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Case Study 20080211

Automatic application of anti-seize compound

by Gordon Reeves

DESIGN PARAMETERS:

a. A machine builder is designing a work cell for automatic assembly of engine components and must apply anti-seize compound to bolt threads prior to assembly in that cell.

b. Because robots will be operating, the work cell is fenced and gated and personnel are not allowed inside during operation.

c. Except for planned maintenance during shut-down, all equipment (including dispensing equipment) must operate without physical intervention or adjustment.

d. Ambient temperatures in the cell can vary between 60 and 100 deg. F.

e. The apparent viscosity of the specified anti-seize compound (Bel-Ray #67700) changes with temperature to become thicker at lower temperatures and thinner at higher temperatures.

f. To control assembly torque, an exact consistent amount of anti-seize compound must be applied to be dispersed equally into the threads of every bolt during assembly.

A brush was not seriously considered for use in an automatic assembly cell:
A brush may be OK for use by a person, but not by a robot or machine. The robot would not be able to dip the brush into the compound to obtain the required amount every time. The brush would wear quickly and require frequent replacement.

Photo shows typical manual application of an unknown quantity of anti-seize compound using a brush. This is not practical in an automatic assembly cell.

Brand and part number of the anti-seize compound in this photo is unknown

Recommended Application

Automatic dispensing equipment will apply beads of anti-seize compound on the threads at the exact bead diameters and lengths required to cause equal dispersion of the compound into the assembled threads.

Multiple beads were necessary because a single bead would not disperse for more than an inch around the circumference of the bolt.

Automatic application of anti-seize compound uses a robot to move the bolt past a stationary nozzle while the compound is extruded. The bolt shown has 5/8-18 threads 1” long. Compound was applied as two 0.140” diameter beads for a total volume of 0.51 cc (0.255 cc per side).

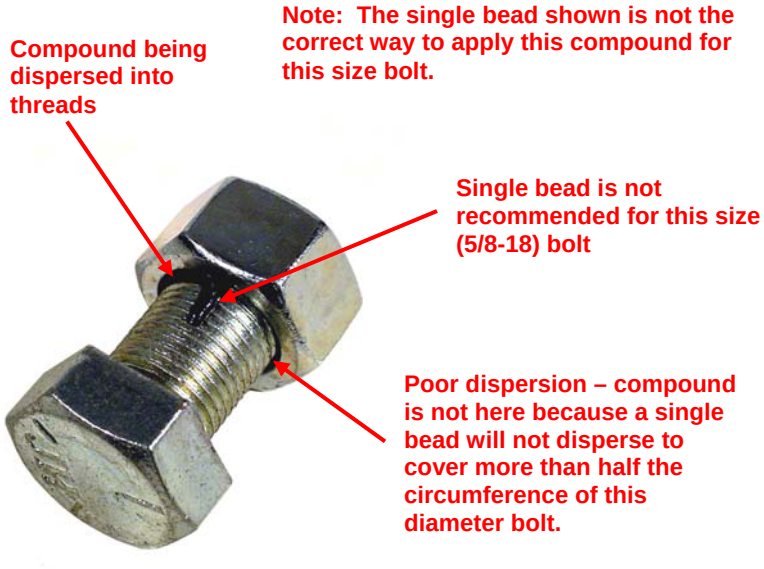
Anti-Seize Compound in these two photos is Bel-Ray #67700.

The same bolt is also shown after a nut was partially assembled and then removed. The two beads of compound have been dispersed into the threads by the rotation of the nut. Although not shown, the leading edge of the nut was almost clean indicating that most of the compound was dispersed into the threads by the rotation of the nut.

This photo shows how the compound is dispersed into 5/8-18 threads as the bolt is rotated clockwise into the nut.

The poor dispersion shown on the right side is based on the (not recommended) single bead shown.

A single bead is not recommended for the 5/8-18 bolt shown in the photo.



The **bead diameter** is calculated to obtain a 0.3 mm thickness (0.012”) on the surface area of the male threads. Larger than specified bead diameters may allow some compound to build up on surface of the nut instead of allowing it to be dispersed into the threads.

The **number of beads** is based on limited ability of the compound to disperse around more than 1” of the **circumference** of the bolt. Multiple beads are to be equally spaced.

The **surface area factor** is based on thread size and pitch.

Compound volume per inch is total, not “per bead”.

The **thread area per inch** of thread length is based on tap drill diameter x pi x thread surface area factor.

Bolt size	Circumference	Thread surface area factor	Thread area per inch of length	Number of beads	Bead diameter	* Compound volume per inch of threads
1/4-20	0.785”	1.30	0.82 sq. in.	1	0.111”	0.16 cc
3/8-16	1.13”	1.28	1.34 sq. in.	2	0.101”	0.26 cc
M10 x 1.5	1.24”	1.36	1.42 sq. in.	2	0.105”	0.28 cc
1/2-20	1.57”	1.30	1.85 sq. in.	2	0.119”	0.36 cc
5/8-18	1.96”	1.44	2.62 sq. in.	2	0.140”	0.51 cc
M24 x 2	2.96”	1.56	4.24 sq. in.	3	0.145”	0.83 cc
1 1/8 x 12	3.53”	1.68	5.53 sq. in.	4	0.145”	1.08 cc

*** Volumes have been calculated to provide full coverage. Correct coverage should be verified by user.**

MAJOR FACTORS TO CONSIDER

1. If bead diameter is too small, not enough anti-seize compound will be present to disperse into the threads of the nut as the bolt rotates. If the bead diameter is too large, some compound will “plow” onto the nut instead of being pushed or pulled into the threads.
2. It may not be possible to apply enough compound as a single bead to disperse for more than an inch of bolt circumference.
3. Dispensing equipment must include the ability to remove air from the compound.
4. Dispensing equipment must be capable of electronically controlling dispense flow rate to match robot or other motion velocity.
5. Robot or other motions for nozzle or bolt must also be electronically controlled to be repeatable.
6. Dispensing (measuring) must be via electronically controlled piston displacement.

HOW TO OBTAIN THE CORRECT BEAD DIAMETERS, LOCATIONS, AND LENGTHS ON THE THREADS:

a. Remove any air bubbles from anti-seize compound prior to measuring and dispensing.

b. Have robot move bolt past nozzle at consistent controlled repeatable velocity.

c. Dispense anti-seize compound at a consistent controlled repeatable flow rate.

d. Start and stop flow precisely to match robot movement

e. Have the robot present bolt to nozzle with xyz repeatability of ± 0.010".

f. If robot velocity is electronically coupled to the dispense flow rate of the anti-seize compound, the velocity of the robot can be variable and the bead size will not change.

g. Use Advanced Air Purge Grease Dispenser (AAPGD) mfg. by G. P. Reeves Inc. The G. P. Reeves air removal system is protected by US patent 6,053,285.

DISPENSING EQUIPMENT THAT WILL NOT WORK WITH THE DESIGN PARAMETERS ON PAGE ONE:

	Doesn't work	Why it will not work
1.	Any dispensing system that doesn't intentionally remove trapped air from the anti-seize compound.	**Trapped air causes erratic dispense flow rates and volumes. Trapped air is a major reason for dispense failures**
2.	Any timed dispense system.	**Timed dispense systems must be re-adjusted frequently to compensate for temperature based viscosity changes in the anti-seize compound.**
3.	Any non-electronically controlled piston dispenser.	**Some bead diameters will be too small and not provide enough anti-seize compound to be dispersed into the threads. Some bead diameters will be too large and some of the compound will be forced onto the leading edge of the nut instead of being dispersed into the threads.**
4.	Any system with rotary gear flow meters and flow valves	**Gear type flow meters cannot remove air from grease and often cannot detect the small amounts of air that will cause voids in the beads and cause nozzles to ooze after dispense.**
5.	Any system that uses non-electronically controlled motions.	**Uncontrolled motions do not have consistent velocity to work with the controlled dispensing flow rates to cause the correct bead diameters.**

More information click on the appropriate links:

http://gpreeves.com/cat/cat-patentedairdetect1.pdf for details about our patented method of removing air from grease and anti-seize compound

http://gpreeves.com/cat/cat-twotypes.pdf for information about the difference between timed dispense and piston dispense

http://gpreeves.com/cat/cat-manualorelectronicadjust.pdf for information about the advantages of electronic control of piston dispensers

http://www.gpreeves.com/aapgdvid.html for video of the G. P. Reeves AAPGD electronically controlled grease dispense

http://gpreeves.com/aapgd for a slide show about the G. P. Reeves Advanced Air Purge Grease Dispensers

http://gpreeves.com/cat/cat-cpk.pdf for capability (CP and CPK) of G. P. Reeves grease dispensers

We also have pumps for Cemco cartridges, standard grease cartridges, metric and US pails, kegs, and drums

Please feel free to contact anyone at G. P. Reeves with questions or comments