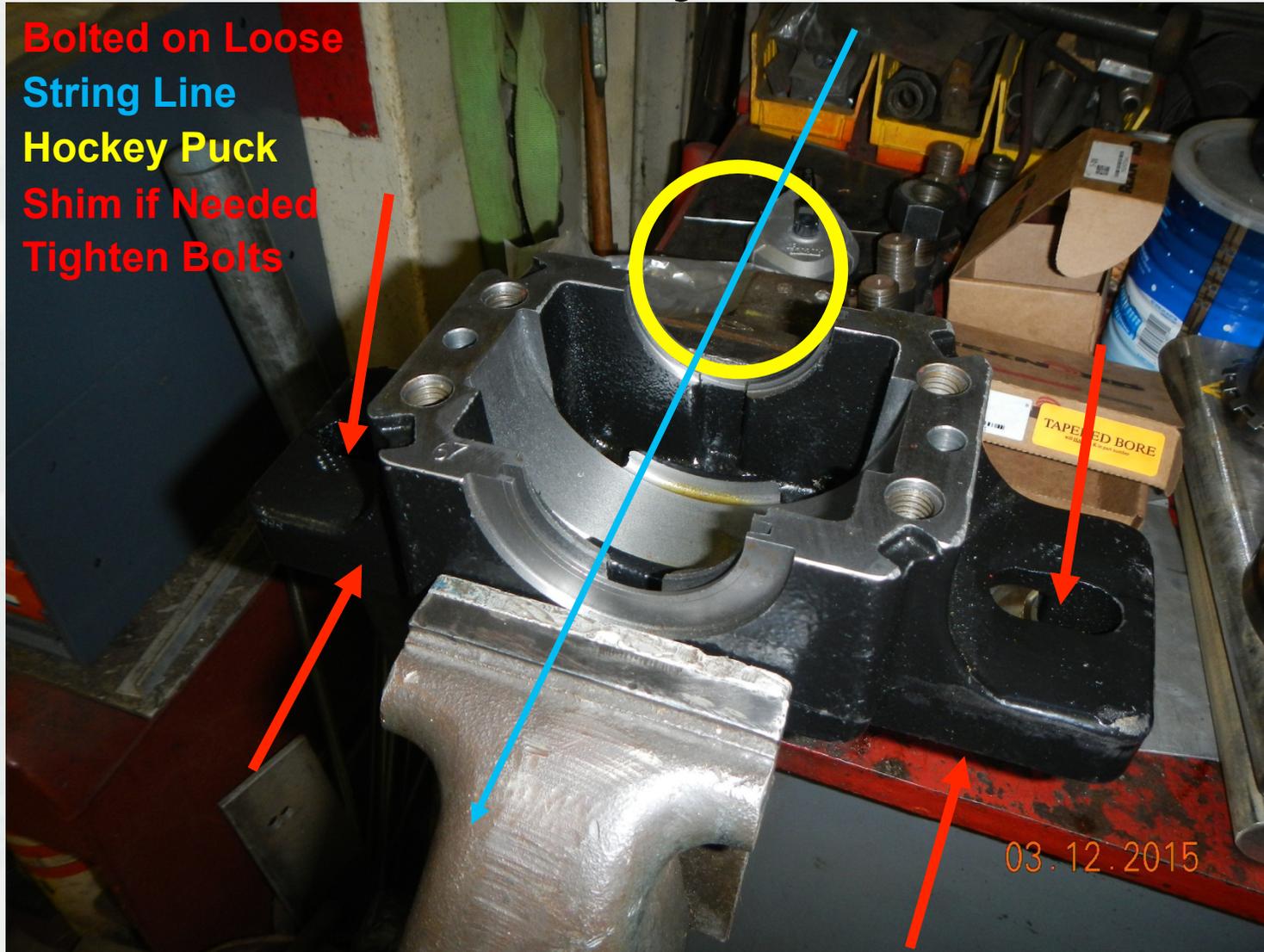
Gear Box

Set Screws



“Hockey Puck”

Bolted on Loose
String Line
Hockey Puck
Shim if Needed
Tighten Bolts





03.29.2015









04.08.2015







Complete



Complete



Gate Operates Great
Everybody is Happy

Until...

...1 Month Later
Gate Falls Again

Any Damage???



Brake - Before



Brake - After



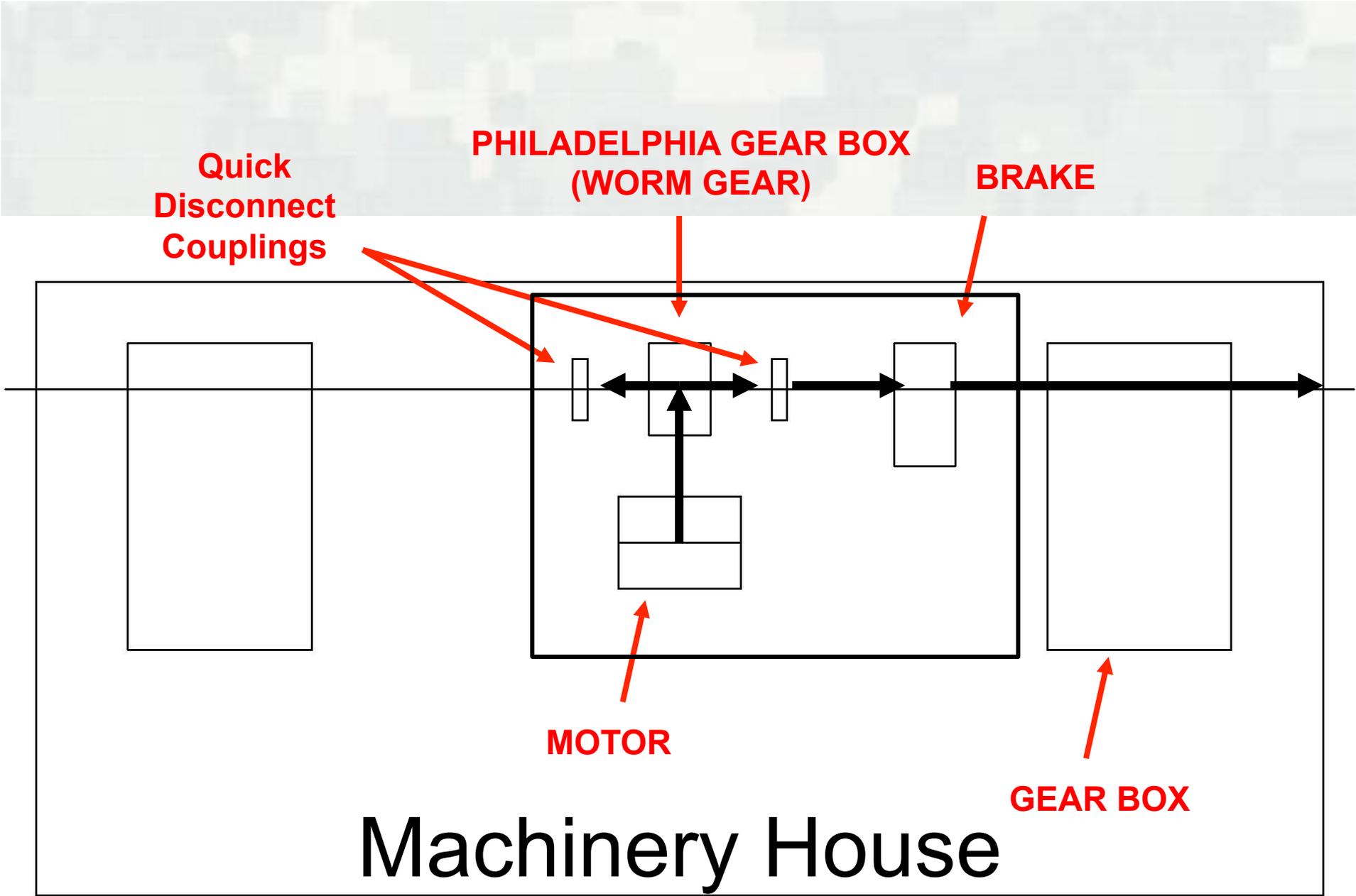
Sequence of Events

1. Lockman operated the Gate from the lockhouse
2. He began lifting the Gate off of the Sill
3. The gages in the lockhouse began climbing as the gate rose
4. The gages read 0..1..2..3..4..5.. Ft
5. Then the gage fell from 5 Ft to 0 Ft to 3 Ft to 0 Ft in an instant
6. Seeing this, the lockman quickly turned the power off

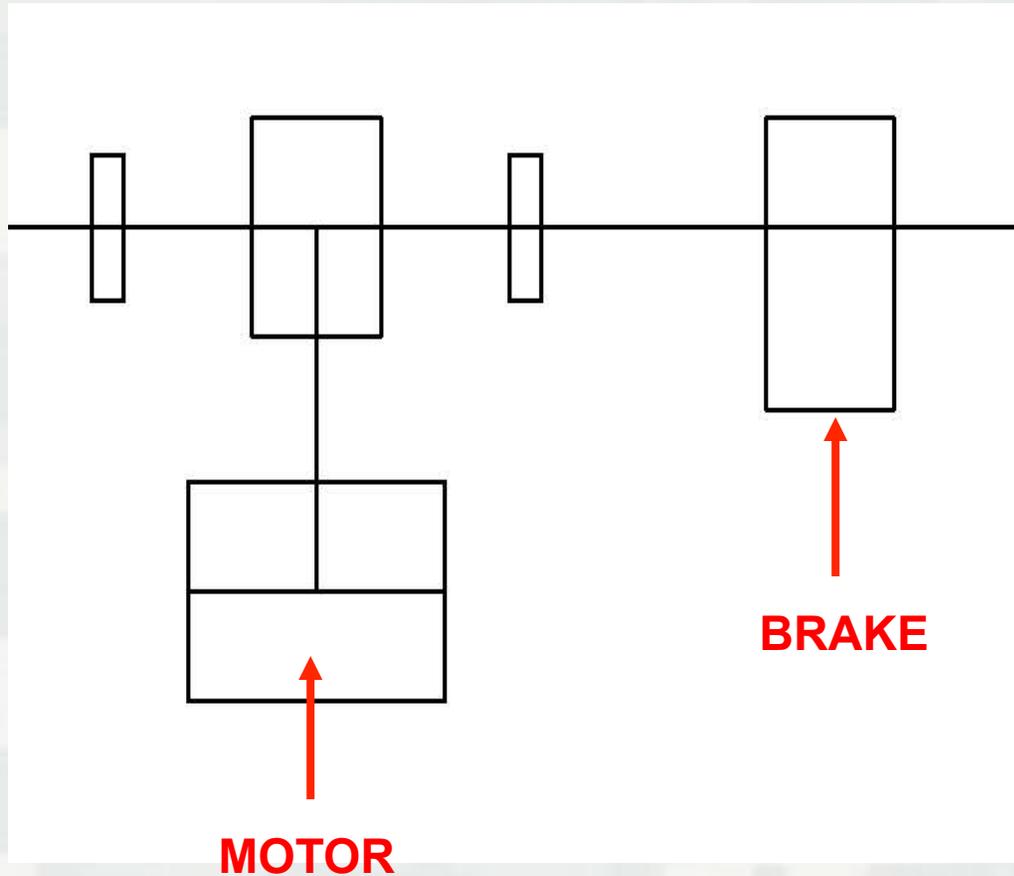


What Happened???





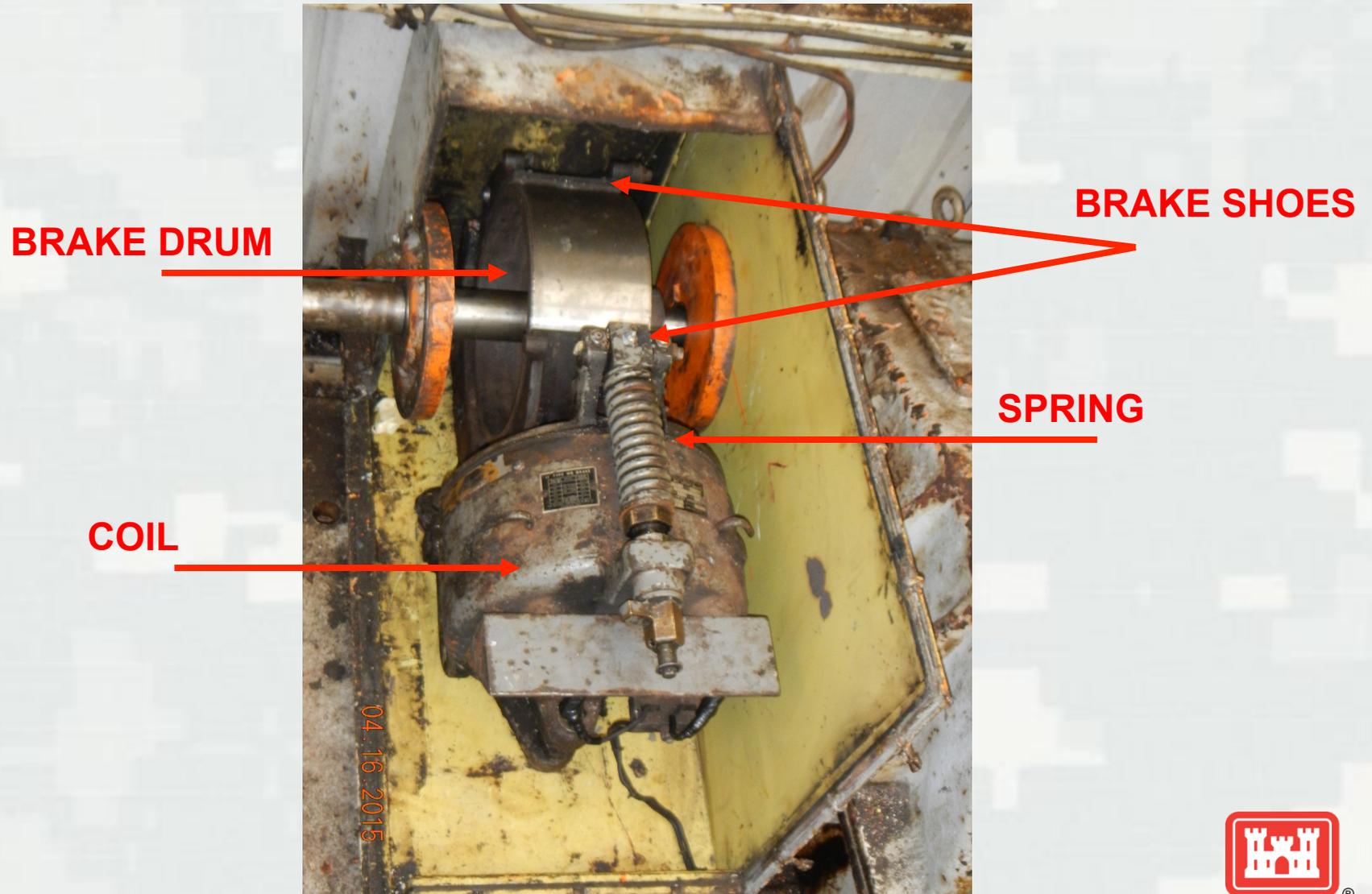
How the Brakes Work



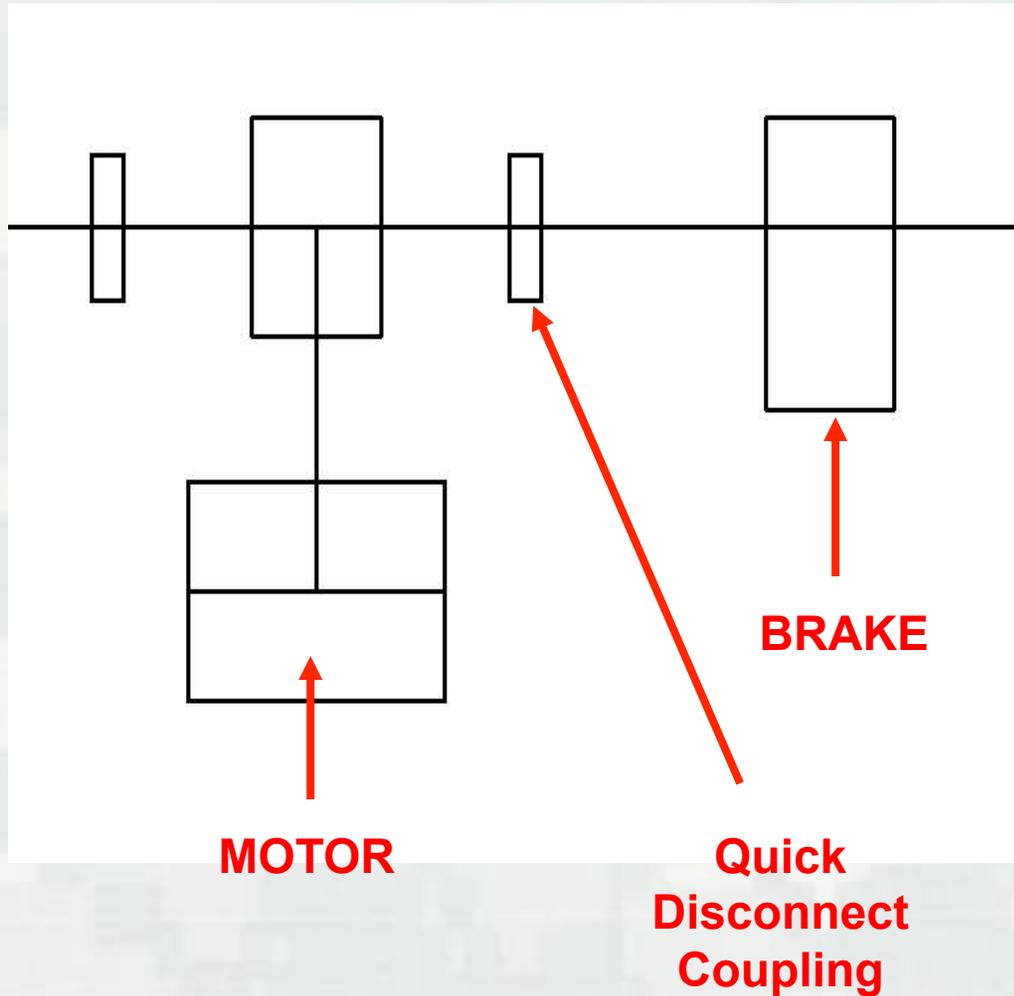
1. Turn the motor on
2. Electric Signal sent to coil in the Brake to overcome the Spring Strength
3. The Brake disengages
4. Line Shaft is allowed to spin
5. If for any reason power is lost, the coil in the brake relaxes and the Spring clamps the brake shoes back onto the brake drum



Brake - Before



What Happened??



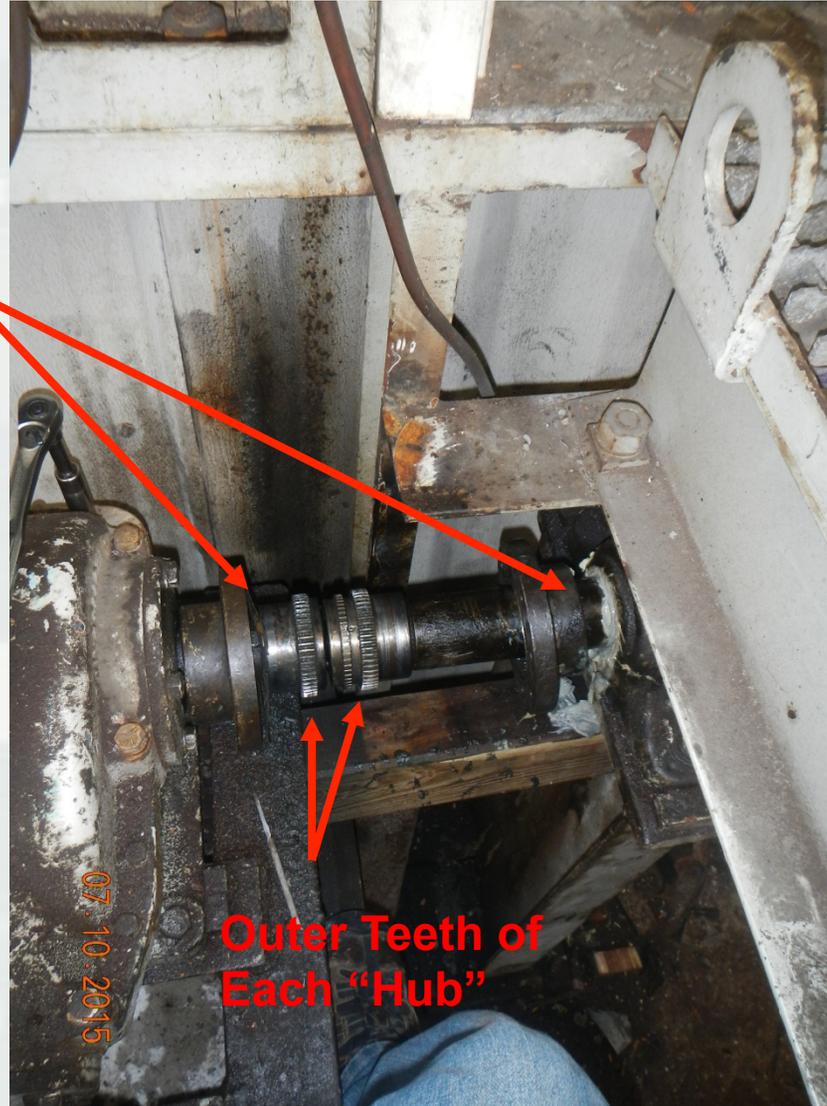
1. The brake did not engage
2. The motor kept running
3. Power was not lost in system
4. Both sides of gate fell uniformly

The Quick Disconnect Coupling was disengaged



Quick Disconnect Coupling

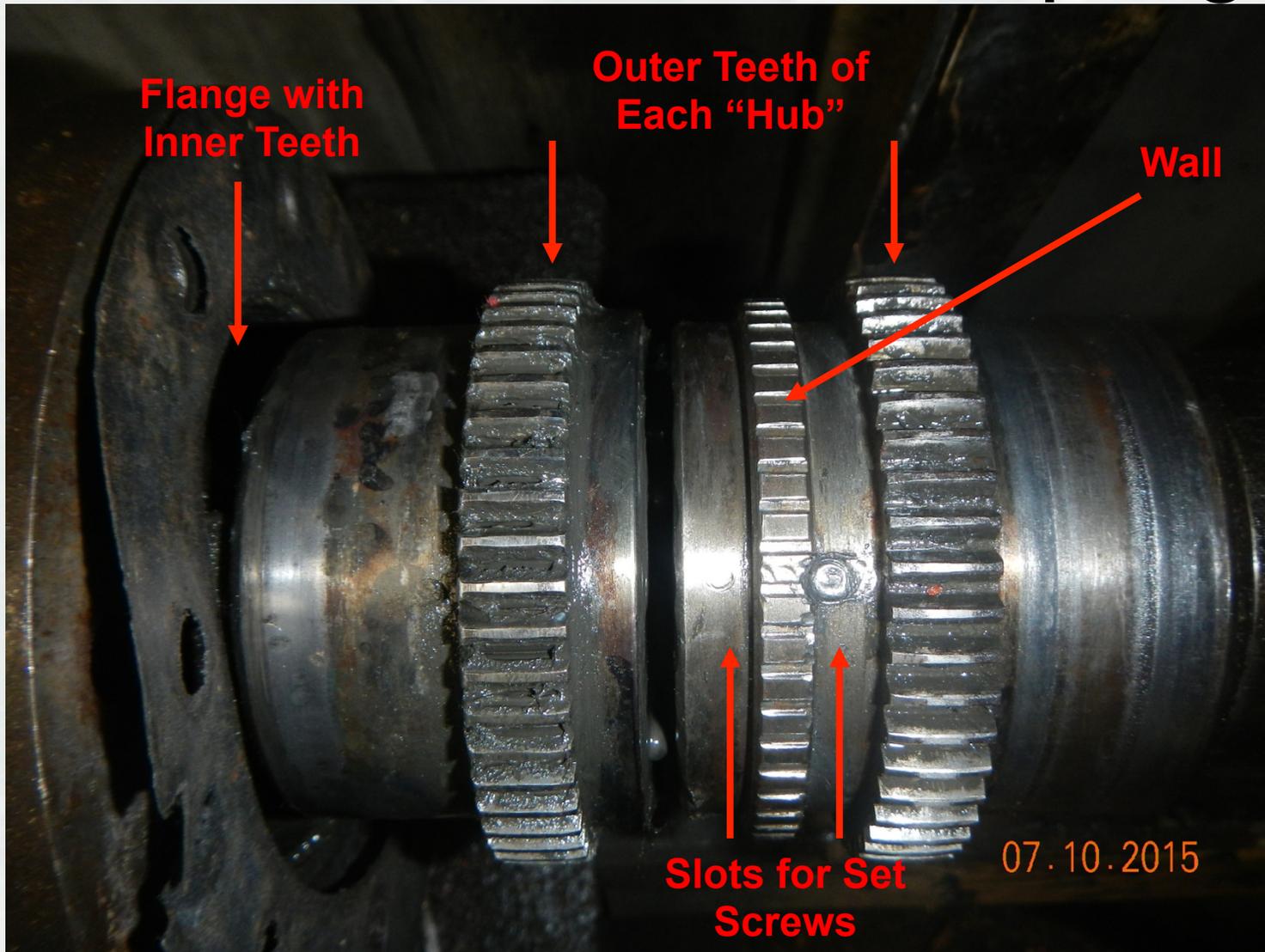
Flanges with
Inner Teeth



Outer Teeth of
Each "Hub"



Quick Disconnect Coupling



Quick Disconnect Coupling

- Flanges would walk off of the hubs as the line shaft rotated
- The set screws are supposed to stop this
- Why didn't it work?
 - 1 Set Screw was sheared
 - 2 Set Screws were backed out



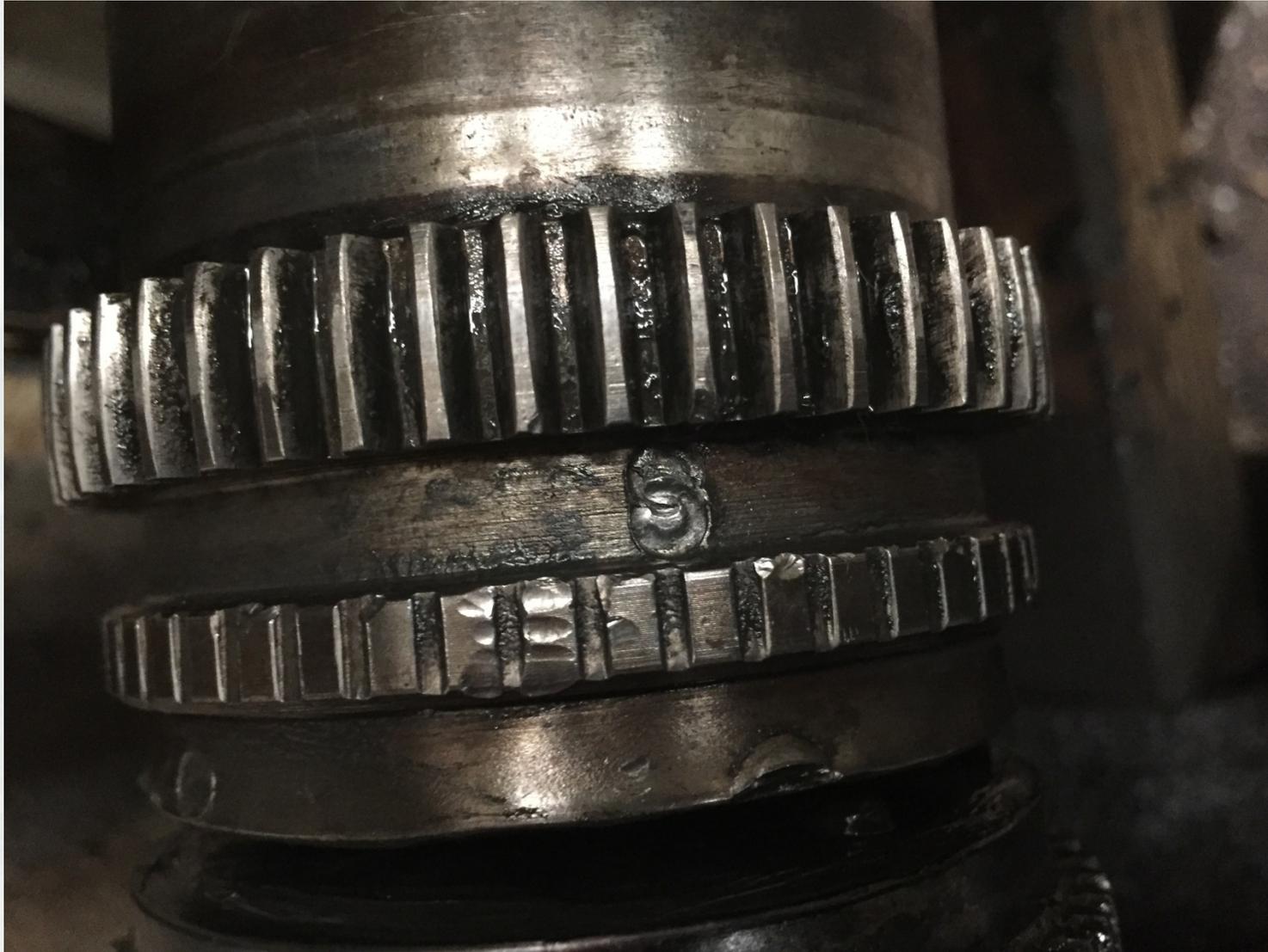
Set Screws



07.10.2015



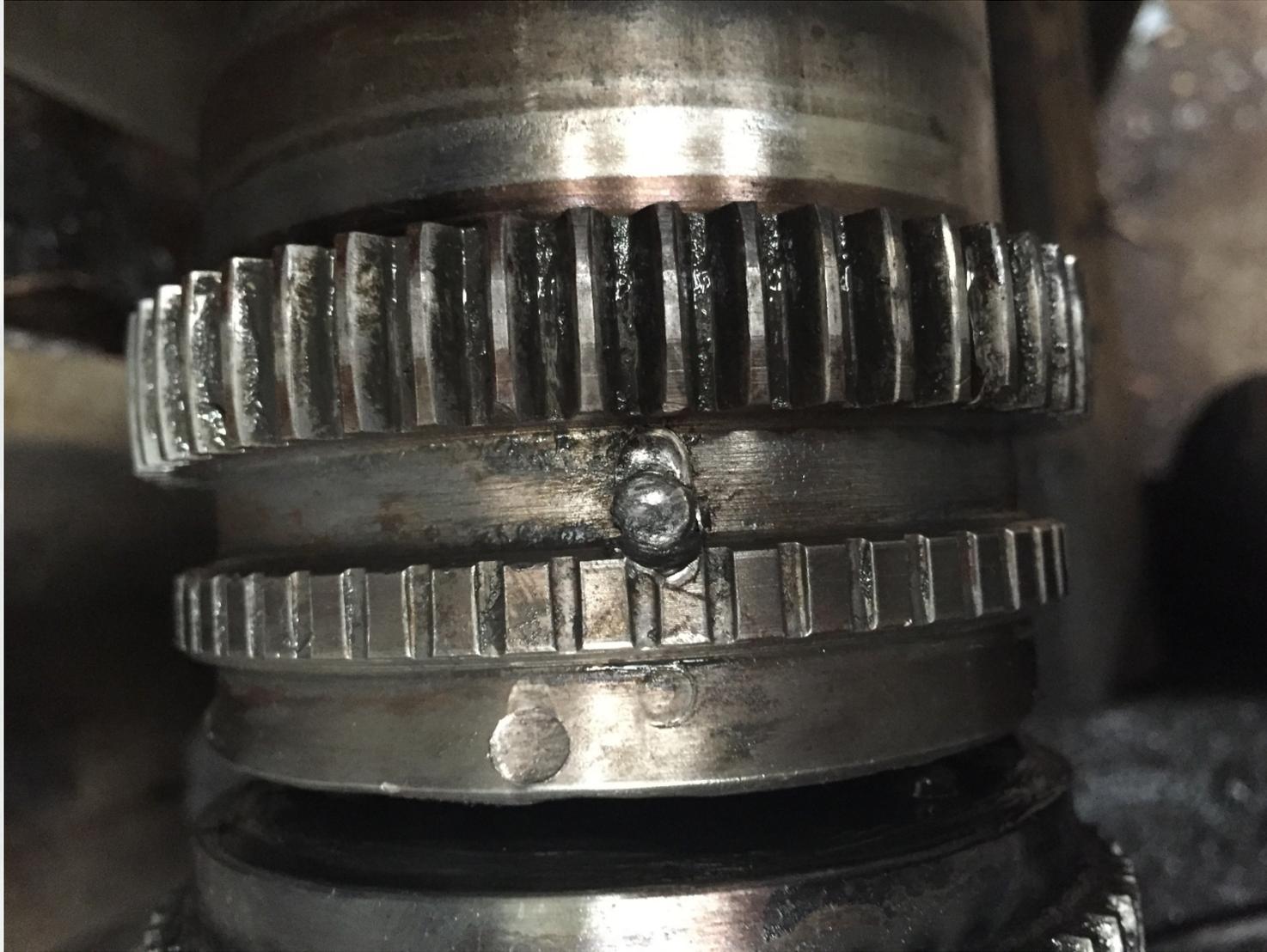
Set Screw Slot 1



Set Screw Slot 2



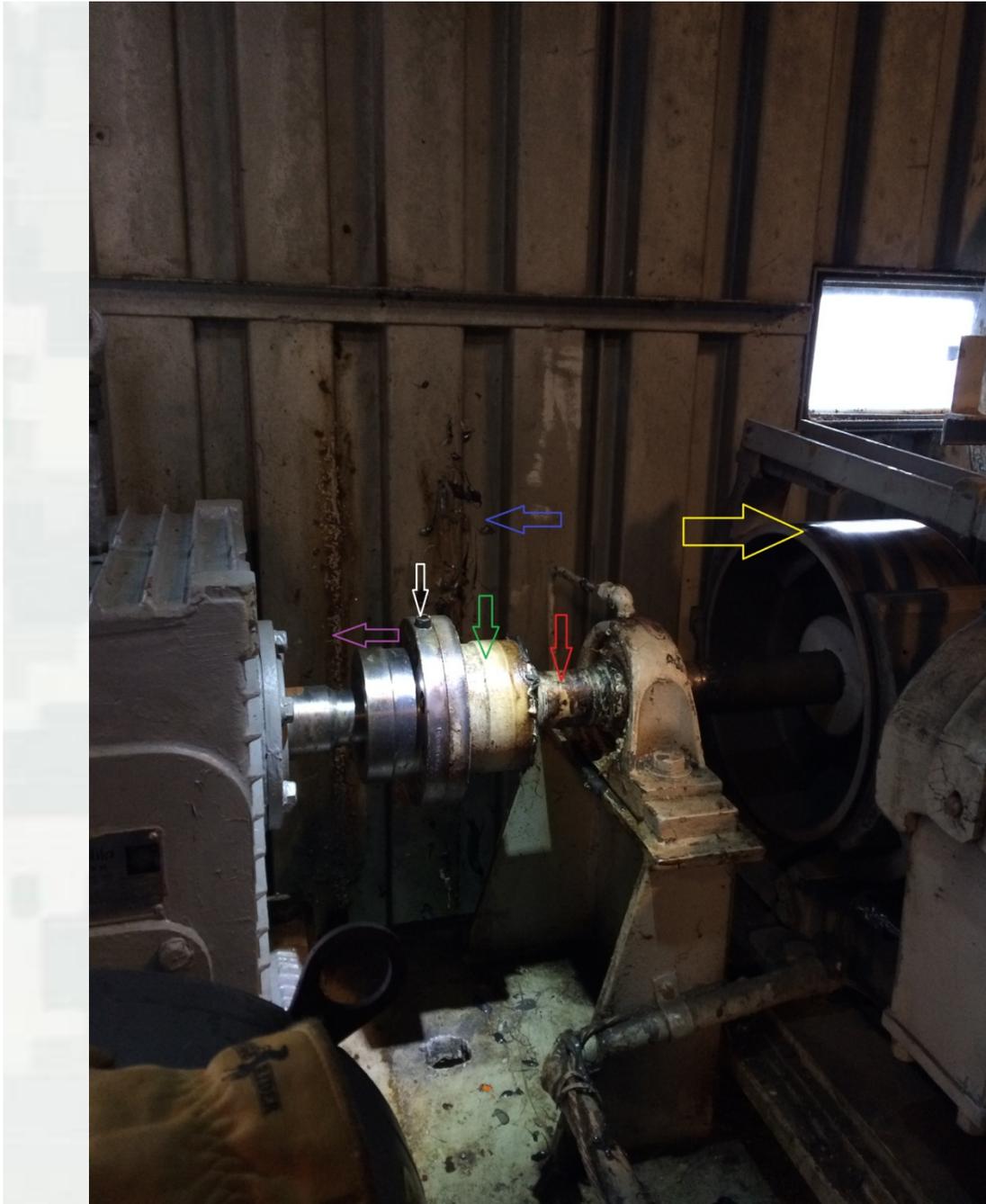
Set Screw Slot 3



Conclusion

- 1st Set Screw was most likely tightened into the “Wall” that divides the slots
- 2nd and 3rd Set Screws bottomed out on top of the “Wall” and were considered engaged
- The coupling could not be moved by hand because of the 1st set screw
- The 1st Set Screw sheared off from the spinning of the Line Shaft





Maxwell L/D



Way Ahead

- First and Foremost, ensure that all Lock Personnel know the proper installation of these couplings
 - ▶ Difficult to tell if it is fully engaged
 - ▶ There is grease, oil, dirt preventing them from being fully engaged
- Second, Come up with a fail safe to ensure that these couplings will not back off even if the set screws fail
- Ideas
 - ▶ Go/No-Go Gage
 - ▶ Install a clamp next to the flange once engaged
 - ▶ Have a district-wide “expert” that will be there for every installation



QUESTIONS?

