Switched Reluctance (SR) Generator

Section 06-01

Komatsu has made every effort to make this manual as accurate as possible based on the information available at the time of publication and printing. Continuous improvement and advancement of product design may cause changes to machines which may not have been included in this publication. Komatsu reserves the right to make changes and improvements at any time. To ensure the most current information, please contact your service center.

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Scope of This Publication

To briefly describe the SR generator, its component parts, generator settings and adjustments. To provide removal, installation and alignment procedures.

Safety

This publication contains special instructions that pertain to safety, operation, maintenance, and repair of the generator. Listed below are the signal words and symbols that precede these instructions and their meanings:

⚠ DANGER

- **The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING

- **The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

⚠ CAUTION

- **The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol ⚠).**

CAUTION

- **The caution label (without safety alert symbol) is used to address practices not related to personal injury – only equipment damage.**

NOTICE

The NOTICE graphic is to indicate areas of importance to the reader that are not related to personal injury or machine damage.

Safety, Warnings, and Cautions

⚠ WARNING

CRUSH HAZARD

- **Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.**
- **Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.**
- **Crush hazards exist when lifting components. Component weights are approximate. Always allow a safety margin when selecting lifting equipment. Consult the engine manufacturer for exact engine weights. Failure to allow a safety margin for lifting equipment can cause crush hazards resulting in serious injury or death.**
- **Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to "HYDRAULIC AND GREASE SYSTEMS", "MANUAL BLEED VALVE ASSEMBLY", in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.**
- **Crush hazards exist when lifting components. The engine/generator assembly weights shown in the tables titled "WEIGHTS" are approximate weights. Always allow a safety margin when selecting lifting equipment. Consult the engine manufacturer for exact engine weights. Failure to allow a safety margin for lifting equipment can cause crush hazards resulting in serious injury or death.**

CRUSH, SHOCK, OR OTHER HAZARDS

- **Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.**

ELECTRICAL SHOCK HAZARD

- **Electrical shock hazard exists when working in areas where electrical connections or components exist. Do NOT touch the braking grids, motor leads, or any electrical connections when the generator is primed or until five minutes after the engine has been shut down, and the absence of bus voltage has been verified, following operation of the machine. Failure to avoid electrical connections or components can cause electrical shock hazards resulting in serious injury or death.**

- **Electrical shock hazard exists when performing inspection or service procedures. Do NOT touch the braking grids, motor leads, or any electrical connections when the generator is primed or until five minutes after the engine has been shut down, and the absence of bus voltage has been verified, following operation of the machine. Failure to avoid electrical connections or components can cause electrical shock hazards resulting in serious injury or death.**
- **Electrical shock hazard exists when working in the converter cabinet even after the engine goes to low throttle or for five minutes after it is shut off. Do NOT touch any electrical connections when the generator is primed or until five minutes after the engine has been shut down, and the absence of bus voltage has been verified, following operation of the machine. Failure to avoid electrical connections or components can cause electrical shock hazards resulting in serious injury or death.**
- **Risk of fatal electrical shock or injury by contact in the converter cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the converter cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the converter cabinet or touch any components in the converter cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.**
- **High voltage may be present. Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings.**

ENTANGLEMENT HAZARD

- **Entanglement hazard exists if attempting to work on rotating equipment. Use extreme caution when conducting vibration tests on operating power unit. KEEP CLEAR OF ROTATING SHAFTS. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities may cause an entanglement hazard that results in serious injury or death.**
- **Entanglement hazard exists if attempting to work on rotating equipment. Never conduct bearing temperature on an operating machine. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities can cause an entanglement hazard that results in serious injury or death.**

SKIN INJECTION HAZARD

- **Skin injection hazard exists when working with compressed air. Compressed air can enter the skin. Always use the correct Personal Protective Equipment (PPE), as required locally, when using compressed air during any work process or procedure. Failure to use appropriate PPE can cause skin injection hazards resulting in serious injury or death.**

EYE INJURY HAZARD

- **Eye injury hazard exists when working with compressed air. Flying debris can enter the eyes. Always use the correct Personal Protective Equipment (PPE), as required locally, when using compressed air during any work process or procedure. Failure to use appropriate PPE can cause eye injury hazards resulting in serious injury or death.**

PINCH POINT HAZARDS

- **Pinch point hazards exist when the generator is removed from the engine. The generator rotor may drop. This is the result of the rotor shaft being supported on the engine end by the engine flex plate. The amount of force to remove the rotor adapter to the flexplate will vary. Ensure hand and fingers are kept clear of pinch points during the separation. Failure to keep hands and fingers clear of the pinch point areas can cause pinch point hazards resulting in serious injury.**

⚠ CAUTION

MULTIPLE HAZARDS

- **Multiple hazards exist when removing the hood structure. Fire, inhalation from accidental system activation and other hazards may be present. The hood structure may have optional fire suppression devices attached. Certified personnel should be consulted prior to disconnecting or reconnecting fire suppression equipment. Personal injury is possible if the equipment is not disconnected or reconnected correctly. Failure to consult certified fire suppression system personnel before removing or installing the hood can cause multiple hazards resulting in personal injury.**

CRUSH HAZARD

- **Crush hazard exists when supporting the rotor. If not properly supported, the rotor can fall. If a crane is not available to support the rotor - it is also permissible (but not required) - to support the rotor with the rotor endplay tools. Failure to properly support the rotor can cause crush hazards resulting in personal injury.**
- **Crush hazards exist when lifting the rotor. Lifting equipment not certified for lifting can fail causing the component to fall. DO NOT use any locally fabricated eyes for lifting. Failure to use certified lifting devices can cause crush hazards from falling objects resulting in personal injury.**

CHEMICAL HAZARD AND INHALATION HAZARD

- **Chemical hazard exists when disconnecting hoses and lines. Avoid personal physical contamination with all fluids, on the skin and especially the eyes. Wear Personal Protective Equipment (PPE) when removing lines containing fluid. Failure to wear appropriate PPE can cause chemical hazards resulting in personal injury.**

BURN HAZARD

- **Burn hazard exists when testing electrical equipment. Make sure the welding unit is OFF prior to performing any testing. Failure to turn the welding machine off prior to testing can cause personal injury.**
- **Burn hazard exists when removing or installing clamps onto generator/motor. Make sure the welding unit is OFF prior to removing or installing clamps onto the generator/motor. Failure to turn the welding machine off prior to clamp connection can cause personal injury.**
- **Burn hazard exists when conducting vibration tests on operating equipment. Components in surrounding areas will be hot and can cause burns. Wear all appropriate personal protective equipment (PPE) to prevent burns. Failure to wear appropriate PPE can cause burn hazards resulting in personal injury.**

Component Description

SR Generator

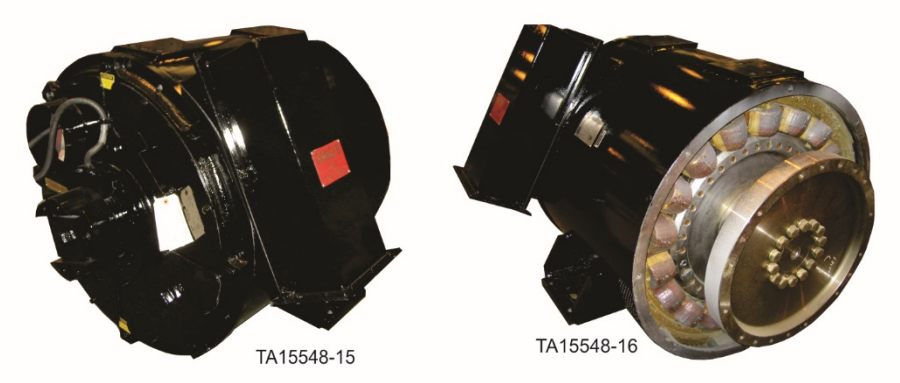


Figure 1. SR generator (typical)

This is a single bearing SR generator that consists of an 18 pole stator and a 12 pole rotor. As with all SR generators the number of poles on the rotor is different from the number of poles on the stator. The SR generator does not use any brushes. The rotor does not have any copper – it consist of laminations with 12 poles mounted on a shaft and pressed and held together with plates at each end. The endbell and bearing components on the generator are the same or similar to those used on the 4B, 7B, 9B and 6R AC generators for parts commonality. There were some small changes to allow mounting of the RPT assembly.

The generator turns at engine speed and is capable of output power at all engine rpm.

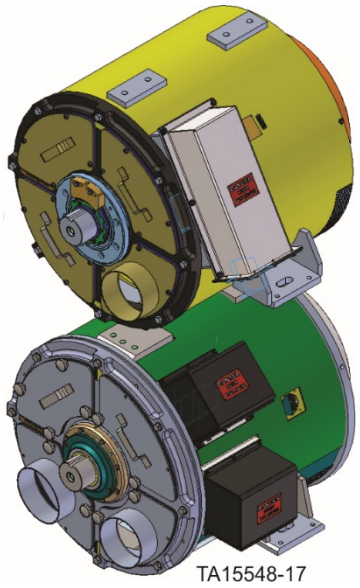


Figure 2. SR generator compared to 6R generator

Generator Laminations

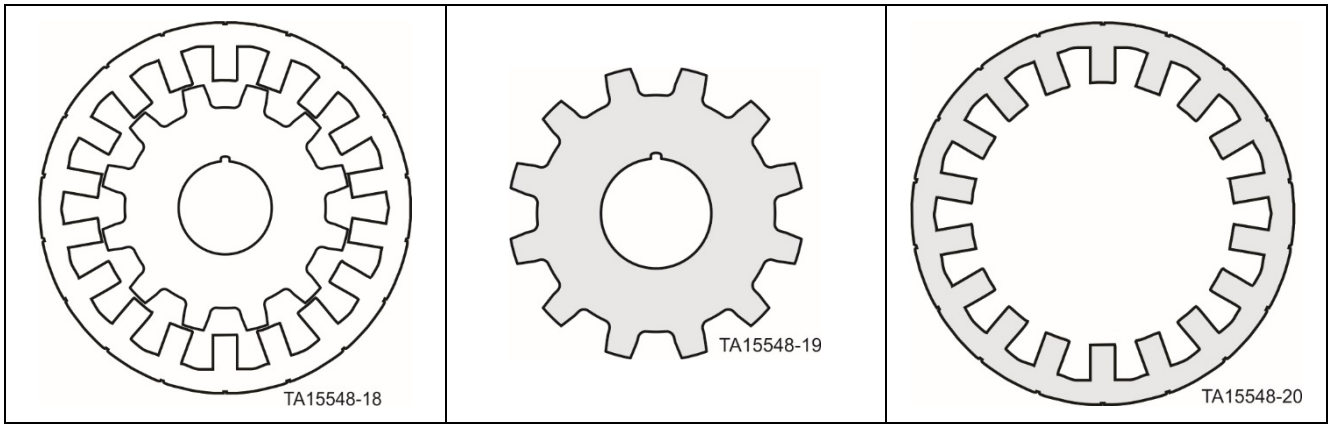


Figure 3. SR generator stator laminations

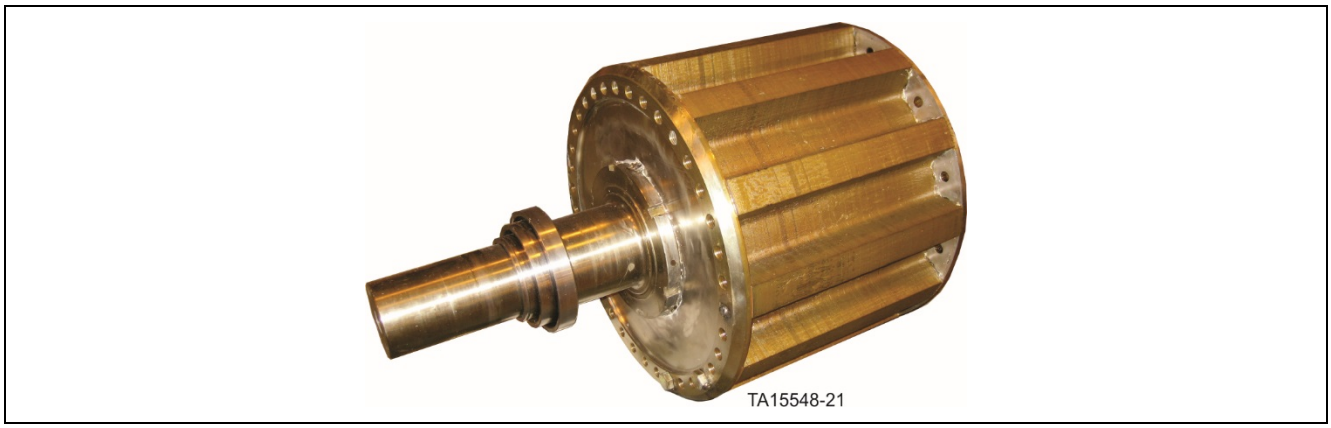
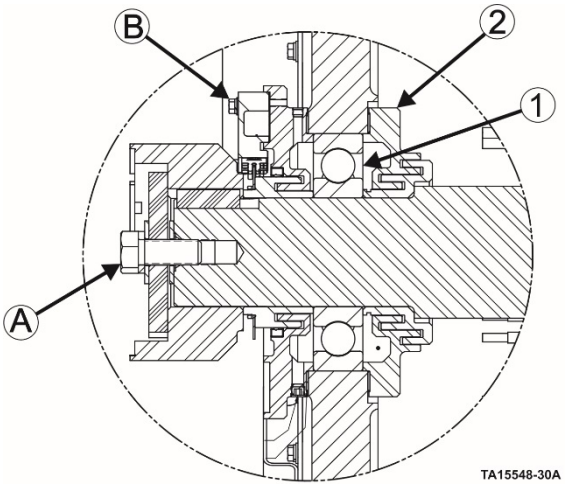


Figure 4. SR generator laminations

Generator Bearing

The bearings and labyrinth seals do not require any additional greasing during their operating lifetime. The grease will be replaced during generator rebuild.

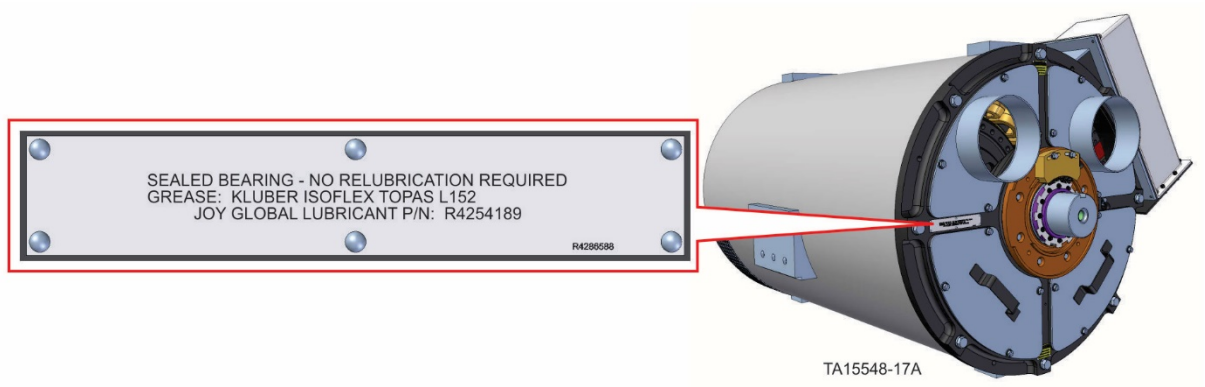


1) Ball bearing, **2)** Inner bearing retainer

A) Apply locktite 271 or locktite 2760 to thread - torque to 230 ft-lbs

B) Apply locktite 271 or locktite 2760 to thread - torque to grade 8 specifications

Figure 5. SR generator bearing



SEALED BEARING – NO RELUBRICATION REQUIRED
GREASE: KLUBER ISOFLEX TOPAS L152
JOY GLOBAL LUBRICANT P/N R4254189

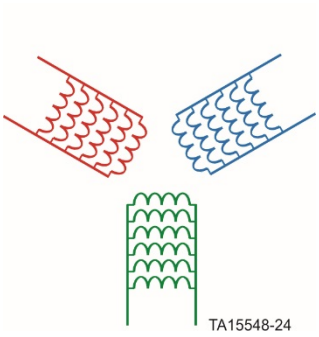
Figure 6. SR generator bearing

Stator Coils

Each pole of the stator has a single multiturn coil of copper wire. These coils are installed in a “green” state (no epoxy or varnish in the coil) and then the stator is processed in a VPI system to fully impregnate the coil and adhere the coil to the stator pole.

Figure 7. SR generator stator coils (typical)

The coils are joined in parallel in three groups or phases. All of the coils in a group are energized at the same time.



SR Generator

3 phases (groups of coils)

6 parallel coils per phase

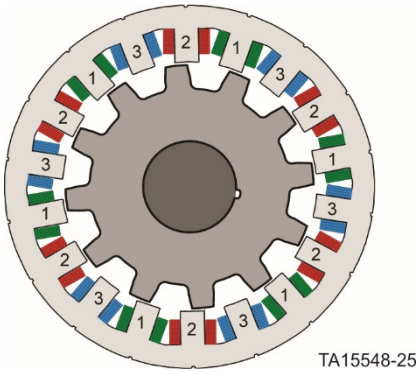
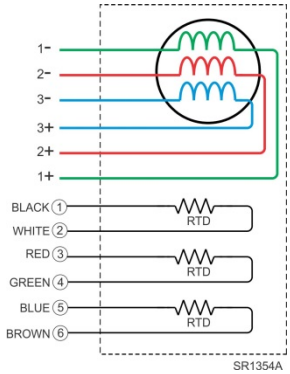


Figure 8. SR generator coil groups

Internal Connections

There are three sets of primary power connections to the outside of the generator.



1) Black, **2)** White, **3)** Red, **4)** Green

5) Blue **6)** Brown

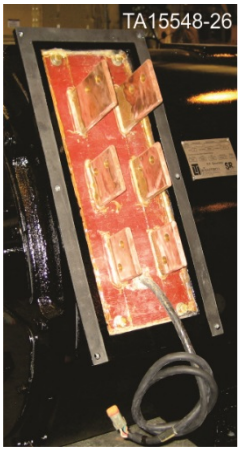


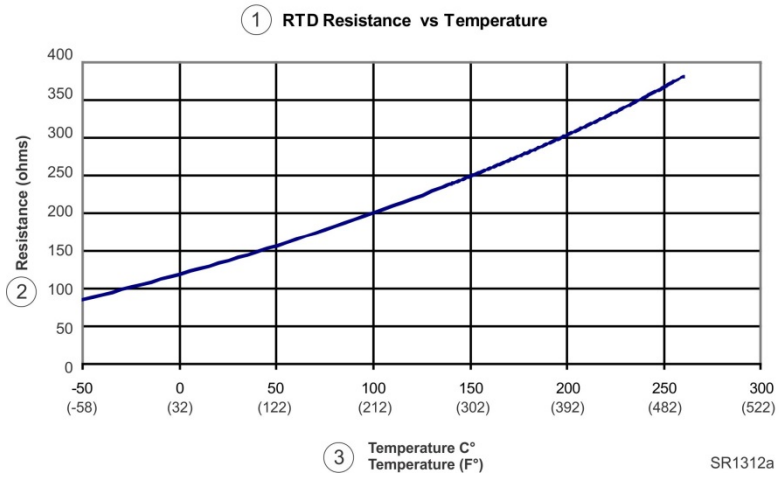
Figure 9. SR generator connections

Resistance Temperature Detector (RTD)

The temperature of the generator is monitored by RTD devices. These are installed along with the coils during fabrication of the stator. The stator is then VPI'd. These devices cannot be changed without changing the coil.

Figure 10. SR generator RTD

The RTD has a nominal resistance of 120 ohms at 0°C (32°F). It increases with temperature increase as shown below. The generator has 3 RTD sensors – one per group of coils. The LINCS II software only looks at the highest temperature so the generator can run with less than 3 RTD's. A defective RTD should be shorted out, so it will be ignored by the LINCS II software.



1) RTD Resistance vs Temperature, **2)** Resistance (ohms), **3)** Temperature c° Temperature (f°)

Figure 11. SR generator RTD temperature chart

There is an RPT connector and RTD connector on the generator. These are connected to a cable located near the power connections on the generator. These devices are all connected directly to the associated master converter panels in the converter cabinet.

Testing RTD Cable Pairs

Configure multimeter to read 200 ohms.

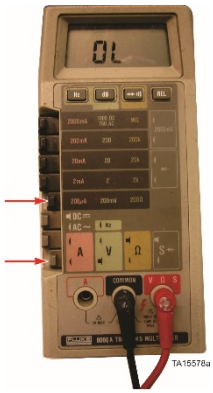


Figure 12. Configure multimeter

Test cable pairs on RTD cable.

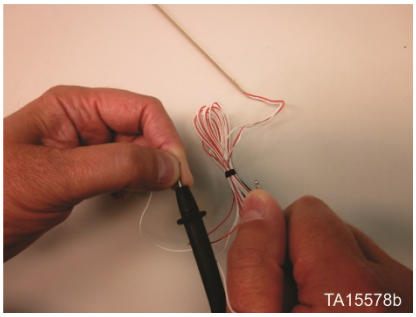


Figure 13. Testing cable pairs

RTD	Six Conductor Cable Pair	Meter Test Leads	Measurement @ Room Temperature
1B	White	Red	134 – 142 Ω
1B	Black	Black	134 – 142 Ω
2C	Orange (Brown)	Red	134 – 142 Ω
2C	Blue	Black	134 – 142 Ω
3A	Green	Red	134 – 142 Ω
3A	Red	Black	134 – 142 Ω

Meter should read between 134 to 142 ohms (optimal reading is 134-142 ohms at room temperature).

Rotor Position Transducer (RPT)

The position and speed of the SR generator is determined by use of RPT (Rotor Position Transducer) devices mounted on the back of the generator next to the bearing. The RPT looks at the position of the shutter tabs as the pass through the sensor. Only three of the six RPT's are used at any one time. The other three are spares.

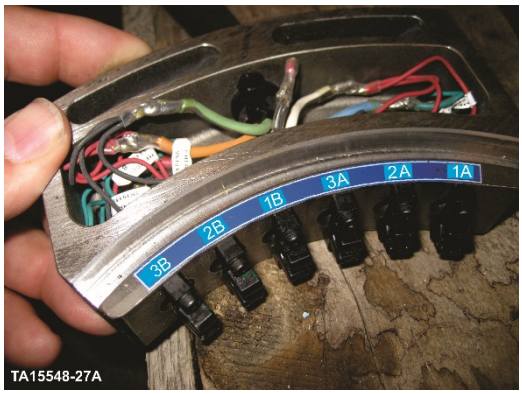
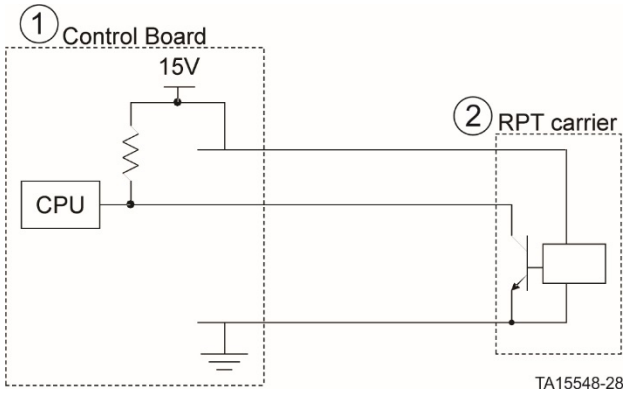


Figure 14. SR generator RPT assembly



1) Control board

2) RPT carrier

Figure 15. SR generator RPT schematic

Settings and Adjustments

⚠ WARNING

Electrical shock hazard exists when working in areas where electrical connections or components exist. Do NOT touch the braking grids, motor leads, or any electrical connections when the generator is primed or until five minutes after the engine has been shut down, and the absence of bus voltage has been verified, following operation of the machine. Failure to avoid electrical connections or components can cause electrical shock hazards resulting in serious injury or death.

⚠ WARNING

Electrical shock hazard exists when performing inspection or service procedures. Do NOT touch the braking grids, motor leads, or any electrical connections when the generator is primed or until five minutes after the engine has been shut down, and the absence of bus voltage has been verified, following operation of the machine. Failure to avoid electrical connections or components can cause electrical shock hazards resulting in serious injury or death.

⚠ WARNING

Electrical shock hazard exists when working in the converter cabinet even after the engine goes to low throttle or for five minutes after it is shut off. Do NOT touch any electrical connections when the generator is primed or until five minutes after the engine has been shut down, and the absence of bus voltage has been verified, following operation of the machine. Failure to avoid electrical connections or components can cause electrical shock hazards resulting in serious injury or death.

⚠ WARNING

Skin injection hazard exists when working with compressed air. Compressed air can enter the skin. Always use the correct Personal Protective Equipment (PPE), as required locally, when using compressed air during any work process or procedure. Failure to use appropriate PPE can cause skin injection hazards resulting in serious injury or death.

⚠ WARNING

Eye injury hazard exists when working with compressed air. Flying debris can enter the eyes. Always use the correct Personal Protective Equipment (PPE), as required locally, when using compressed air during any work process or procedure. Failure to use appropriate PPE can cause eye injury hazards resulting in serious injury or death.

RPT Setting Procedure G100 & G200 Generators

Safety Preparations

⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

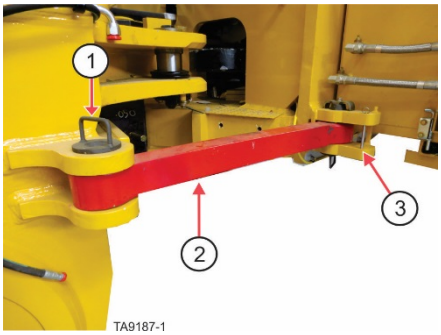
a. Stop the wheel loader on flat level ground.

b. Set bucket flat and level on the ground.

c. Move the frame lock to the locked position so that the frame cannot be steered.

⚠ WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Frame lock in locked position

1) Retaining pin for locked position, **2)** Frame lock - shown in locked position,

3) Retaining pin bracket for un-locked position

Figure 16. Frame Lock

d. Place wheel chocks in front and behind each wheel.

e. Set the parking brakes.

Converter Bus Voltage

WARNING

Risk of fatal electrical shock or injury by contact in the converter cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the converter cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the converter cabinet or touch any components in the converter cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

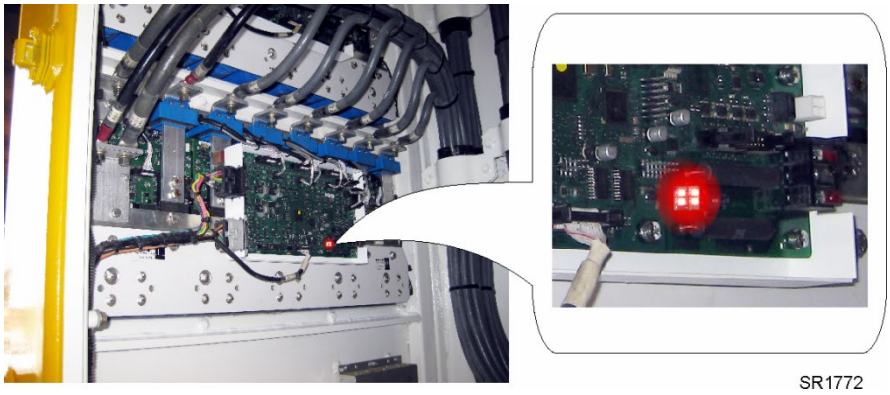


Figure 17. Converter assembly bus LED's

There are three different methods that are combined to verify when it is safe to enter the converter cabinet.

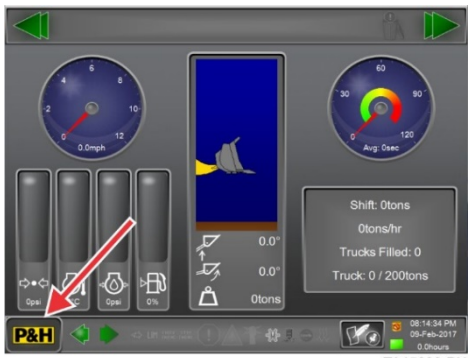
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

In Cab Verification Using LINCS II Display

1. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.



Main Menu Button

Data Logging & Logging/Monitoring

Figure 18. LINCS logging/monitoring menu access

3. Select the Trash Can icon and the select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 19. Remove channels

4. Scroll down the left hand list until Drive Fuses is displayed.

Figure 20. Left hand scroll

5. Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

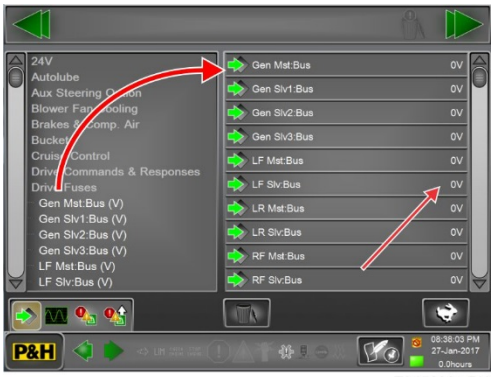


Figure 21. Bus voltage indication

6. Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

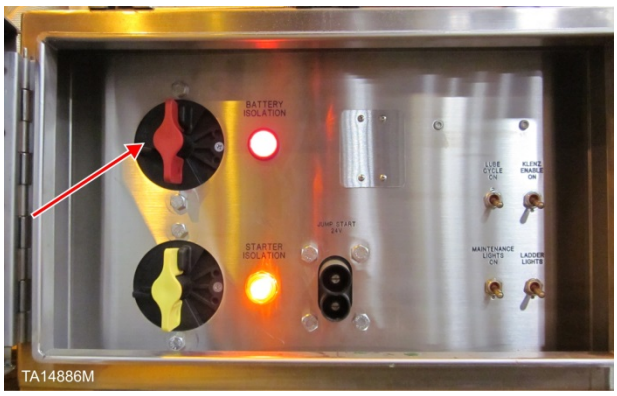
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.



Isolate the battery and lockout the machine

Figure 22. Isolation and control switch assembly

- The SR electrical converter cabinet door should now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

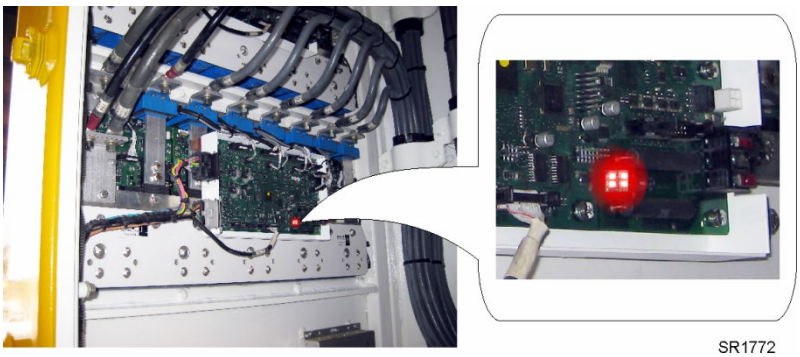


Figure 23. Bus voltage LED array on SR control board

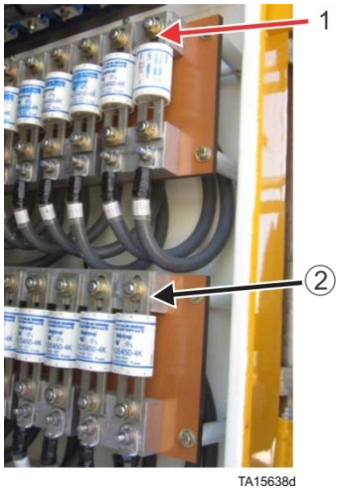
Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

a. Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

⚠ WARNING

High voltage may be present. Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings.



1) Positive bus bar, **2)** Negative bus bar

Figure 24. Main bus bars

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

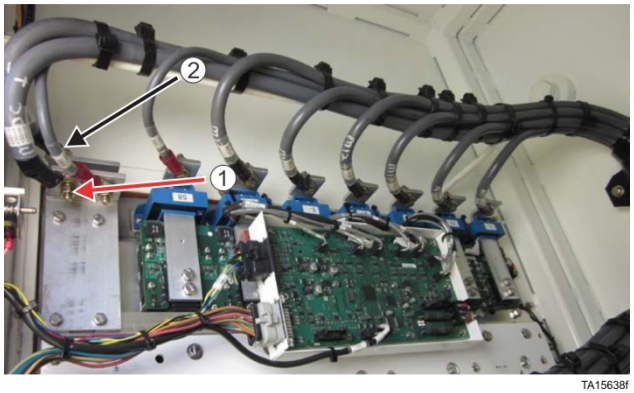
NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

1) Positive bus bar, **2)** Negative bus bar

Figure 25. Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 26. Converter assembly bus connections (front of cabinet)

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

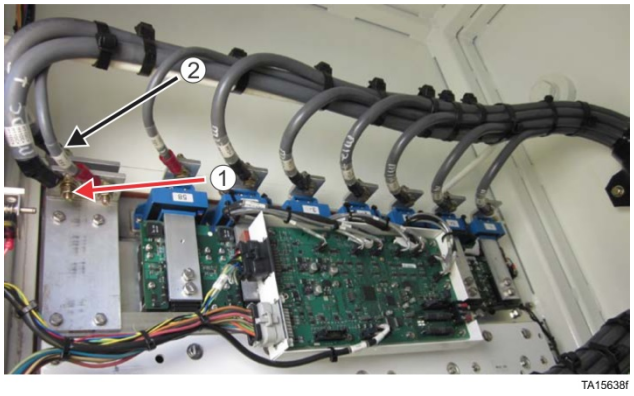
NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

a. Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

1) Positive bus bar, **2)** Negative bus bar

Figure 27. Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 28. Converter assembly bus connections (front of cabinet)

Adjusting the RPT:

NOTICE

This procedure requires turning the rotor in order to test the LED's. This is accomplished by rotating the engine crankshaft.

Items Required

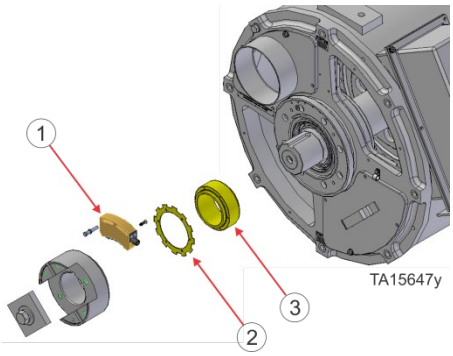
Item	Part Number
RPT/RTD Tester	427-0151
Test Cable RPT/RTD	427-2153
Power Cable RPT/RTD Tester	427-2154
DC Power Source (+5 to +24VDC)	
Portable DC Welder Capable of 600 AMPS	
	
1) RPT assembly, **2)** Shutter, **3)** Outer race	

Figure 29. RPT, shutter and outer race

NOTICE

The outer race is an interference fit on the shaft and does not align to the rotor. Alignment is performed by adjusting the RPT assembly.

a. Visually inspect the shutter for bent tabs or damage prior to adjusting the RPT. Repair or replace as necessary.

b. Attach the 23 pin female connector on the Test Cable to the 23 pin male connector on the RPT/RTD Tester Card.

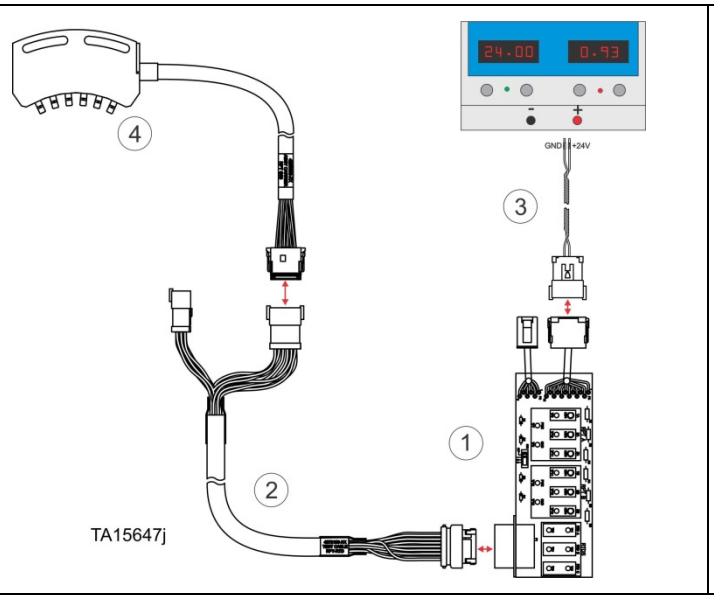
c. Attach the power cable RPT/RTD Tester to the 12 pin male connector on the RPT/RTD Tester Card.

d. Connect the Ground and 24V leads on the Power Cable RPT/RTD Tester to a +24VDC power supply.

NOTICE

The drive shaft must be disconnected in order to allow the alignment of the rotor.

e. Disconnect the drive shaft at the generator end.



1. RPT/RTD tester card
2. Test cable RPT/RTD
3. Power cable RPT/RTD tester
4. RPT carrier assembly

Figure 30. RPT tester card and cables

f. Plug the RPT carrier cable into the 12 pin connector located on the RPT/RTD test cable.

g. Make sure SW1 on RPT/RTD Tester card is switched to OFF.

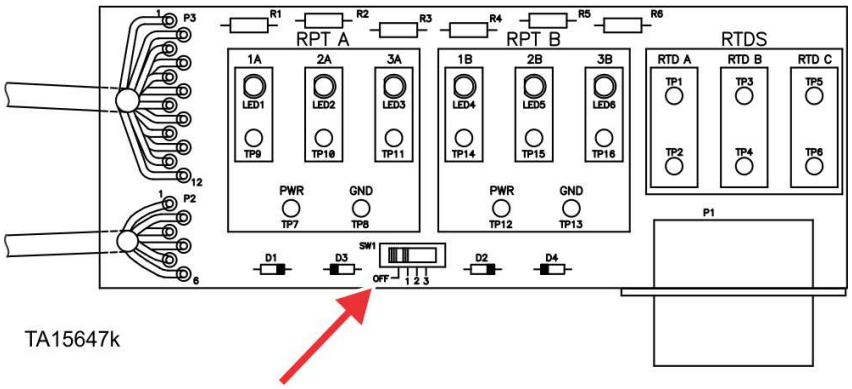


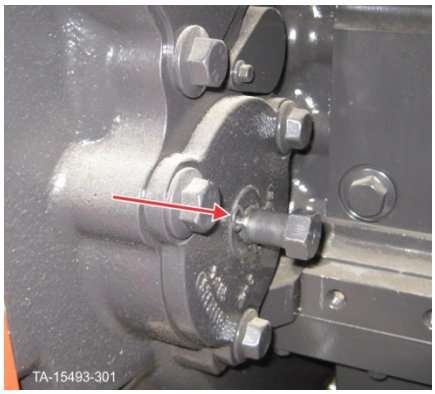
Figure 31. Tester card (SW1 OFF)

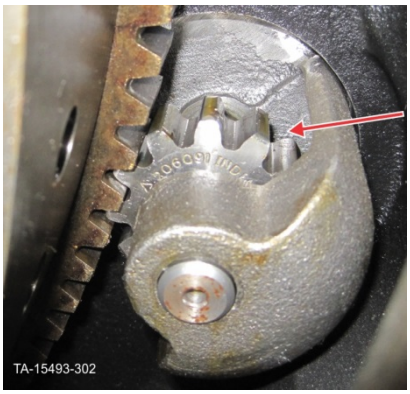
h. Turn on the DC power supply and check to see that at least one of the RPT LED's illuminates.

NOTICE

If none of the LED's illuminate, rotate the rotor a small amount. If no LED's are illuminated after rotating the rotor it will be necessary to troubleshoot/replace the RPT carrier and/or the test card. The rotor can be rotated by rotating the engine crankshaft as detailed below. Make sure power is present at the test card.

Crankshaft rotation procedure for Teir 1 and Teir 2 Cummins Engine





Cummins Engine engine rotation tool, retainer ring, and internal gear

Figure 32. Cummins engine rotation tool

1. Remove the retainer ring from the engine rotation tool. (The tool is normally held in the out position with a retainer ring so that it does no contact he flexplate gear, it is also spring loaded to keep it away from the flexplate gear).
2. On completion of procedure, pull the spring loaded shaft to the out position and reinstall the retainer ring.

NOTICE

If rotation tool not installed on engine, consult your local Cummins dealer.

Crankshaft rotation procedure for Teir 1 Detroit Engine

a. Remove the crankshaft grounding strap from the front of the engine.

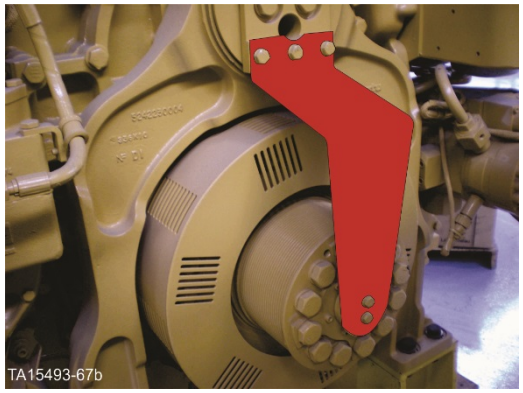
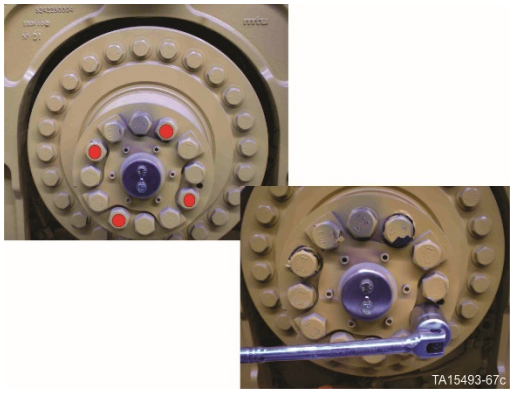


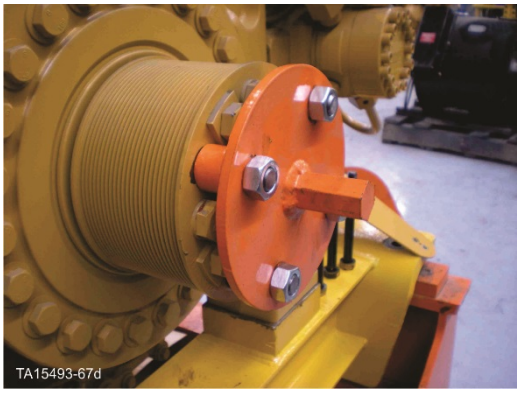
Figure 33. Crankshaft grounding strap - typical

b. Remove four of the 10.9 M20-2.5 bolts from the engine's crankshaft pulley, one every 90°.

c. Leave the engine grounding strap adapter on the engine's crankshaft pulley.



d. Install the indexing tool LET (P/N 103-7405); using four 250mm long M20-2.5 bolts or M20-2.5 all thread studs and nuts, as illustrated in the graphic below.



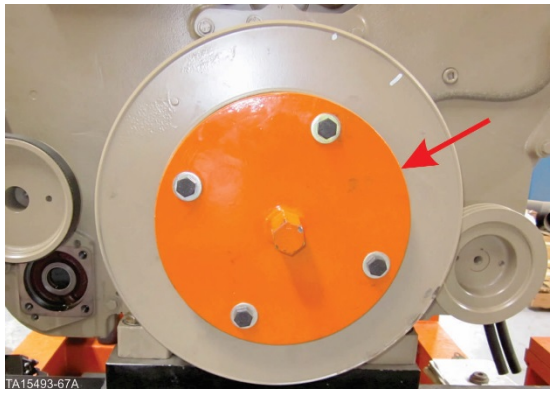
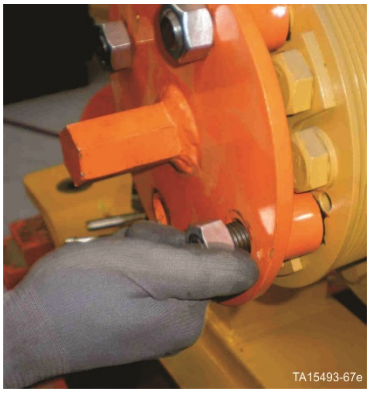


Figure 34. Rotating engine crankshaft from front of engine

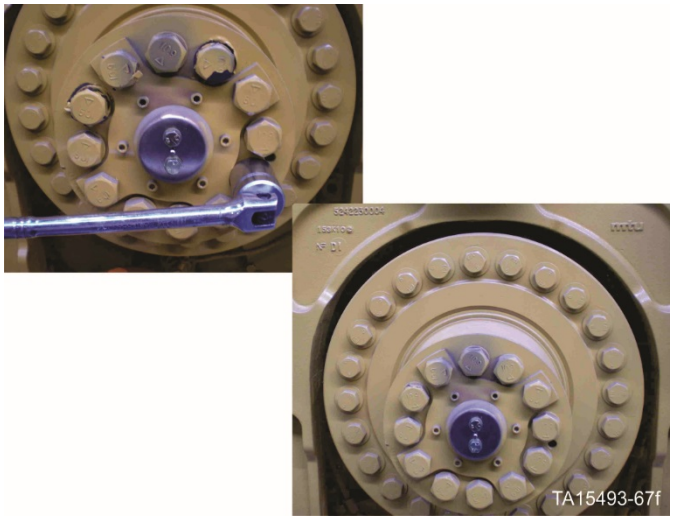
NOTICE

Remove tool after engine rotation process is no longer required.

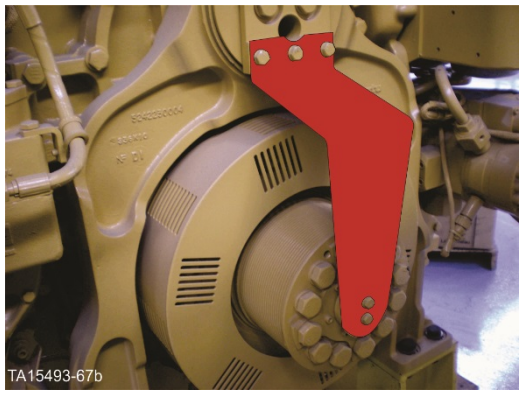
e. Remove the four 250mm long M20-2.5 bolts or M20-2.5 all thread and nuts and remove the tool.



f. Reinstall the original 10.9 M20-2.5 bolts and torque to the specified torque called for from the Detroit Diesel service manual. (500-550 N•m - none lubed)



g. Reinstall the crankshaft grounding strap on the front of the engine.



Rotating the Engine Crankshaft with Manual Drive Gear

While it is not recommended, some engines might be rotated from the starter end. This is done with an engine rotation tool that engages the teeth of the flywheel.

a. Remove the starter from the rear of the engine.

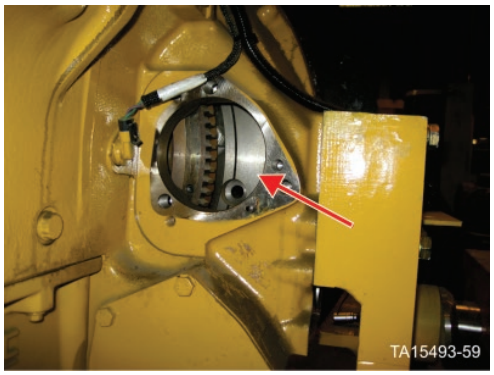


Figure 35. Remove starter

NOTICE

Commercial tool is available from Detroit dealers. Contact your Detroit dealer for more information.

b. Install the engine rotation tool.

Figure 36. Detroit engine rotation tool

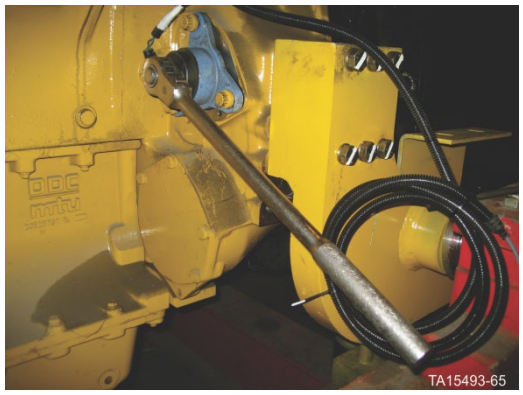


Figure 37. Rotating engine crankshaft with manual drive gear

c. On completion of procedure, remove the rotation tool from the engine.

CAUTION

The engine rotation tool must be removed from the engine after each use.

Crankshaft Rotation Procedure for Teir 2 Detroit Engine

Rotating the Engine Crankshaft with Manual Drive Gear

a. Remove the starter from the rear of the engine.

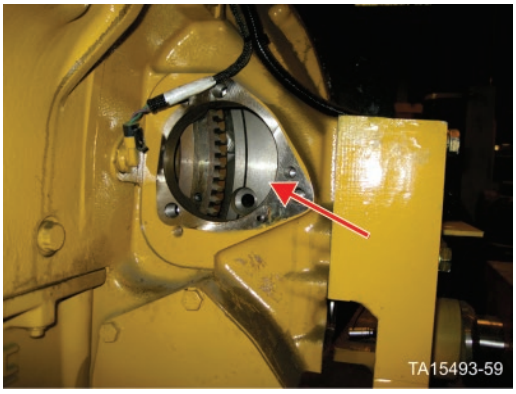


Figure 38. Remove starter

NOTICE

Commercial tool is available from Detroit dealers. Contact your Detroit dealer for more information.

b. Install the engine rotation tool.

Figure 39. Detroit engine rotation tool

Figure 40. Rotating engine crankshaft with manual drive gear

c. On completion of procedure, remove the rotation tool from the engine.

CAUTION

The engine rotation tool must be removed from the engine after each use.

⚠ WARNING

Electrical burn and shock hazards exist when using a 600 amp welding machine during testing. The remainder of the RPT test includes the use of a portable DC welder capable of outputting at least 600 Amps. All safety precautions must be followed while working with this equipment. Do not perform this test under wet conditions. Failure to follow all safety precautions can cause electrical burn and shock hazards resulting in serious injury or death.

⚠ CAUTION

Burn hazard exists when testing electrical equipment. Make sure the welding unit is OFF prior to performing any testing. Failure to turn the welding machine off prior to testing can cause personal injury.

Setting Phase 3

a. Attach the welding leads to phase 3 + and – terminal posts.

b. Set the welder to 600 Amps and energize phase 3.

- With phase 3 energized, the rotor will rotate to align with the phase 3 stator poles.

NOTICE

Depending on the size of the welding leads, it may be necessary to attach a bolt to the terminal post in order to provide a good clamp location.

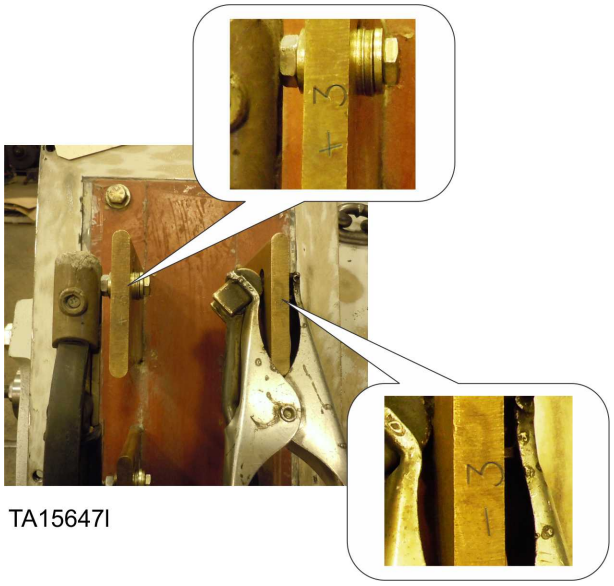
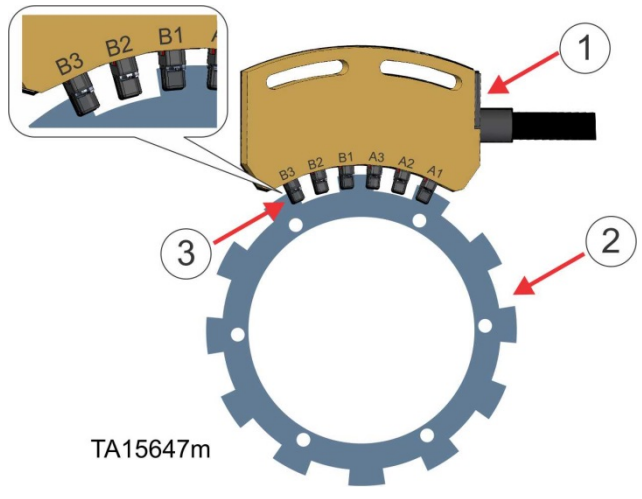


Figure 41. Phase terminal posts

c. Adjust the RPT carrier so that one of the shutter tabs aligns to RPT B3 as shown. Both the 3B and 3A LED's should now be lit on the RPT Tester, if not, adjust the RPT carrier until both LED's are ON.



1) RPT carrier

2) RPT shutter

3) Shutter aligned to RPT B3

Figure 42. Shutter aligned to RPT

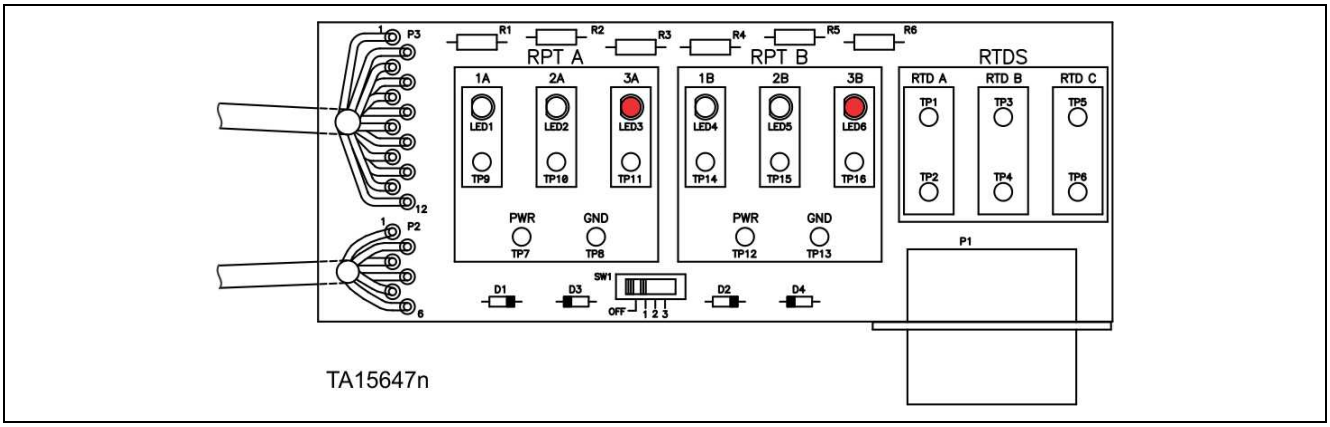


Figure 43. Tester card Phase 3 LED's

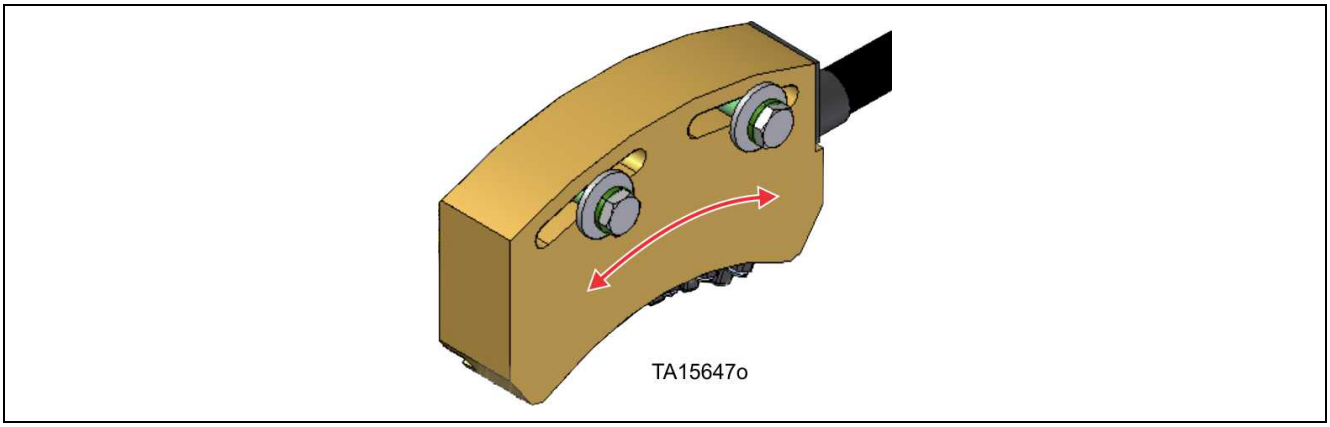
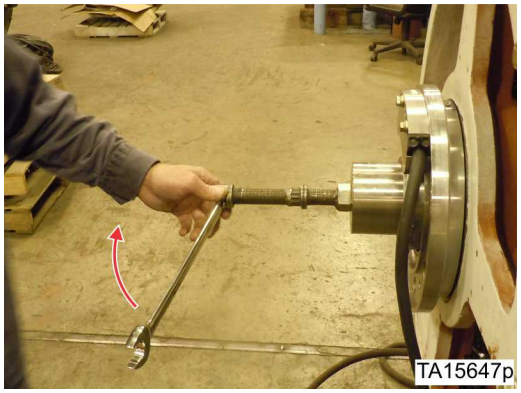


Figure 44. RPT adjustment

NOTICE

There are two mounting positions for the RPT carrier, if unable to align to the shutter, move the RPT carrier to the alternate position.

d. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.



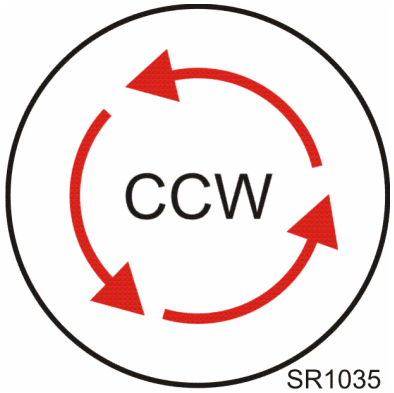


Figure 45. Counter clockwise alignment

NOTICE

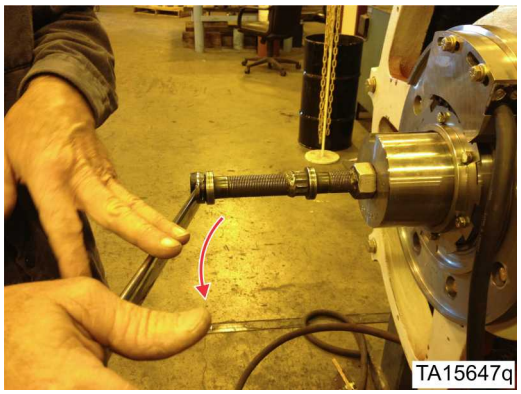
In order to rotate the rotor, it may be necessary to insert a bolt or allthread with a jam nut attached, into the rotor shaft. An open ended wrench can then be used to rotate the rotor, removal of the wrench will allow the rotor to return to it's alignment position.

e. Verify that both 3B and 3A LED's remain ON.

f. If the LED's turn OFF, loosen the RPT carrier bolts and adjust the carrier slightly in the clockwise direction. Tighten the carrier bolts.

g. Repeat the test until both LED's remain ON as the rotor returns to the aligned position.

h. Turn the rotor slightly in the clockwise direction and allow the rotor to return to its aligned position.



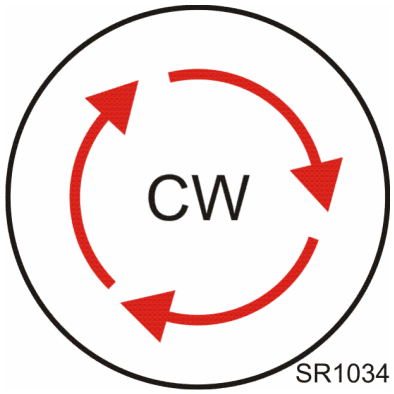


Figure 46. Clockwise alignment

i. Verify that both 3B and 3A LED's turn OFF.

j. If the LED's stay ON, loosen the RPT carrier bolts and adjust the carrier slightly in the counter clockwise direction. Tighten the carrier bolts.

k. Repeat the test until both LED's remain OFF.

l. Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.

Setting Phase 2

a. Turn OFF welding unit and move welding leads to phase 2 + and – terminal posts.

⚠ CAUTION

Burn hazard exists when removing or installing clamps onto generator/motor. Make sure the welding unit is OFF prior to removing or installing clamps onto the generator/motor. Failure to turn the welding machine off prior to clamp connection can cause personal injury.

b. Make sure the welder is set to 600 Amps and energize phase 2.

- With phase 2 energized, the rotor will rotate to align with the phase 2 stator poles.

c. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

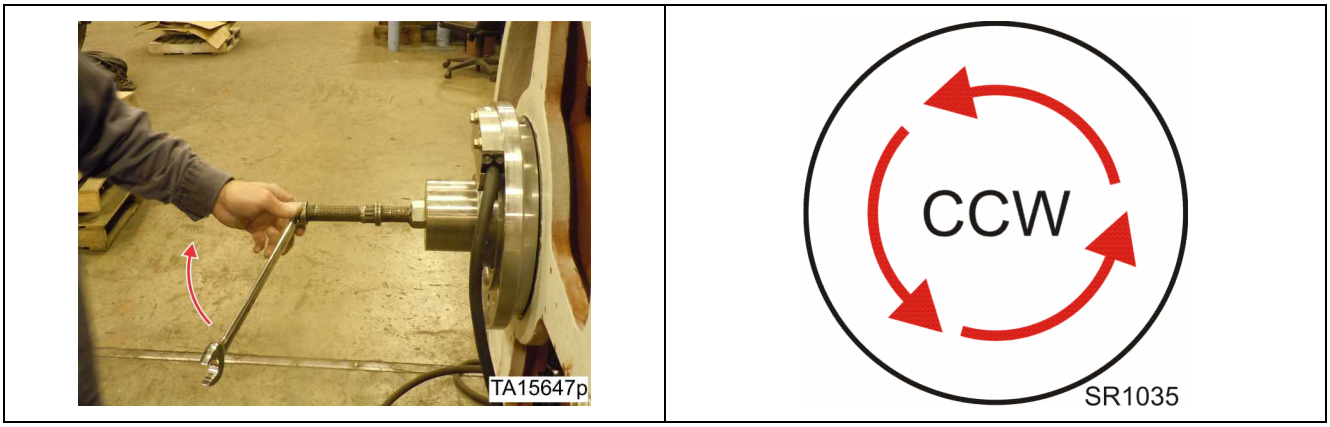


Figure 47. Counter clockwise alignment

d. Verify that both 2B and 2A LED's are now ON.

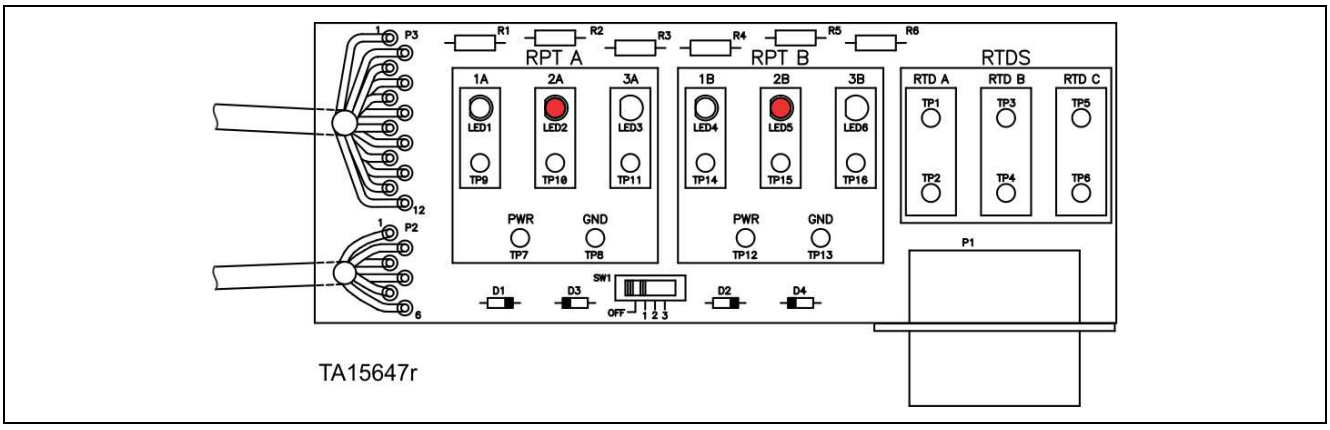
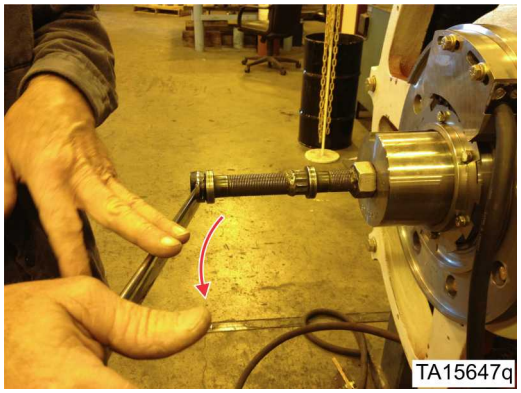


Figure 48. Tester card Phase 2 LED's

e. If the LED's do not turn ON, loosen the RPT carrier and adjust slightly in the clockwise direction.

f. Repeat the test until both LED's turn ON.

g. Turn the rotor slightly in the clockwise direction and allow the rotor to return to its aligned position.



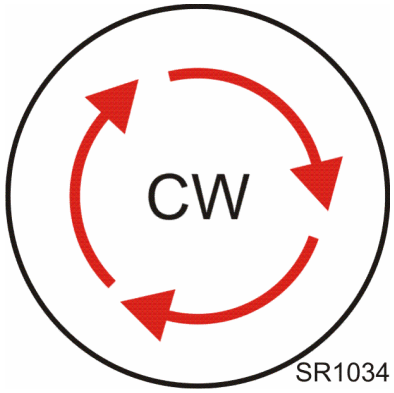


Figure 49. Clockwise alignment

h. Verify that both 2B and 2A LED's are now OFF.

i. If the LED's do not turn OFF, loosen the RPT carrier and adjust slightly in the counter clockwise direction.

j. Repeat the test until both LED's are now OFF.

k. Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.

l. If any adjustments had to be made to the RPT carrier during phase 2 testing, re-perform the test for phase 3.

m. Once phase 2 and 3 are properly aligned, remove one RPT carrier mounting bolt and apply Loctite 2760 or equivalent.

n. Re-install and torque this bolt to 18 ft-lbs (24 Nm).

o. Remove the other mounting bolt and perform the same process.

p. Upon completion of procedure, follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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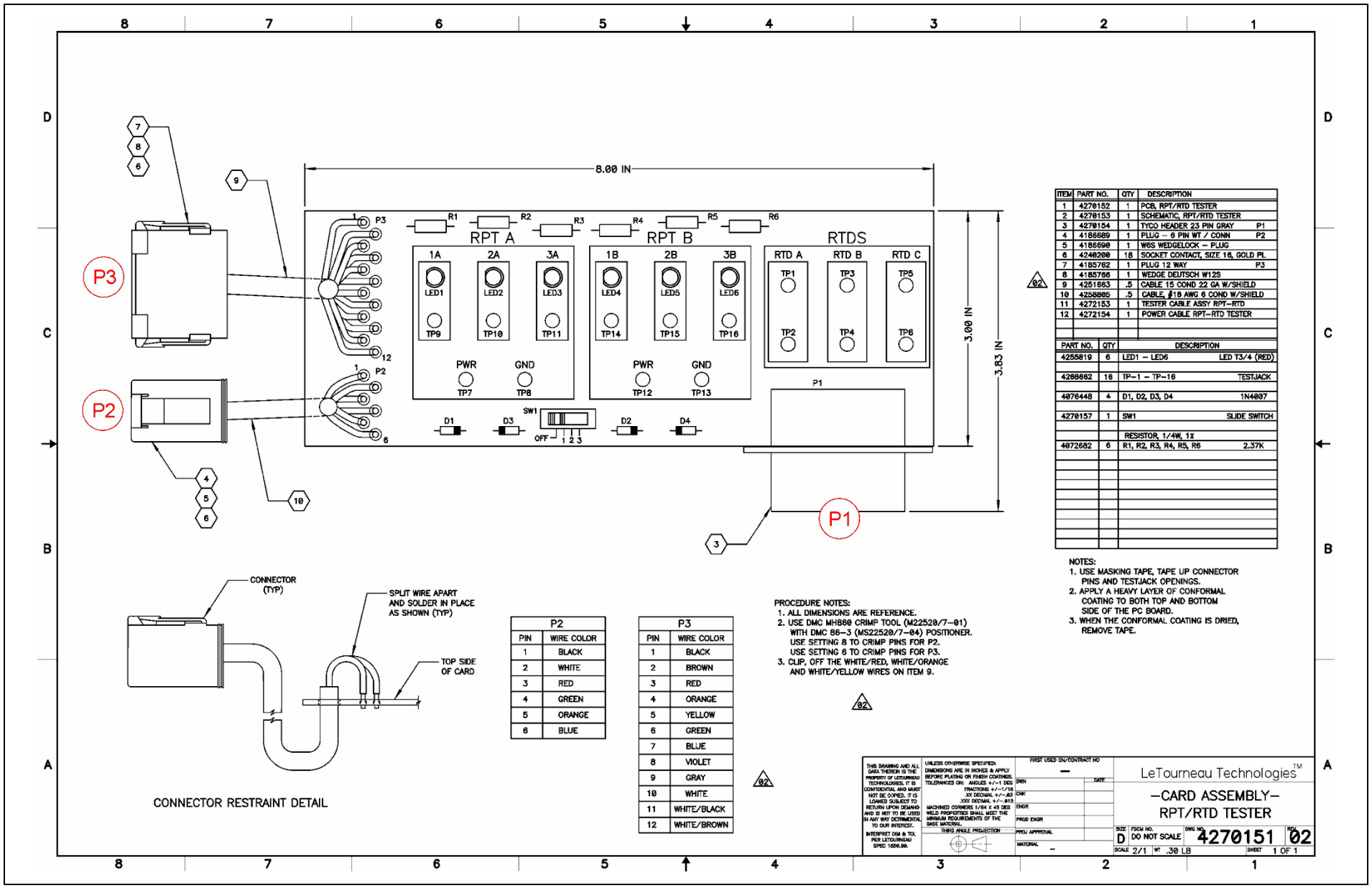


ITEM	PART NO.	QTY	DESCRIPTION
1	4270152	1	PCB, RPT/RTD TESTER
2	4270153	1	SCHEMATIC, RPT/RTD TESTER
3	4270154	1	TYCO HEADER 23 PIN GRAY P1
4	4186689	1	PLUG – 6 PIN WT / CONN P2
5	4186690	1	W6S WEDGELOCK – PLUG
6	4248200	18	SOCKET CONTACT, SIZE 16, GOLD PL
7	4185782	1	PLUG 12 WAY P3
8	4185786	1	WEDGE DEUTSCH W12S
9	4251663	.5	CABLE 15 COND 22 GA W/SHIELD
10	4258865	.5	CABLE, #18 AWG 6 COND W/SHIELD
11	4272153	1	TESTER CABLE ASSY RPT–RTD
12	4272154	1	POWER CABLE RPT–RTD TESTER

PART NO.	QTY	DESCRIPTION
4255819	6	LED1 – LED6 LED T3/4 (RED)
4288682	16	TP–1 – TP–16 TESTJACK
4076448	4	D1, D2, D3, D4 1N4007
4270157	1	SW1 SLIDE SWITCH
		RESISTOR, 1/4W, 1%
4072682	6	R1, R2, R3, R4, R5, R6 2.37K

NOTES:
1. USE MASKING TAPE, TAPE UP CONNECTOR PINS AND TESTJACK OPENINGS.
2. APPLY A HEAVY LAYER OF CONFORMAL COATING TO BOTH TOP AND BOTTOM SIDE OF THE PC BOARD.
3. WHEN THE CONFORMAL COATING IS DRIED, REMOVE TAPE.

P2	
PIN	WIRE COLOR
1	BLACK
2	WHITE
3	RED
4	GREEN
5	ORANGE
6	BLUE

P3	
PIN	WIRE COLOR
1	BLACK
2	BROWN
3	RED
4	ORANGE
5	YELLOW
6	GREEN
7	BLUE
8	VIOLET
9	GRAY
10	WHITE
11	WHITE/BLACK
12	WHITE/BROWN

PROCEDURE NOTES:
1. ALL DIMENSIONS ARE REFERENCE.
2. USE DMC MH880 CRIMP TOOL (M22520/7–01) WITH DMC 86–3 (MS22520/7–04) POSITIONER. USE SETTING 8 TO CRIMP PINS FOR P2. USE SETTING 6 TO CRIMP PINS FOR P3.
3. CLIP, OFF THE WHITE/RED, WHITE/ORANGE AND WHITE/YELLOW WIRES ON ITEM 9.

LeTourneau Technologies™
–CARD ASSEMBLY–
RPT/RTD TESTER
SIZE D | DO NOT SCALE | 4270151 | 02
SCALE 2/1 | WT .30 LB | SHEET 1 OF 1

Figure 50. RPT/RTD test card

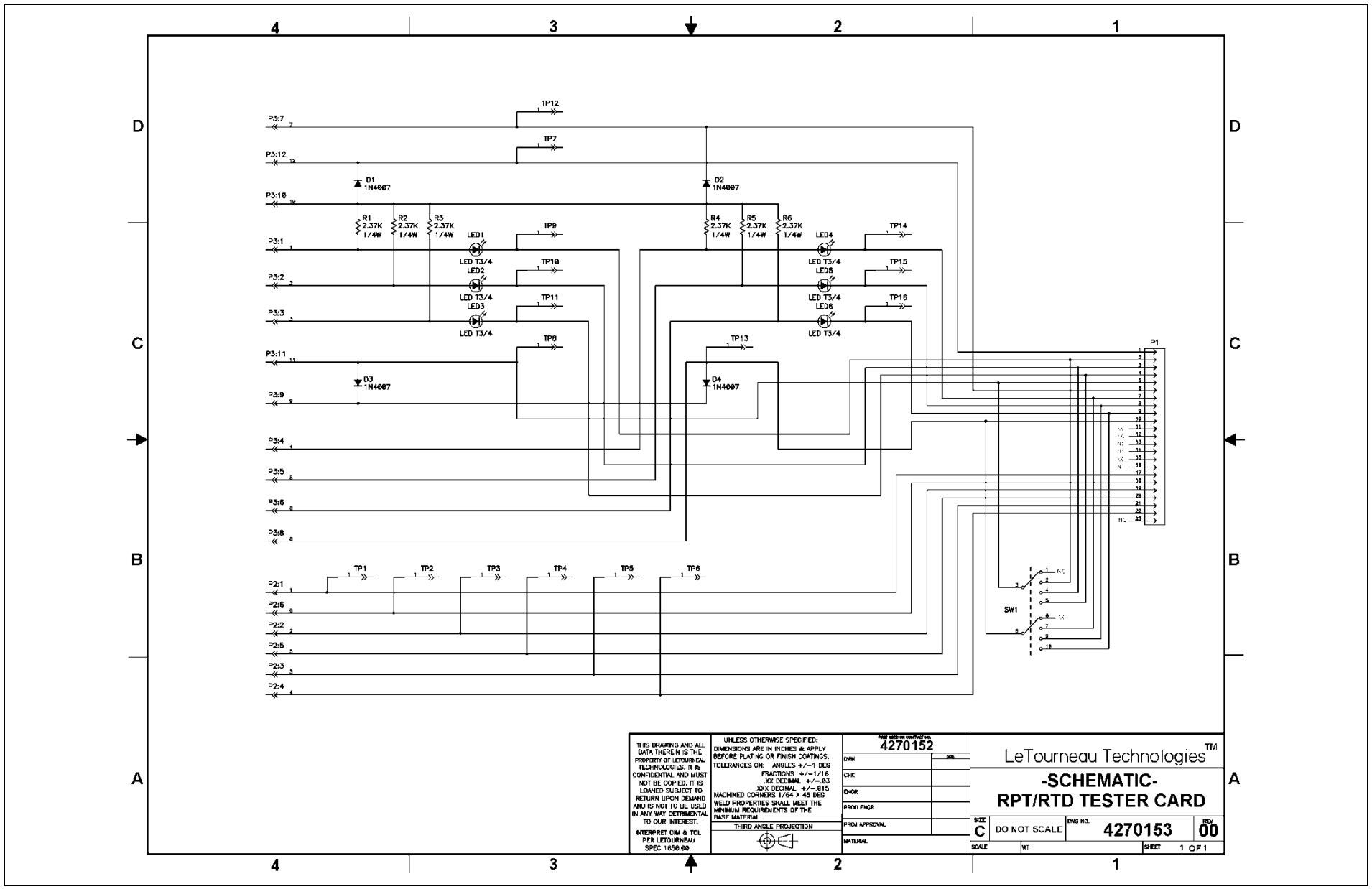
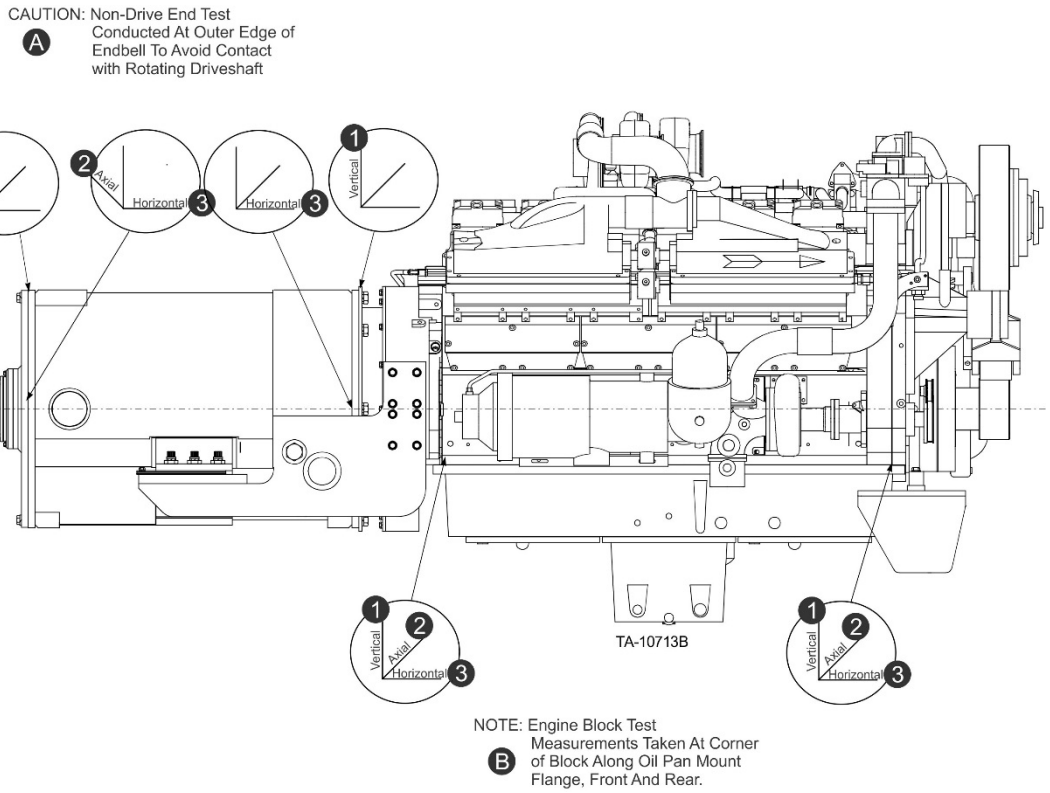


Figure 51. RPT/RTD tester card schematic

Troubleshooting

Generator Vibration Testing



A. CAUTION: Non-Drive End Test conducted at outer edge of Endbell to avoid contact with rotating driveshaft.

B. NOTE: Engine Block Test measurements taken at corner of block along oil pan mount flange, front and rear.

1) Vertical, **2)** Arial, **3)** Horizontal

Figure 52. Typical loader power unit vibration test locations

Vibration testing of the power unit should be conducted every 500 hours of operation and compared to previous results. A baseline figure should be established at the initial 500-hour interval as part of break-in service procedures. A sharp increase in vibration as compared to the trend should warrant further investigation.

Safety Preparations

⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

a. Stop the wheel loader on flat level ground.

f. Place bucket flat and level on ground.

g. Set the parking brakes.

⚠ WARNING

Entanglement hazard exists if attempting to work on rotating equipment. Use extreme caution when conducting vibration tests on operating power unit. KEEP CLEAR OF ROTATING SHAFTS. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities may cause an entanglement hazard that results in serious injury or death.

Measure Vibration Levels

The vibration levels at the following measurement points should be measured and recorded. All measurements should be taken as close to the rotational centerline as possible with the engine at high throttle and no load and with the machine on tires and bucket (loaders) one to three feet off of the ground. Refer to illustration "TYPICAL LOADER POWER UNIT VIBRATION TEST LOCATIONS" for vibration testing locations.

a. Generator "non drive end" vertical on the endbell.
b. Generator "non drive end" horizontal on the endbell.
c. Generator "non drive end" axial on the endbell.
d. Generator drive end vertical on the endbell.
e. Generator drive end horizontal on the endbell.
f. Rear engine vertical on engine block.
g. Rear engine horizontal on engine block.
h. Rear engine axial on engine block.
i. Front engine vertical on engine block.
j. Front engine horizontal on engine block.
k. Front engine axial on engine block.

NOTICE

1. Horizontal and vertical readings, only, will be taken at the "non drive end" of the generator. The reading taken on endbell must avoid contact with rotating driveshaft.

2. Vibration tests, as described herein, must be conducted following generator or power unit reinstalled.

3. **Significant increases in vibration readings, compared to baseline readings at the time of commissioning or component change-out, should be further analyzed to aid in the elimination of the cause of the excessive vibration (i.e. unbalance, misalignment, etc.)**

4. **Record vibration results on the vibration Test Record Sheet.**

Generator Vibration Test Record Sheet						
Item		**Test #1**	**Test #2**	**Test #3**	**Test #4**	**Test #5**
Date of test						
Machine s/n						
Hourmeter reading						
Generator axial vibration	NDE					
Generator horiz. Vibration	NDE					
Generator vert. Vibration	NDE					
Generator horiz. Vibration	DE					
Generator vert. Vibration	DE					
Engine rear vert.	Engine block					
Engine rear horiz.	Engine block					
Engine rear axial	Engine block					
Engine front vert.	Engine block					
Engine front horiz.	Engine block					
Engine front axial	Engine block					
Test conducted by:		By:	By:	By:	By:	By:
Date:		Date:	Date:	Date:	Date:	Date:
NDE = Non Drive End DE = Drive End						

Figure 53. Vibration test record

NOTICE

Use this sheet as a template & make copies for recording actual data.

- **The readings should be within 5 mil displacement at all locations.**
- **Any high readings indicate a problem which should be corrected.**
- **Excessive vibration on the non drive end could be indicating a bearing problem or incorrectly balanced rotor.**
- **Vibration on the engine end may be due to misalignment between engine and generator or engine problem.**

Generator Bearing Temperature Testing

Checking the temperature of the outer bearing retainer of the SR generator is one method for determining the condition of the bearing and grease. By taking bearing temperature measurements, on a consistent periodic basis, under consistent conditions, a temperature history can be generated, which is advantageous in developing a bearing temperature baseline. As a result, future readings will be conclusively indicative of bearing condition. The recommended test interval is every 500 hours as part of the 500 hour electrical P.M.

Temperature monitoring can be done during normal material handling operations, and should not require the machine to be out of service for more than a few minutes. A standard contact pyrometer is required to conduct bearing temperature monitoring.

To conduct temperature monitoring of the generator's bearing, perform the following procedure:

⚠ WARNING

Entanglement hazard exists if attempting to work on rotating equipment. Never conduct bearing temperature on an operating machine. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities can cause an entanglement hazard that results in serious injury or death.

Safety Preparations

⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

a. Operate the machine for 2 to 3 hours.

b. Record ambient temperature.

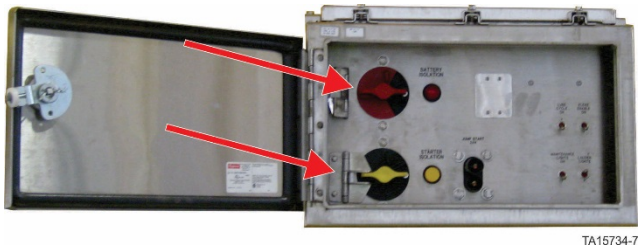
c. Ensure the bucket is empty and clear of debris.

d. Park the machine with the bucket flat and level on the ground.

e. Set the parking brakes.

f. Shut off the engine.

g. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



Battery Isolation Box – Battery isolation switch in OFF position with locks in place

Measure the bearing temperature

a. Place the pyrometer probe against the bearing retainer.

- Perform this as quickly as possible following machine shutdown.

b. Allow reading to stabilize and record temperature on Generator Bearing Temperature Record Sheet.

NOTICE

The maximum allowable temperature rise over ambient of the outer bearing carrier should never exceed 100° F (56° C), under any operating condition. Contact your distributor, if bearing shows sustained temperatures outside this range.

Following bearing replacement, it is essential to perform the above bearing temperature check, after one hour of operation.

Use this sheet as a template & make copies for recording actual data.

Generator Bearing Temperature					
Item	**Test #1**	**Test #2**	**Test #3**	**Test #4**	**Test #5**
Date of test					
Machine S/N					
Hourmeter reading					
Ambient temperature°F					
Bearing retainer temperature °F					
Comments:					
Test conducted by:					
NOTE! Maximum allowable temperature rise over ambient is 100°F (56°C). To convert °F to °C, (°F – 32) x 5/9 e.g., 100° F would calculate as: (100 – 32) X 5/9 = 37.78°C.					

Figure 54. Bearing temperature test data record

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Removal and Installation

Removing the Generator/Power Unit from the Vehicle

The power unit assembled in the machine consists of the diesel engine and generator.

Experience has shown that when it is necessary to remove the engine from the machine, it is most convenient to remove the engine and generator as a unit. The generator can be removed without removal of the engine; however, it is recommended that the entire power unit be removed if the generator must be removed.

The instructions provided herein cover removing both the engine and generator as a unit.

During disassembly, make note of the orientation of shims, bolts, hosing, etc. to facilitate re-assembly and re-installation of the power unit or generator into the machine. Re-installation is accomplished by reversal of the removal procedures.

NOTICE

Information on maintenance and repair of the diesel engine can be found in the engine manufacturer's owner's manual.

NOTICE

Some of the following procedures contain steps to disconnect lines containing various fluids such as hydraulic oil, engine coolant, fuel, and converter panel coolant. Ensure all local rules and regulations are followed during those steps to contain and properly dispose of all fluids.

⚠ CAUTION

Chemical hazard exists when disconnecting hoses and lines. Avoid personal physical contamination with all fluids, on the skin and especially the eyes. Wear Personal Protective Equipment (PPE) when removing lines containing fluid. Failure to wear appropriate PPE can cause chemical hazards resulting in personal injury.

The following instructions are for removal of the engine and generator as one unit.

Reviewing Safety

Reviewing Component Weights

⚠ WARNING

Crush hazards exist when lifting components. Component weights are approximate. Always allow a safety margin when selecting lifting equipment. Consult the engine manufacturer for exact engine weights. Failure to allow a safety margin for lifting equipment can cause crush hazards resulting in serious injury or death.

NOTICE

These weights are only approximate and provided as a guide for determining proper lifting procedures and equipment. In all cases, adequate equipment should be used to provide a good safety margin.

Item/Equipment	LBS.	KGS.
Engine, Cummins QSK38	9,500	4,310
Engine, Cummins QSK50	13,000	5,897
Engine, Cummins QSK60SS	18,500	8,392
Engine, Detroit Diesel 16v2000	7,500	3,402
Engine, Detroit Diesel 12v4000	17,000	7,712
Engine, Detroit Diesel 16v4000	18,500	8,392
G100 Generator	5,000	2,268
G200 Generator	9,000	4,083
6R Generator	3,500	1,588
7B Generator	5,500	2,495
9B Generator	7,000	3,176
12B Generator	9,500	4,310
12C Generator	10,500	4,863
Hood Structure (Without Attachments such as Fire System, Hand Rails etc.)	2,000	908
Cooling Air System/Air Filtration Unit/Blower	4,000	1,815

⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

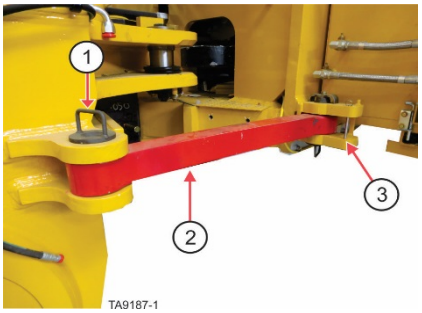
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. Place wheel chocks in front and behind each wheel.

⚠ WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position,

3) Retaining pin bracket for un-locked position

Frame Lock

d. Set bucket flat and level on the ground.

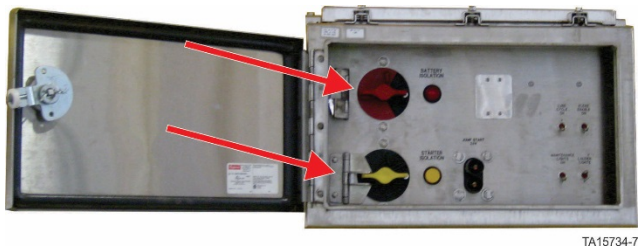
e. Set the parking brakes.

f. Shut off the engine.

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

g. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



Battery Isolation Box – Battery isolation switch in OFF position with locks in place

h. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

- Turn the handle to the up position as shown

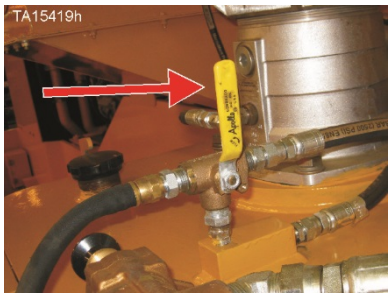
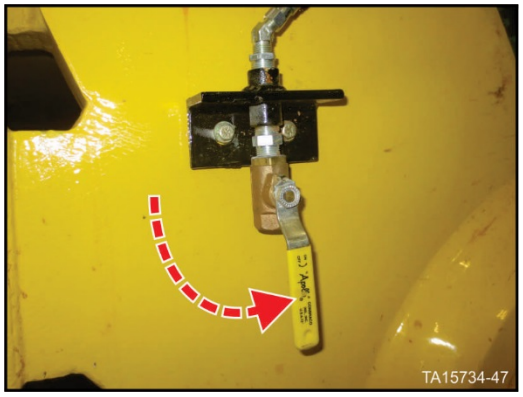
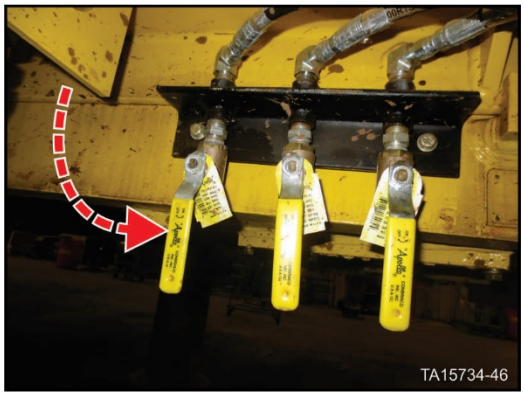


Figure 55. Hydraulic reservoir air valve handle UP

i. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir
One valve on right side of front frame near hoist cylinder ball cap





Open air reservoir bleed valves

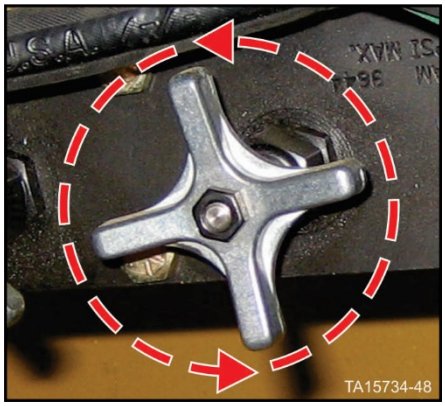
⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to "HYDRAULIC AND GREASE SYSTEMS", "MANUAL BLEED VALVE ASSEMBLY", in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

j. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.

k. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

- Open the valve completely and leave it open during this procedure.



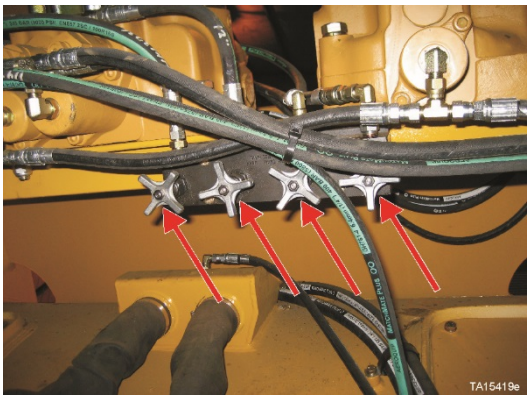


Figure 56. Pressure bleed down valves

l. Following all local environmental rules and regulations, drain the hydraulic reservoir and any residual fluid in the hydraulic lines.

Removing the Cab Grating

a. Remove the catwalk grating and cross-member anchoring grating behind the operator's cab.

NOTICE

Removal and installation of the hood structure requires either a truck-mounted crane or overhead crane of sufficient height and capacity to lift the hood assembly, and the combined cooling air system, air filtration unit, and blower assembly.

Removing the Hood

a. Disconnect and tag all hoses and fittings on the radiator surge reservoir and drive packages surge reservoir.
b. Disconnect the wiring to the surge reservoirs.
c. Disconnect the wiring for all service lights mounted to the rear hood.
d. Remove the engine exhaust stacks.
e. Examine under the hood for any interference of the engine intake and exhaust lines and the hood.
f. Disconnect and tag the hoses (front and rear) connected to the drive package return line.
g. Remove any fire suppression system interconnection wiring and hoses between the hood and other parts of the machine.

⚠ CAUTION

Multiple hazards exist when removing the hood structure. Fire, inhalation from accidental system activation and other hazards may be present. The hood structure may have optional fire suppression devices attached. Certified personnel should be consulted prior to disconnecting or reconnecting fire suppression equipment. Personal injury is possible if the equipment is not disconnected or reconnected correctly. Failure to consult certified fire suppression system personnel before removing or installing the hood can cause multiple hazards resulting in personal injury.

NOTICE

The hood structure may have optional fire suppression devices. Certified personnel should be consulted prior to disconnecting or reconnecting fire suppression equipment. Equipment damage is possible if the equipment is not disconnected or reconnected correctly.

h. Remove the rear hood structure.

Figure 57. Hoisting the hood assembly

Removing the Blower and KLENZ Filter Assembly

a. Disconnect and cover the cooling air lines going to the generator, coming from the KLENZ air plenum.
b. Disconnect and cover the cooling air lines going to the front frame cooling tube, coming from the KLENZ air plenum.
c. Disconnect and cover the cooling air lines going to the rear axle, coming from the KLENZ air plenum.
d. Disconnect and cover the cooling air lines going to the engine turbochargers, coming from the engine safety filters on the KLENZ air box. Cover the inlet ports of the turbochargers to protect the air pipes from contamination.
e. Disconnect the cab air pressurizing line coming from the KLENZ box.

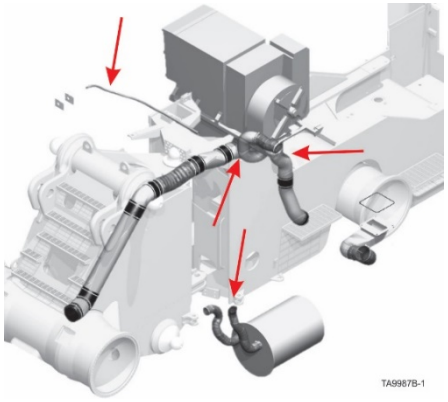
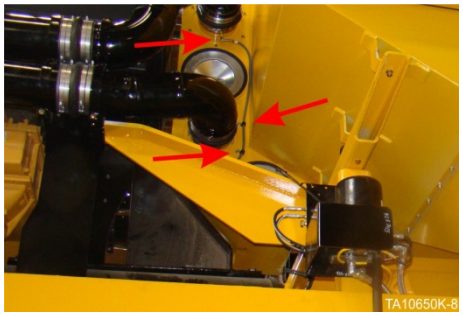


Figure 58. Typical cooling air hoses to be disconnected

f. Disconnect the engine restriction gauge air lines and clamps holding the lines to the air box.



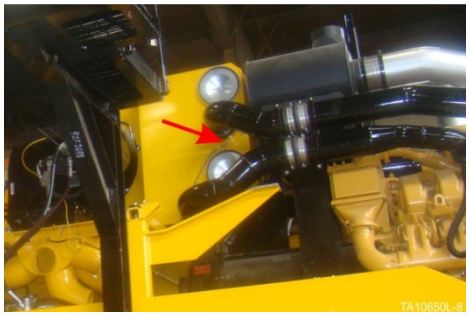
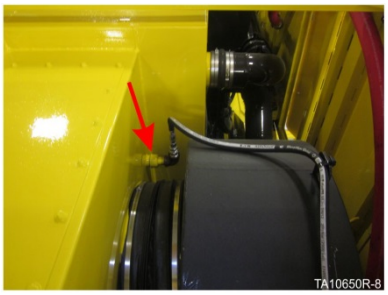


Figure 59. Engine restriction gauge air lines and clamps holding the lines to the air box (two locations on each side of air box - total 4 air line connections)

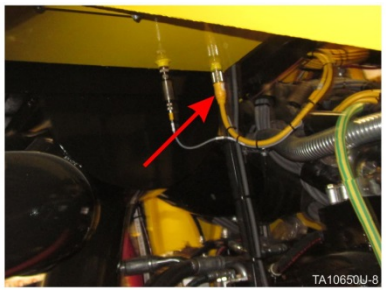
g. Disconnect the compressed air line from the KLENZ reservoir, going to the KLENZ pulse valve manifold.
h. Disconnect the TURCK cable connected to the KLENZ structure.
i. Disconnect the temperature sensor going to the KLENZ structure.

L-950/1150 air line, typically located under KLENZ air box, beside bottom plenum



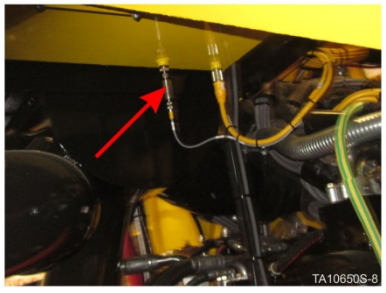
L-1350/1850/2350 air line, typically located behind cab, beside blower wheel housing

L-950/1150 TURCK cable



L-1350/1850/2350 TURCK cable, typically located under KLENZ air box

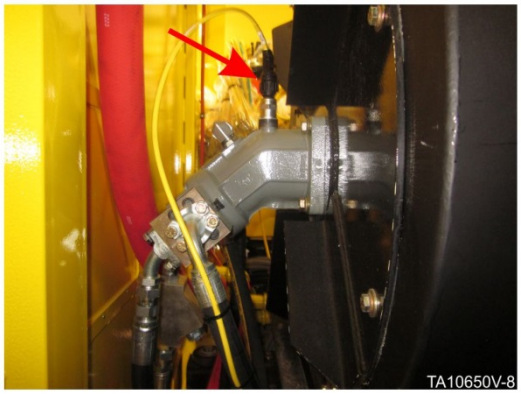
L-960/1150 temperature sensor cable



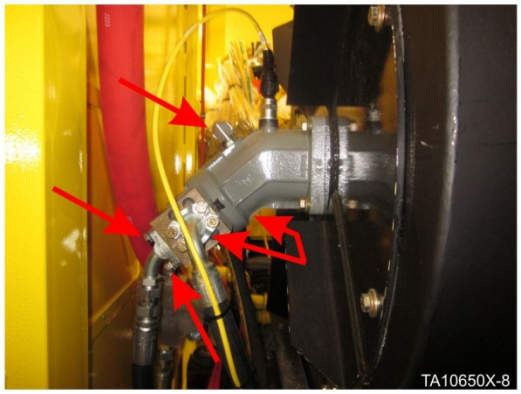
L-1350/1850/2350 temperature sensor cable

Figure 60. Compressed air line and electrical TURCK cable to KLENZ™ air filtration unit

j. Disconnect the electrical Turck line connected to the cooling air blower speed sensor.
k. Remove, label, and cap hydraulic lines going to the air blower motor.



TURCK cable connection



Various hydraulic hose connections

Figure 61. Hydraulic hose connections and electrical TURCK cable to cooling air blower

l. Attach straps or chokes to the air box system in preparation for removing.
m. Remove the bolts holding the KLENZ box in position.
n. Remove central air blower assembly and KLENZ™ air filtration unit.

CAUTION

Before lifting, inspect the KLENZ™ structure to ensure all hoses, pipes and wires are removed and clear of the structure.

Wooden cribbing is required to support the blower and KLENZ™ air filtration unit to ensure no damage is done to housings or tubing when the units are removed from the machine. Remove the KLENZ™ air filtration and blower assembly as a unit. Position the assembly on wooden cribbing to ensure no damage occurs to tubing or housings. Securely cover all openings to prevent ingression of dirt or debris.

Figure 62. Hoisting of KLENZ™ and blower assembly

Figure 63. KLENZ™ and blower assembly supported by cribbing - 1 of 3

Figure 64. KLENZ™ and blower assembly supported by cribbing - 2 of 3

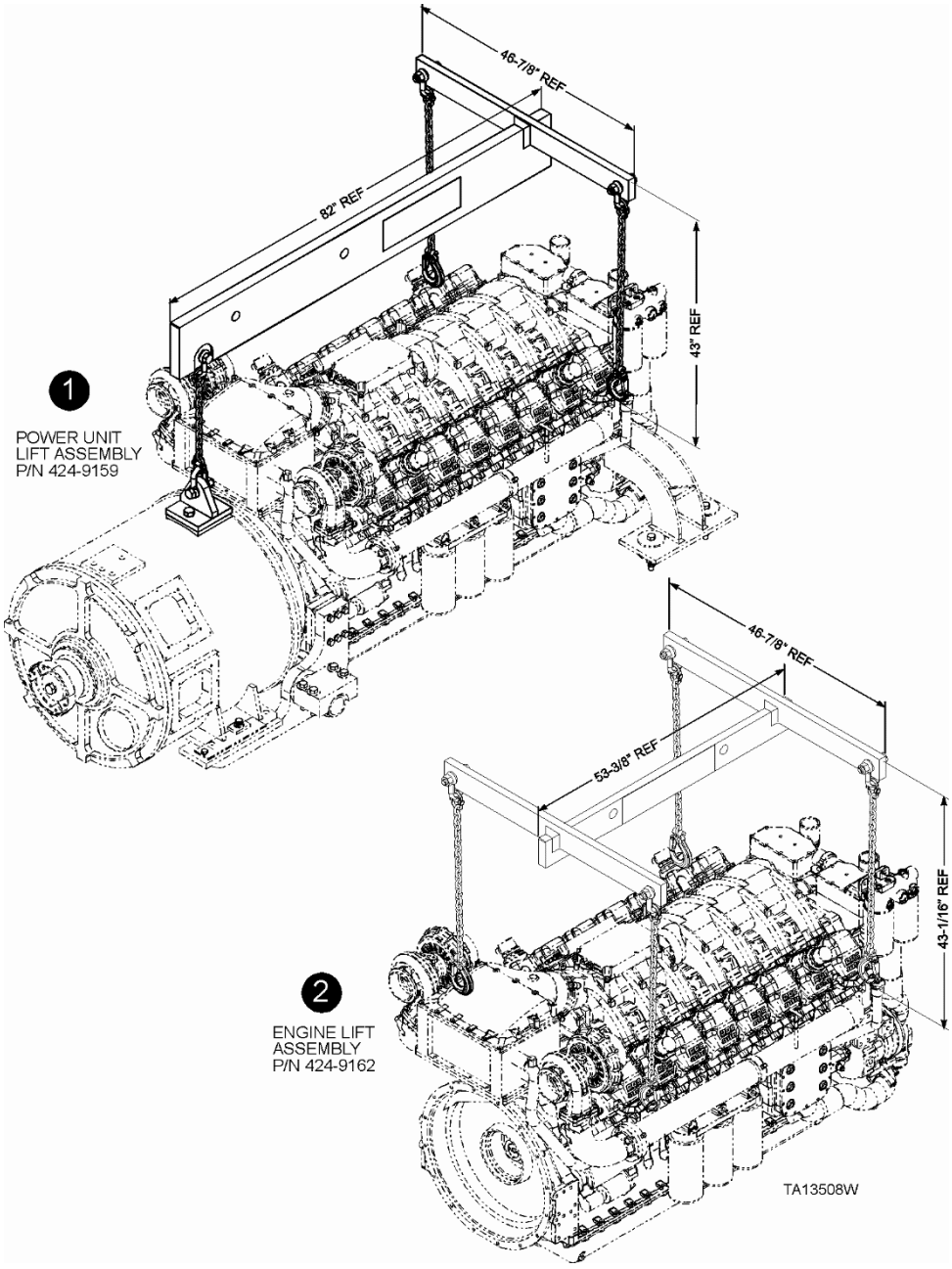
Figure 65. KLENZ™ and blower assembly supported by cribbing - 3 of 3

Completing the Power Unit Removal

a. Label and disconnect electrical connections from the engine at the frame to the engine wiring junction box.

Figure 66. Typical engine junction box, locations vary by model

b. Drain engine coolant.
c. Remove, label, and cap all fuel lines.
d. Remove and label the cab heater lines.
e. Label and disconnect electrical connections from the generator to the electrical converter cabinet.
f. Cap and plug all air, exhaust, fuel and coolant pipes and hoses going to the engine.
g. Disconnect all 24v wiring to the engine.
h. Attach hoisting device to engine lifting fixtures. Refer to following pages for structure examples.

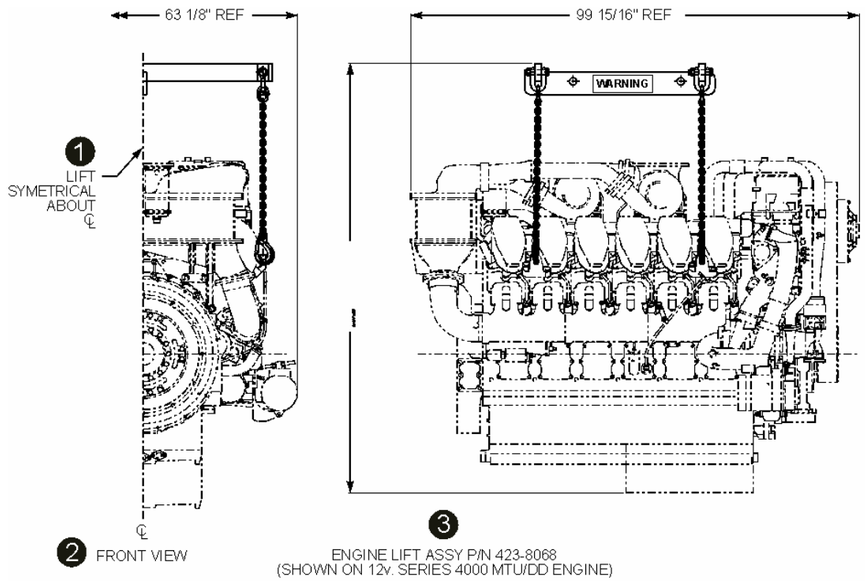


1) Power Unit Lift Assembly P/N 424-9159, **2)** Engine Lift Assembly P/N 424-9162

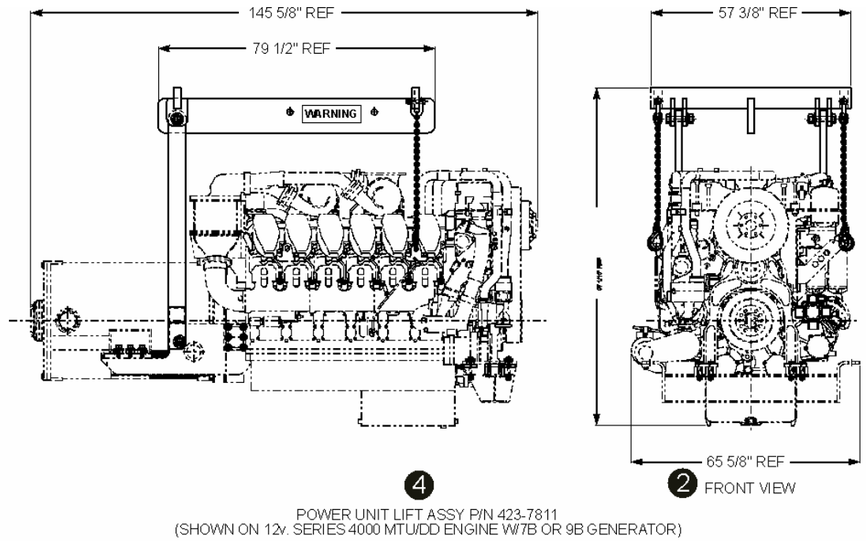
NOTICE

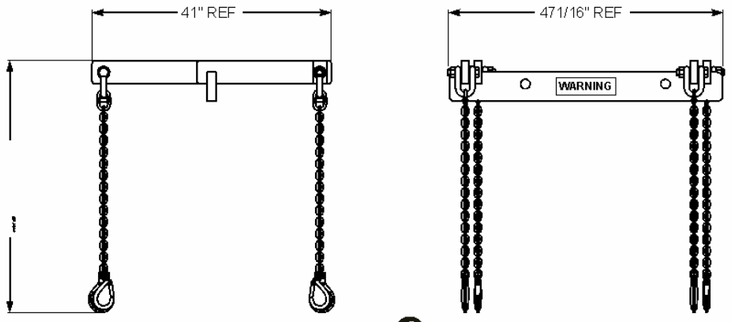
This figure shows typical power unit/engine lifting fixture installation for power units and engines. Installation for all power unit/engine lifting fixtures is similar to those shown. Refer to your engine manufacturer's owner's manual (available through manufacturer's website) or authorized distributor for additional information and recommendations concern hoisting of the engine.

Figure 67. Power unit and engine lifts – L/D-950



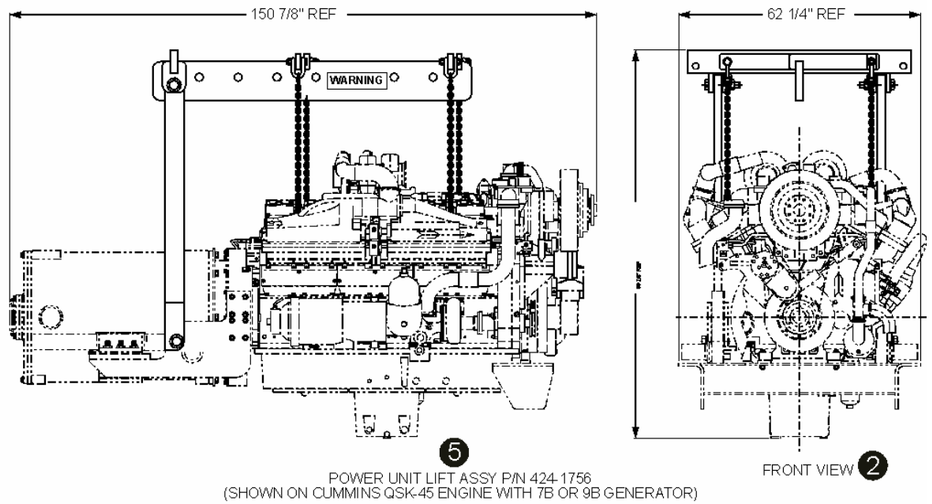
NOTE: USE FOR ENGINE LIFT ONLY - NOT INTENDED FOR POWER UNIT LIFTING





NOTE: USE FOR ENGINE LIFT ONLY - NOT INTENDED FOR POWER UNIT LIFTING

NOTE: DIMENSIONS ARE SUBJECT TO CHANGE DUE TO DESIGN IMPROVEMENT



TA-10390W

1. Lift Symmetrical
2. Front View
3. Engine Lift Assy P/N 423-8068 (shown on 12v Series 4000 M TU/DD Engine)
4. Power Unit Lift Assy P/N 423-7811 (shown on 12v Series M TU/DD Engine w/ 7B or 9B Generator
5. Power Unit Lift Assy P/N 424-1756 (shown on Cummins QSK-45 Engine with 7B or 9B Generator
6. Engine Lift Assy P/N 424-1755 (For Cummins QSK-45 Engine – not shown)

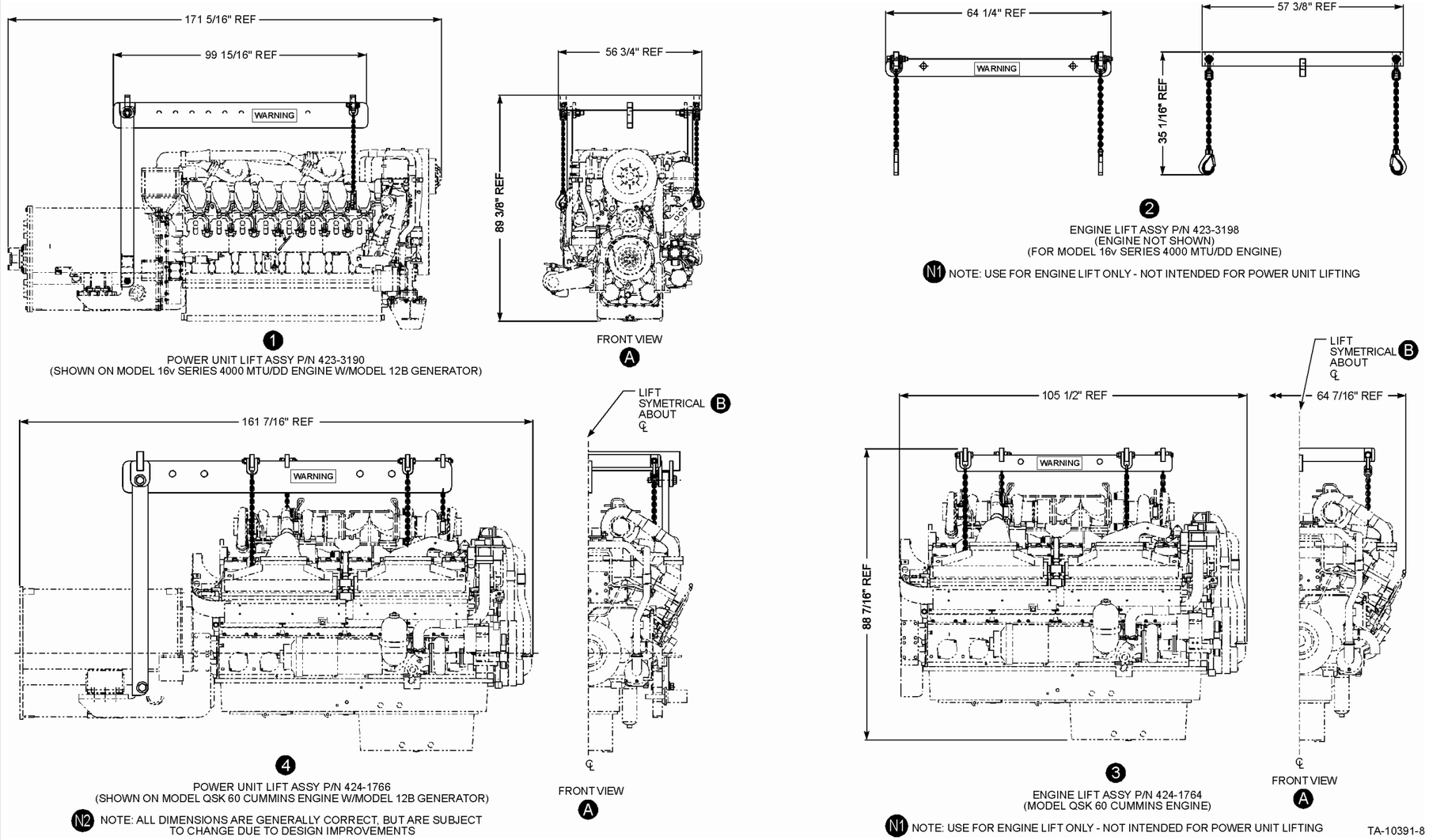
NOTE: use for engine lift only – not intended for power unit lifting

NOTE: dimensions are subject to change due to design improvement.

NOTICE

This figure shows typical power unit and engine lifting fixture installation for four (4) loader power units and engines. Installation for all power unit/engine lifting fixtures is similar to those shown. Refer to your engine manufacturer's owner's manual or authorized distributor for additional information and recommendations concern hoisting of the engine or power unit.

Figure 68. Power unit and engine lifts –L-1350 loaders



1. Power Unit Lift Assembly P/N 423-3190 (Shown on Model 16v Series 4000 M TU/DD Engine w/ Model 12B Generator)
2. Engine Lift Assy P/N 423-3198 (Engine Not Shown) (for Model 16v Series 4000 M TU/DD Engine)
3. Engine Lift Assy P/N 424-1764 (Model QSK 60 Cummins Engine)
4. Power Unit Lift Assy P/N 424-1766 (Shown on (Model QSK 60 Cummins Engine w/ model 12B Generator)

A. Front View
B. Lift Symmetrical about

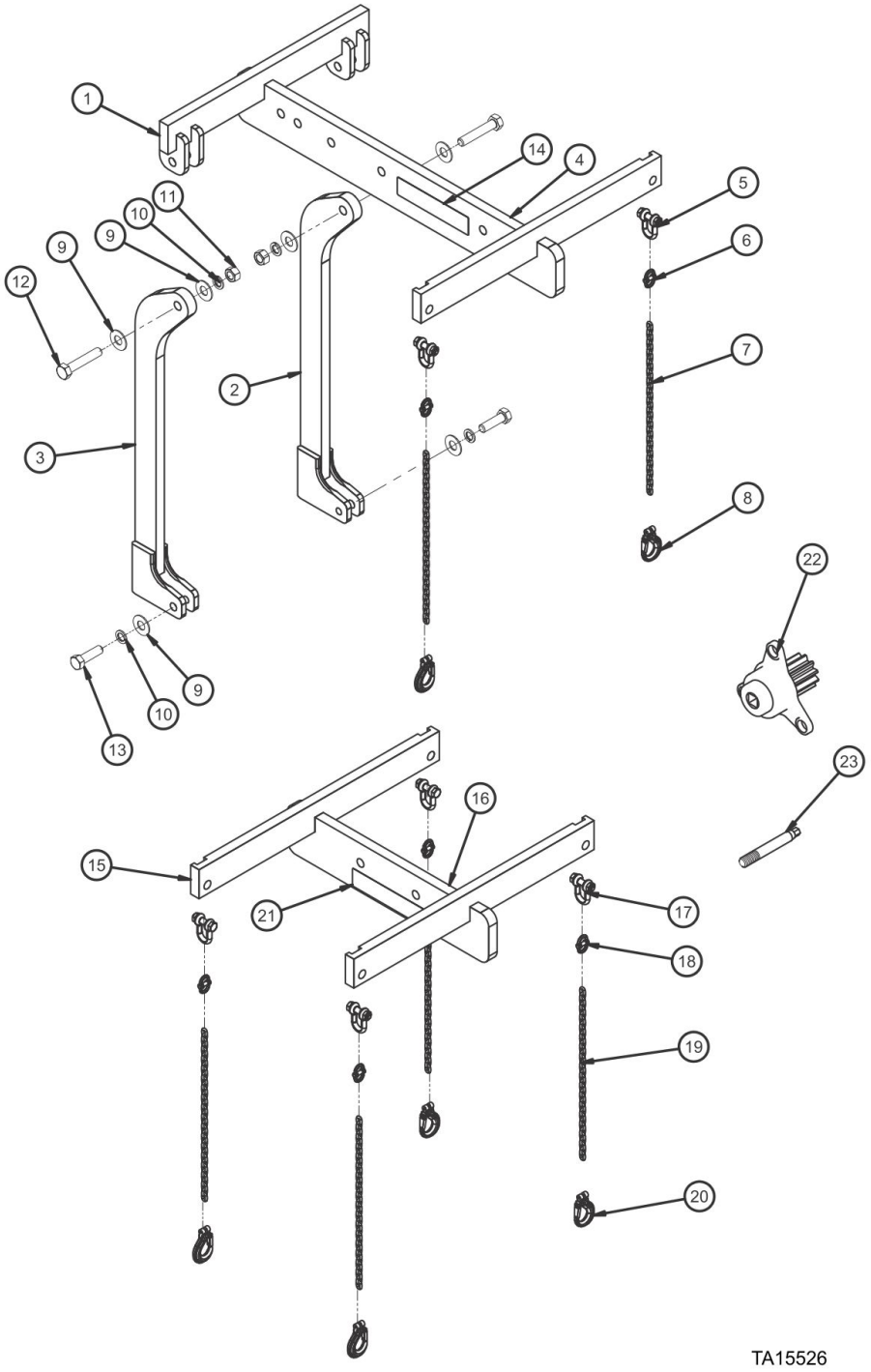
N1) NOTE: Use for Engine Lift Only – Not Intended for Power Unit Lifting

N2) NOTE: All Dimensions are Generally Correct but are Subject to Change Due to Design Improvements

NOTICE

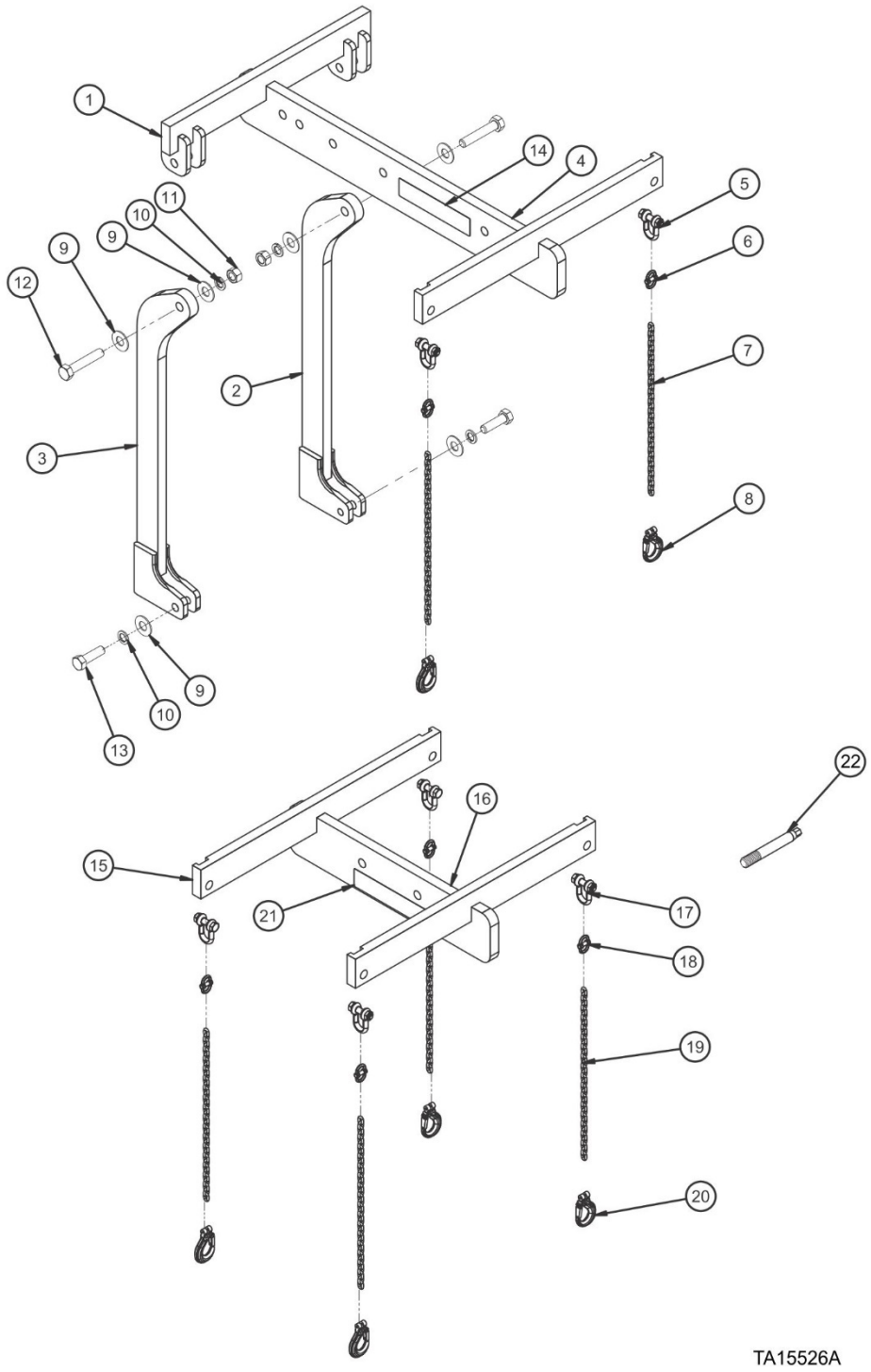
This figure shows typical power unit and engine lifting fixture installation for four (4) loader power units and engines. Installation for all power unit/engine lifting fixtures is similar to those shown. Refer to your engine manufacturer's owner's manual or authorized distributor for additional information and recommendations concern hoisting of the engine or power unit.

Figure 69. Power unit and engine lifts – L-1850/L-2350 loaders



1) Engine/Generator Unit Lifting Group, Dd - 12v4000/G100, **2)** Link Structure, Power Unit Lifting - R.H), **3)** Link Structure, Power Unit Lifting - L.H), **4)** Frame Structure, Power Unit Lifting, **5)** Shackle, Chain - With 7/8" Bolt, **6)** Link, Connecting, **7)** Chain, 39", **8)** Hook, **9)** Flatwasher, 1-1/2", **10)** Lockwasher, 1-1/2", **11)** Nut, 1-1/2"-6, **12)** Bolt, 1-1/2"-6 X 8", **13)** Bolt, 1-1/2"-6 X 5", **14)** Label, Safety - Power Unit Lifting Assembly, **15)** Engine Lifting Group, Dd - 12v4000, **16)** Engine Lift Structure, **17)** Shackle, Chain - With 7/8" Bolt, **18)** Link, Connecting, **19)** Chain, 39", **20)** Hook, **21)** Label, Safety - Engine Lifting Assembly, **22)** Engine Barring Device, **23)** Stud, Alignment

Figure 70. Power unit and engine lift – Detroit Diesel 12v4000, G100 generator P/N R4271408



1) Engine/Generator Unit Lifting Group, Dd - 12v4000/G100, **2)** Link Structure, Power Unit Lifting - R.H), **3)** Link Structure, Power Unit Lifting - L.H), **4)** Frame Structure, Power Unit Lifting, **5)** Shackle, Chain - With 7/8" Bolt, **6)** Link, Connecting, **7)** Chain, 39", **8)** Hook, **9)** Flatwasher, 1-1/2", **10)** Lockwasher, 1-1/2", **11)** Nut, 1-1/2"-6, **12)** Bolt, 1-1/2"-6 X 8", **13)** Bolt, 1-1/2"-6 X 5", **14)** Label, Safety - Power Unit Lifting Assembly, **15)** Engine Lifting Group, Dd - 12v4000, **16)** Engine Lift Structure, **17)** Shackle, Chain - With 7/8" Bolt, **18)** Link, Connecting, **19)** Chain, 39", **20)** Hook, **21)** Label, Safety - Engine Lifting Assembly, **22)** Stud, Alignment

Figure 71. Power unit and engine lift – MTU 12v4000, G100 generator P/N R4287580

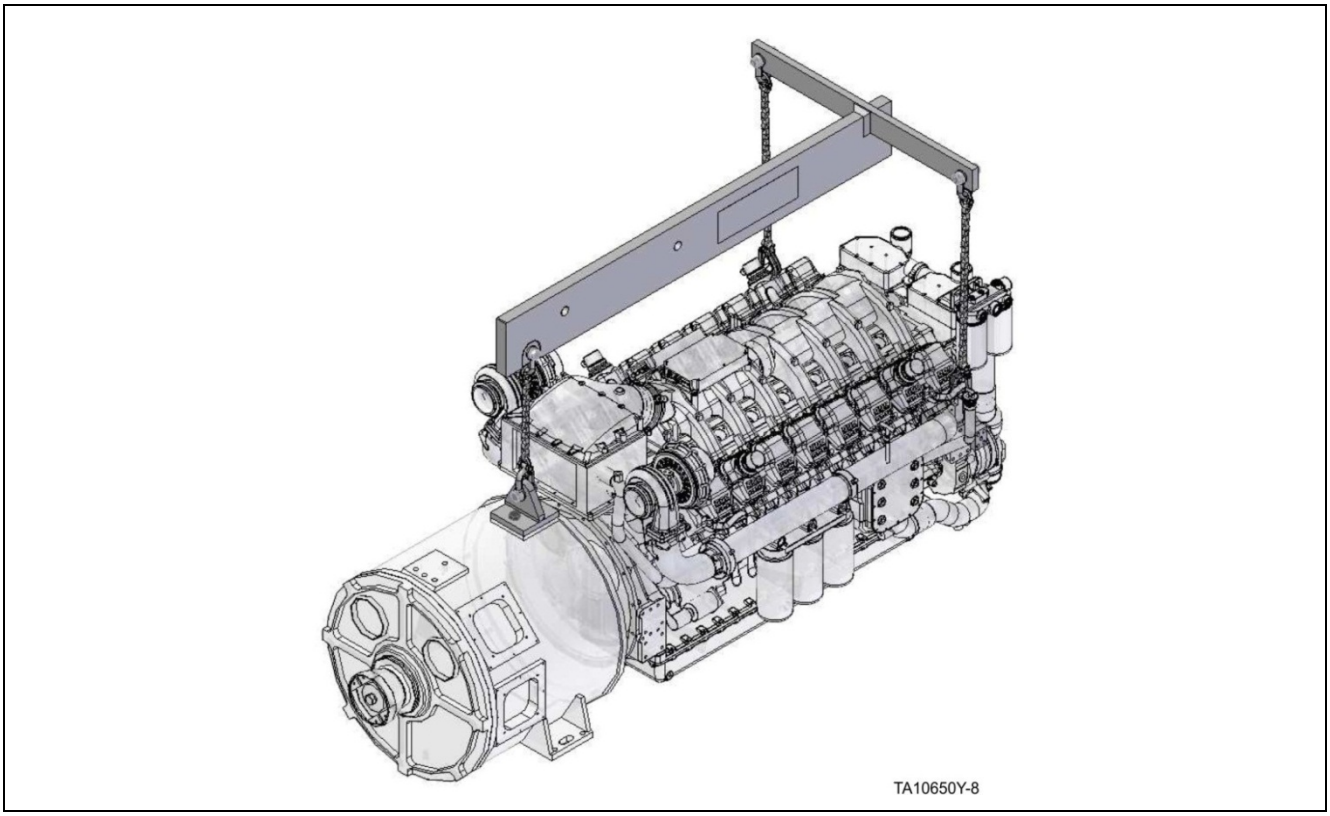


Figure 72. Power unit and engine lift – 12v2000T2, G100 generator (R4249159)

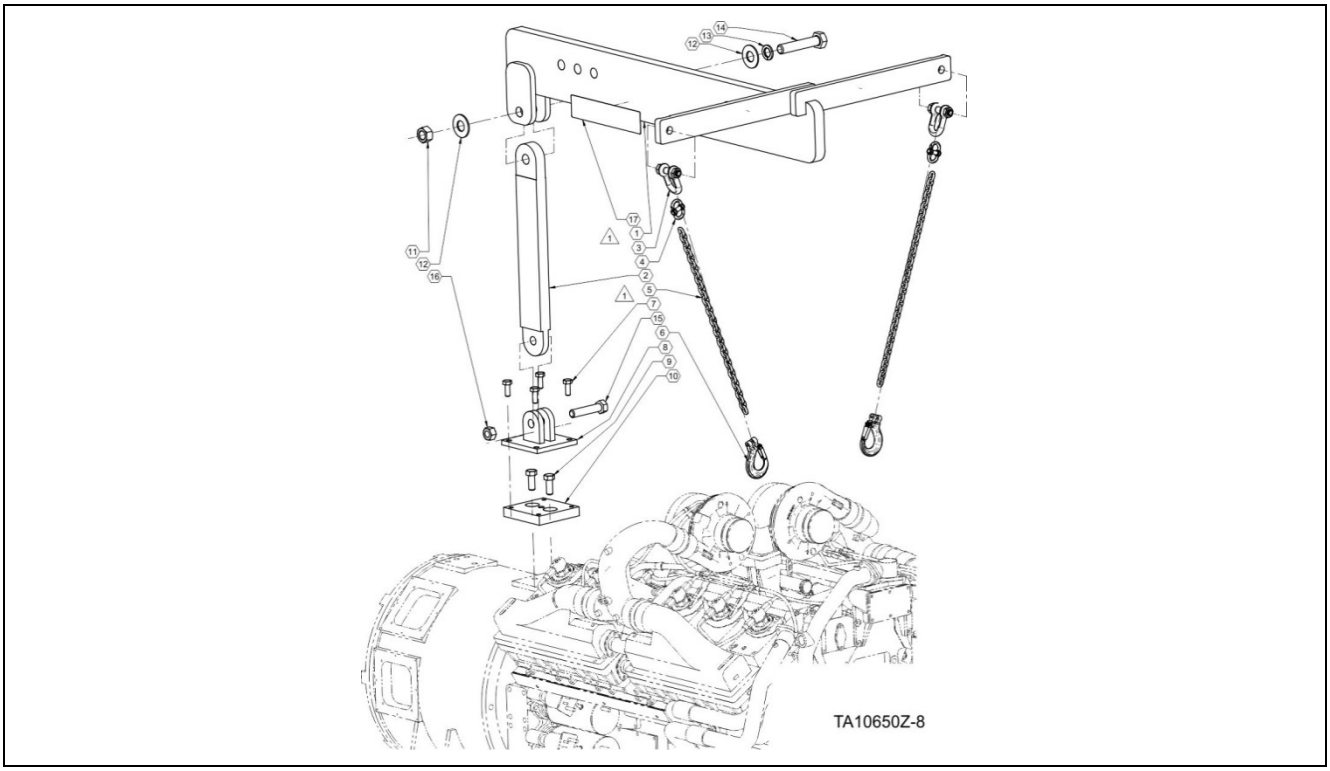
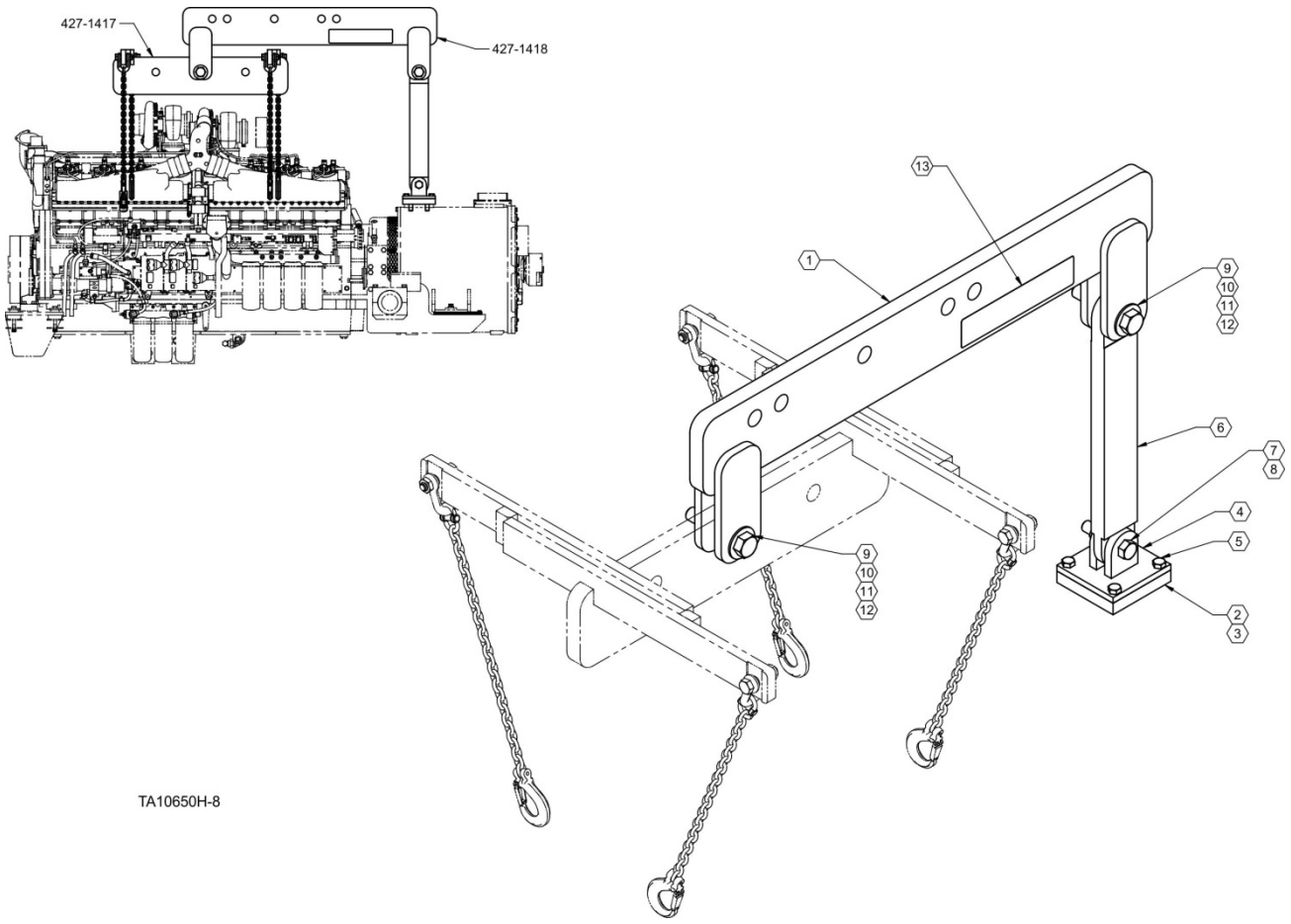
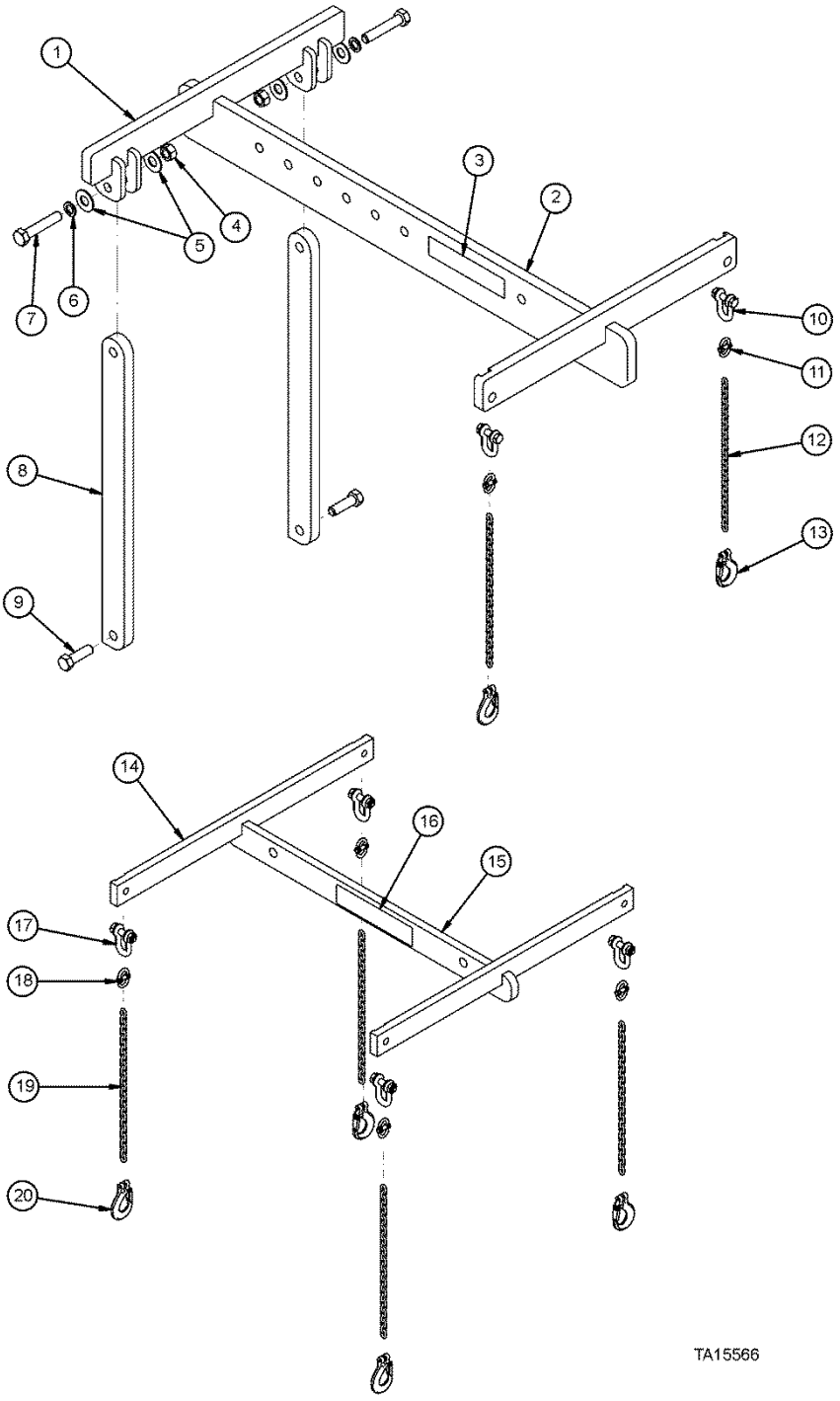


Figure 73. Power unit and engine lift – 12v2000T2, G100 generator (R4249159)



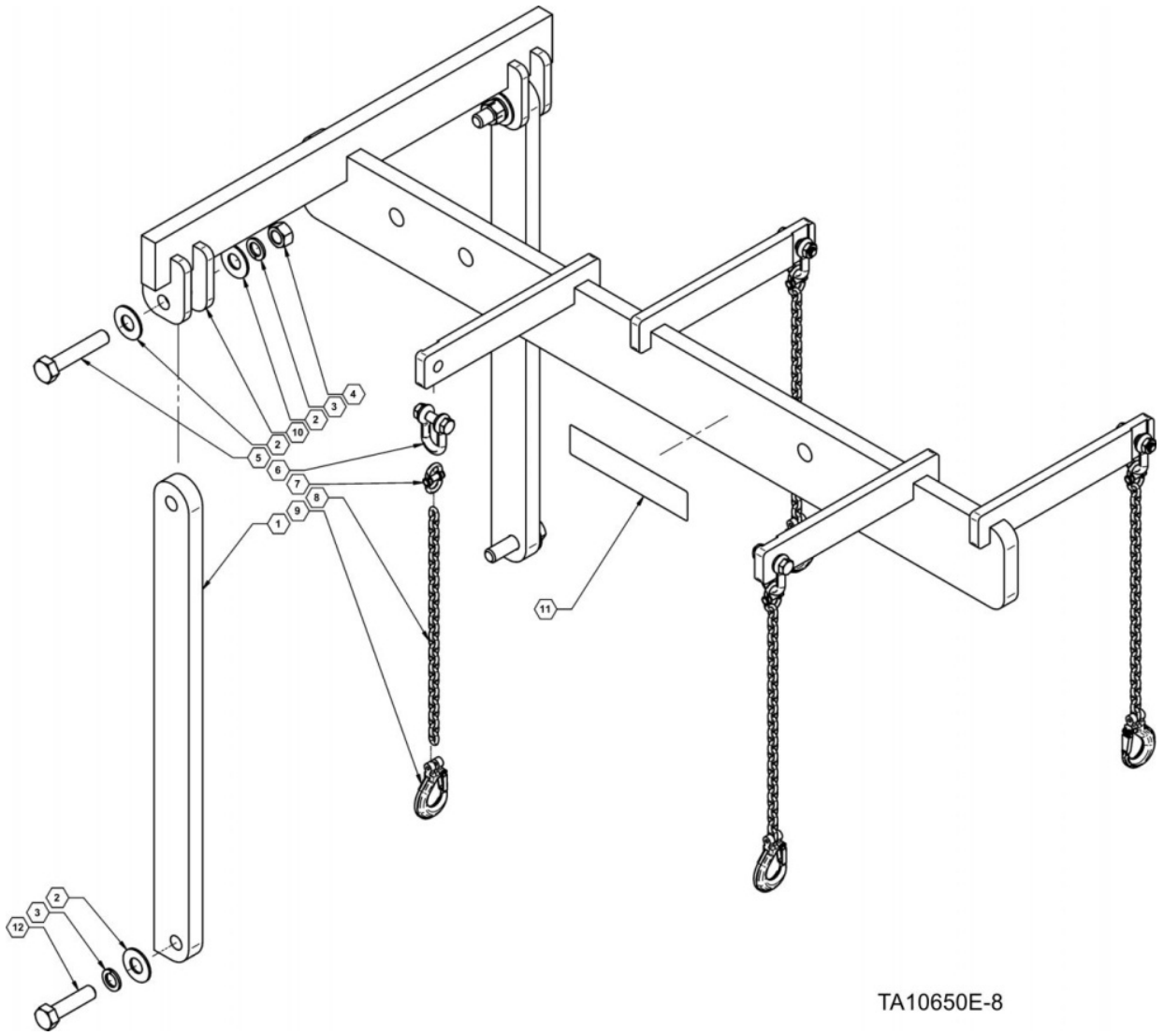
1) Str Power Unit Lift Frame, **2)** Mount Plate, **3)** Bolt Hex, **4)** Ear Str Rear Link, **5)** Bolt Hx., **6)** Plate Lift Arm Rear Qsk38, **7)** Bolt Hx, **8)** Nut Hx, **9)** Washer Flat, **10)** Washer Lock Spring, **11)** Nut Jam Hx, **12)** Bolt Hex 1.500 Unc X 8.00 Lg, **13)** Safety Label

Figure 74. Power unit and engine lift – QSK 50, G100 generator P/N R4271418



1) Power Unit Transport Assembly, Dd - 16v4000, **2)** Power Unit Transport Structure, **3)** Label, Safety - Power Unit Transport, **4)** Nut, 1-1/2"-6, **5)** Flatwasher, 1-1/2", **6)** Lockwasher, 1-1/2", **7)** Bolt, 1-1/2"-6 X 8", **8)** Arm, Power Unit Transport, **9)** Bolt, 1-1/2"-6 X 5", **10)** Shackle, Chain - With 7/8" Bolt, **11)** Link, Connecting, **12)** Chain, 30", **13)** Hook, **14)** Engine Lifting Assembly, Dd - 16v4000, **15)** Engine Lift Structure, **16)** Label, Safety - Engine Lifting Assembly, **17)** Shackle, Chain - With 7/8" Bolt, **18)** Link, Connecting, **19)** Chain, 30", **20)** Hook

Figure 75. Power unit and engine lift – Detroit Diesel 16v4000, G200 generator P/N 4272119



1) Arm, Transport, **2)** Flatwasher, 1-1/2", **3)** Lockwasher, 1-1/2", **4)** Nut, 1-1/2"-6, **5)** Bolt, 1-1/2"-6 X 8", **6)** Shackle, Chain - With 7/8" Bolt, **7)** Link, Connecting, **8)** Chain, 30", **9)** Hook, **10)** Power Unit Transport Assembly

Figure 76. Power unit and engine lift – QSK 60, G200 generator P/N 4275052

i. Remove the trunnion caps and the front engine mounting bolts.
j. Make a visual inspection to ensure that all wires, hoses, etc. have been disconnected from the engine and generator and are not in a position to become entangled when the assembly is hoisted.
k. Carefully hoist the engine/generator assembly into the clear and remove it away from the machine.

NOTICE

After the engine/generator assembly has been placed in the prepared area, separate the generator from the engine as described below.

Separating the Engine from the Generator

a. Working through the engine bell housing inspection hole, remove the bolts that hold the flywheel to the rotor adapter plate.

- **CUMMINS ENGINE:** The Cummins engine is factory equipped with an engine rotation tool on the right side of the engine (opposite the starters) to rotate the crankshaft for access to the bolts which secure the flywheel to the rotor adapter. In-board of the engine rotation tool is an inspection hole, which is covered by a plate. Remove the plate to gain access to the flywheel. It may be necessary to remove the two oil filters closest to the engine rotation tool and access hole to gain sufficient clearance to see and remove the bolts.
    - To use the engine rotation tool, remove the clip and push the device shaft TOWARD the flywheel. Attach a long-handle ratchet or breaker handle with socket and rotate the crankshaft as required.
- **DETROIT DIESEL ENGINE:** For the Detroit Diesel engine, an engine rotation tool (P/N R4213898) is available for use in turning the crankshaft for access to the bolts which secure the flywheel to the rotor adapter. One of the starters must be removed for installation of the engine rotation tool. An inspection hole is provided in-board of the starter mounting location for access to the bolts. Remove the pipe plug in the inspection hole for access to the flywheel.
    - To use the engine rotation tool, remove the clip and push the device shaft TOWARD the flywheel. Attach a long-handle ratchet or breaker handle with socket and rotate the crankshaft as required.

Rotating the Engine Crankshaft from the Front of the Engine

NOTICE

Rotating from the front of the engine is the preferred method. The engine must be rotated in the direction that will tighten the bolt. Forward engine rotation will require a torque multiplier, and this method will reduce the flexplate distortion that occurs when the engine is rotated via the manual drive gear typically provided (refer to illustration "Rotate engine crankshaft with manual drive gear").

a. Remove the crankshaft grounding strap from the front of the engine.

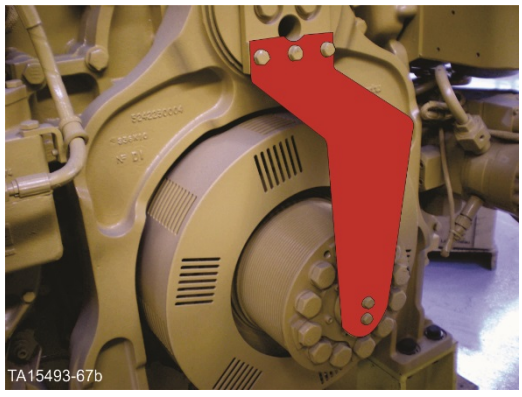
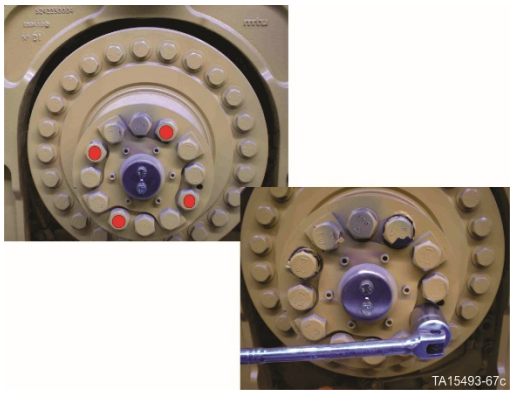
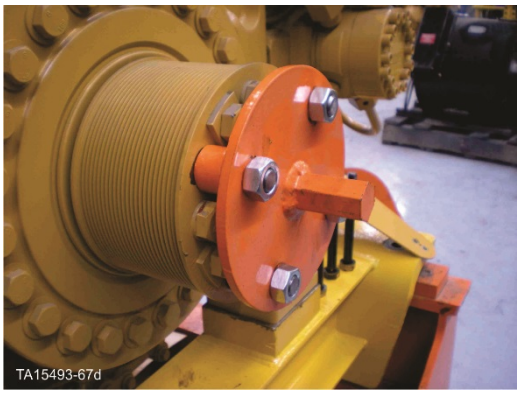


Figure 77. Crankshaft grounding strap - typical

b. Remove four of the 10.9 M20-2.5 bolts from the engine's crankshaft pulley, one every 90°.
c. Leave the engine grounding strap adapter on the engine's crankshaft pulley.



d. Install the indexing tool LET (P/N 103-7405); using four 250mm long M20-2.5 bolts or M20-2.5 all thread studs and nuts, as illustrated in the graphic below.



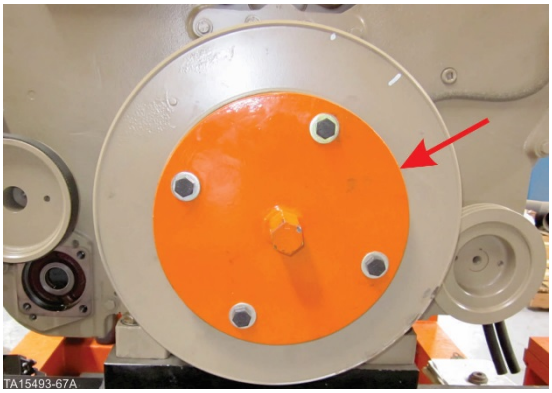
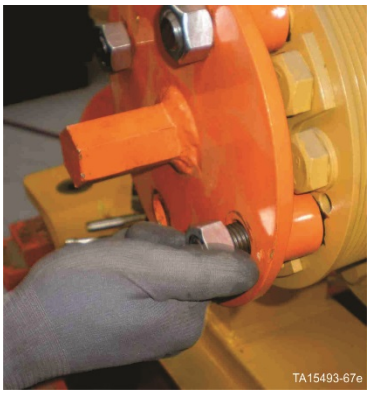


Figure 78. Rotating engine crankshaft from front of engine

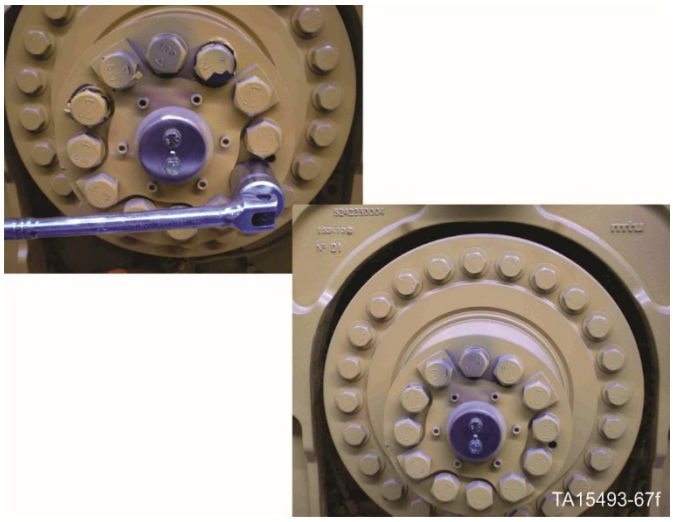
NOTICE

Remove tool after engine rotation process is no longer required.

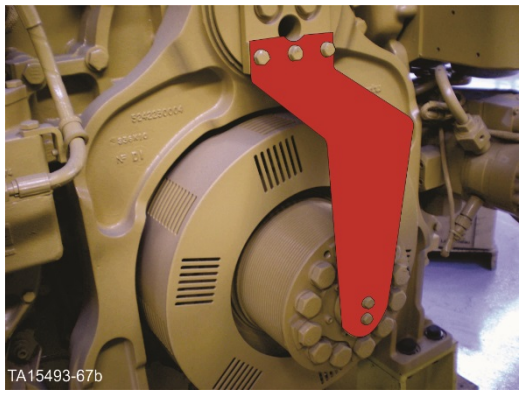
e. Remove the four 250mm long M20-2.5 bolts or M20-2.5 all thread and nuts and remove the tool.



f. Reinstall the original 10.9 M20-2.5 bolts and torque to the specified torque called for from the Detroit Diesel service manual. (500-550 N•m - none lubed)



g. Reinstall the crankshaft grounding strap on the front of the engine.



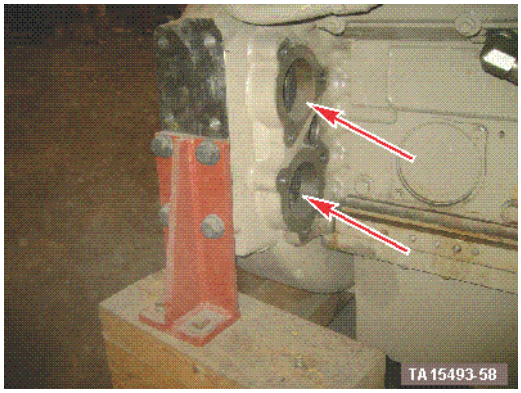
Rotating the Engine Crankshaft with Manual Drive Gear

While it is not recommended, some engines might be rotated from the starter end. This is done with an engine rotation tool that engages the teeth of the flywheel.

NOTICE

Rotating from starter end can cause the flexplate to "flex" and affect the axial and radial readings. This is typical with used flex plates that are no longer stiff. It may be necessary to rotate engine from the front (as previously described) to get valid readings.

a. Remove the cover from the rear of the engine that allows access to the clearance holes in the flexplate. Where necessary, also remove the starter.



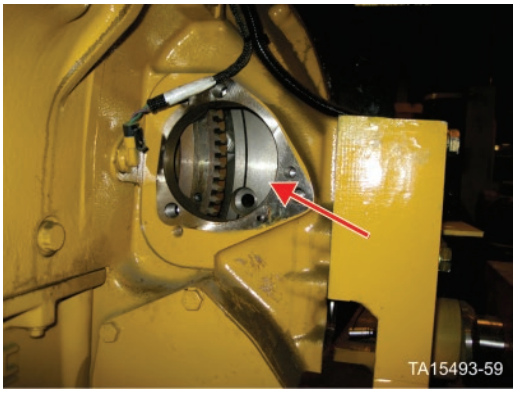


Figure 79. Remove cover/starter to access back side of flexplate

b. Cummins engines are normally provided with a rotation tool.

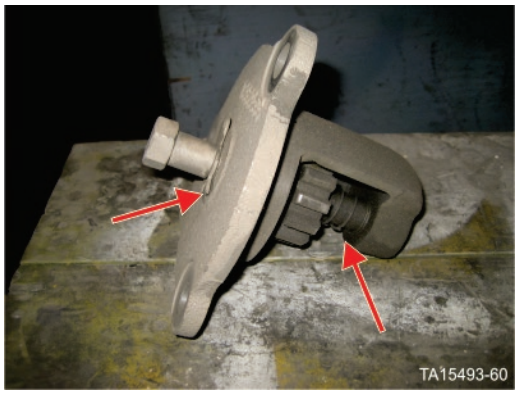


Figure 80. Cummins engine rotation tool - retainer and spring

c. The tool is normally held in the out position with a retainer ring so it does not contact the flexplate gear. It is also spring loaded to keep it away from the flexplate gear.

CAUTION

Put the retainer ring on the engine rotation tool back in place after using.

d. The bolt has to be pushed in and held in place when rotating. This will typically require a small spacer inside the socket to assure it is fully pressed in.

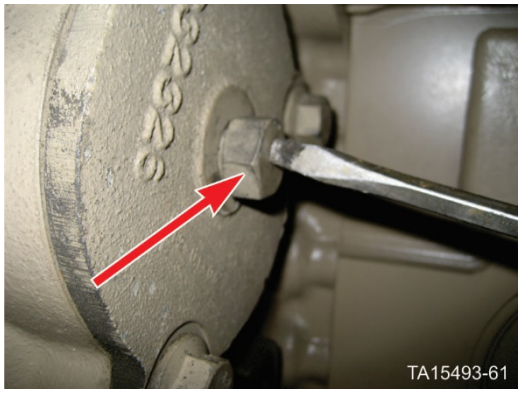


Figure 81. Cummins engine rotation tool

e. Commercial tool is available from Detroit dealers that will turn both Cummins and Detroit engines. Contact your Detroit dealer for more information.

CAUTION

The engine rotation tool must be removed from the engine after each use.

Figure 82. Engine rotation tool

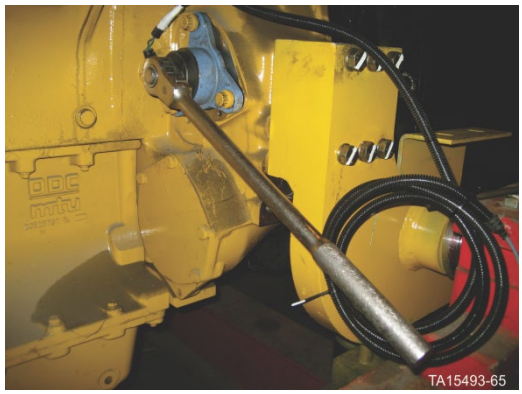


Figure 83. Rotating engine crankshaft with manual drive gear

f. Attach the generator lifting device per the selection below:

- **9B generator:** Install 1”-14 UNS threaded lifting eyes to lifting blocks at each end of generator.
- **12B or 12C generator:** Attach generator lifting device (P/N R4148729, 12B or P/N R4167273, 12C).

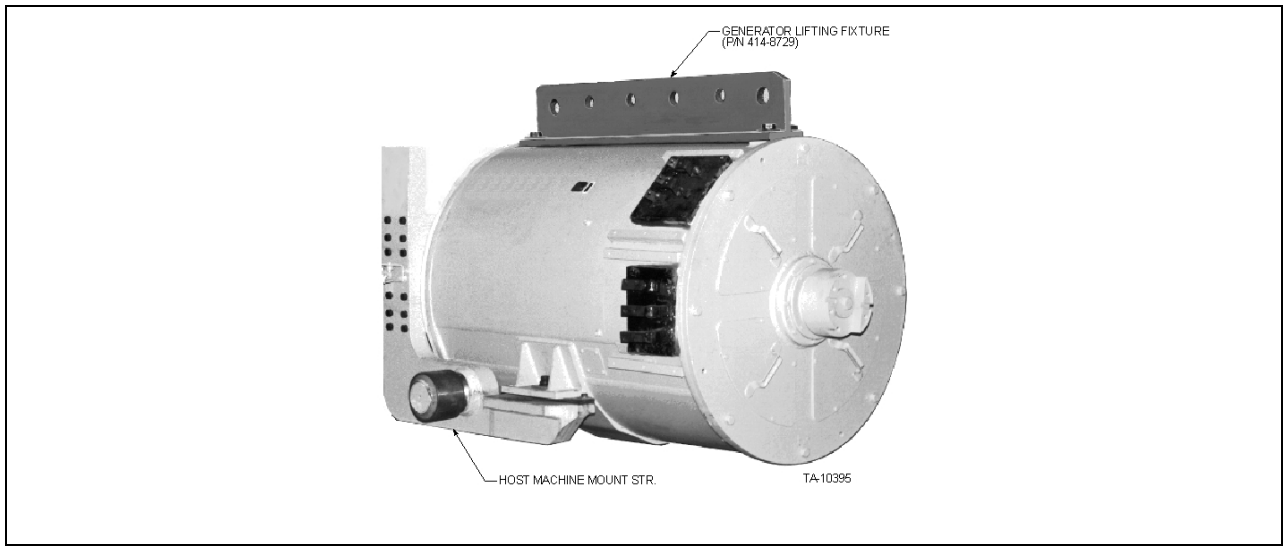


Figure 84. Generator lifting fixture (illustrated is fixture used on ac generator 12b)

- **G100 generator:** Attach generator lifting device (P/N R1036782

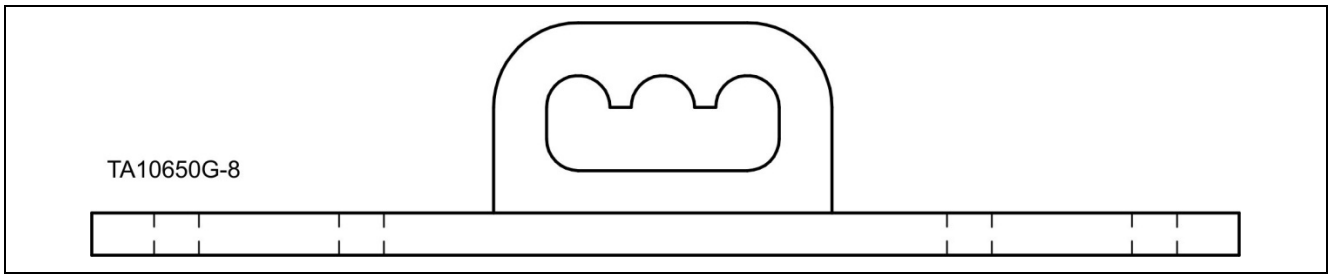


Figure 85. G100 generator lifting device

- **G200 generator:** Attach generator lifting device (P/N R1036777)

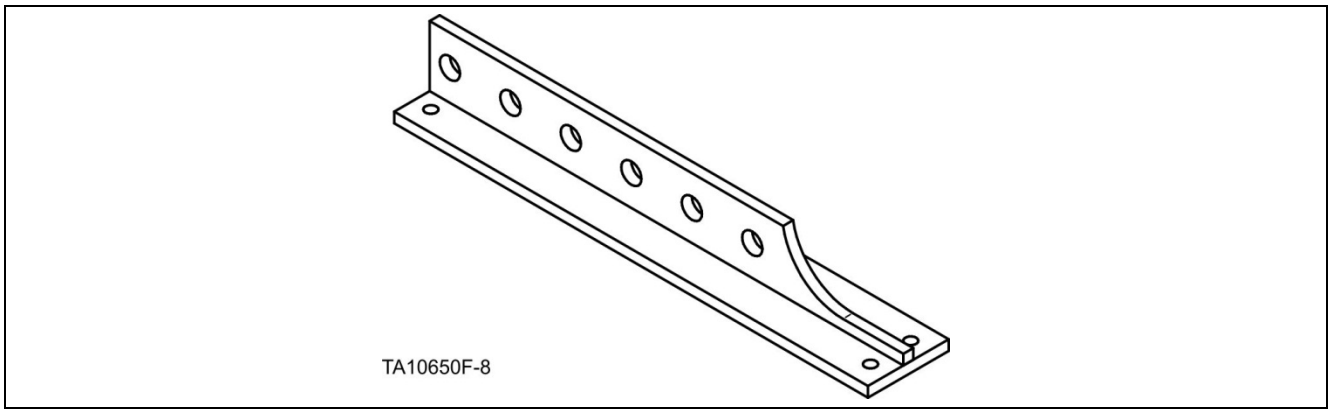


Figure 86. G200 generator lifting device

g. Use jack supports under rear engine mount to stabilize engine.

Figure 87. Support jacks under rear engine mount

h. Attach hoist to the lifting device or threaded lifting eyes (as applicable) and support the generator.
i. Remove the lockwashers and flatwashers from the generator mount feet.

Figure 88. Generators with vertically installed bolts in mounting feet

Figure 89. Generators with horizontally installed bolts in mounting feet

j. Remove the bolts that hold the generator stator to the adapter plate.

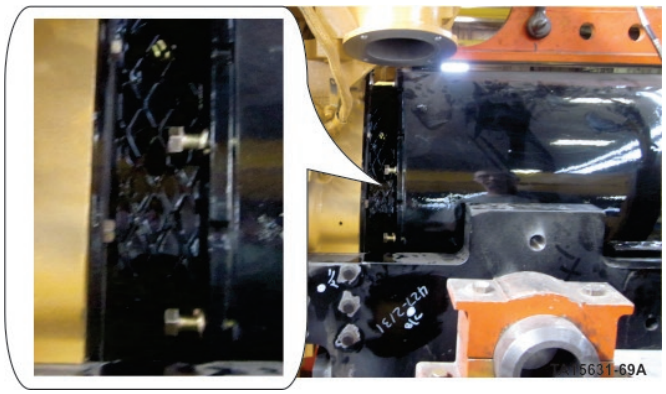


Figure 90. Bolts holding generator stator to the adapter plate

⚠ WARNING

Crush hazard and struck-by hazards exist when separating the generator from the engine. DO NOT stand behind the generator while pulling the generator from the engine. Stand clear from the generator when separating it from the engine. The separation may be sudden, causing the generator to kick toward the rear. Failure to stand clear of the generator when separating from the engine can cause crush hazards resulting in serious injury or death.

k. Physically remove the generator from the stator adapter. It may be necessary to use “pusher bolts” between the generator stator adapter and the generator stator.

⚠ WARNING

Pinch point hazards exist when the generator is removed from the engine. The generator rotor may drop. This is the result of the rotor shaft being supported on the engine end by the engine flex plate. The amount of force to remove the rotor adapter to the flexplate will vary. Ensure hand and fingers are kept clear of pinch points during the separation. Failure to keep hands and fingers clear of the pinch point areas can cause pinch point hazards resulting in serious injury.

Installing the Shipping Bars

a. Place the generator on suitable blocking.

b. Hoist the rotor upward using a nylon strap around the rotor shaft.

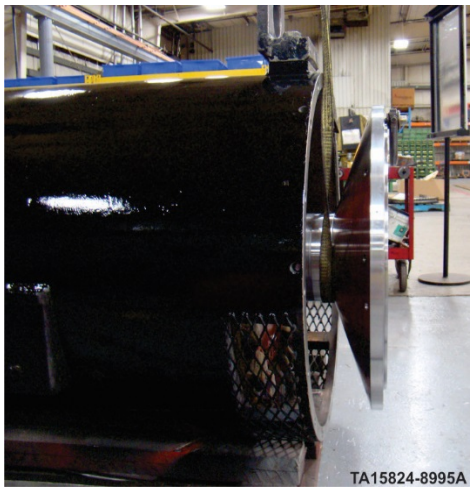
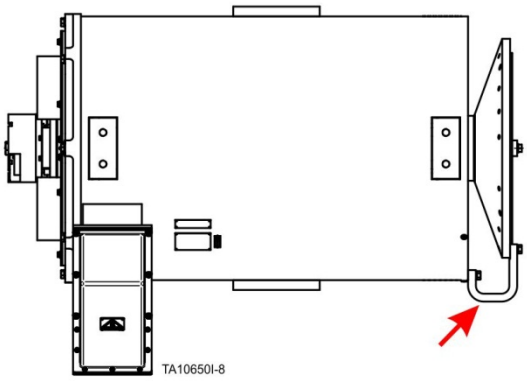


Figure 91. Nylon strap around the rotor shaft (typical)

c. Bolt four shipping bars (refer to table below for P/N or shipping bars, as applicable) to both the stator bolt ring and the rotor adapter plate to secure the rotor during shipping.



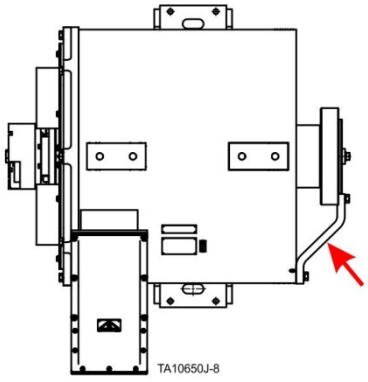


Figure 92. Typical shipping bar installation

Generator	P/N
9b (SAE 00)	R4240440
12b (SAE 0)	R4132127
12b (SAE 00)	R4240441
12c (SAE 00)	R4240442
G100 Detroit Diesel T1	R4273258
G100 Qsk50 T2	R4264747
G100 & G200 Generators – Detroit Diesel T2	R4278458
G200 Detroit Diesel, T1 And Cummins T1 and T2	R4278713

Figure 93. Shipping Bars

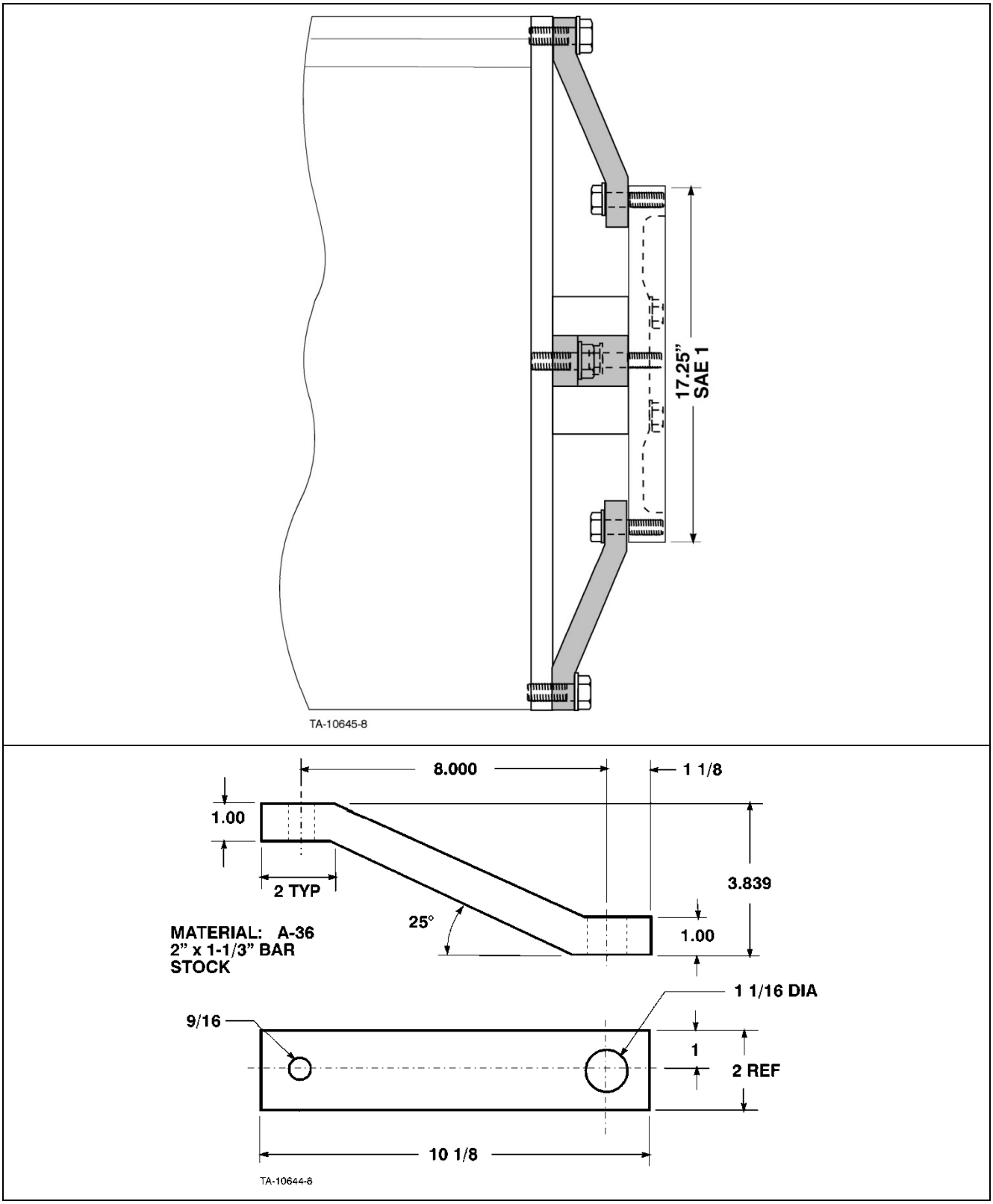


Figure 94. P/N R4216173 shipping bars for 4B, 7B – SAE 1 flywheel

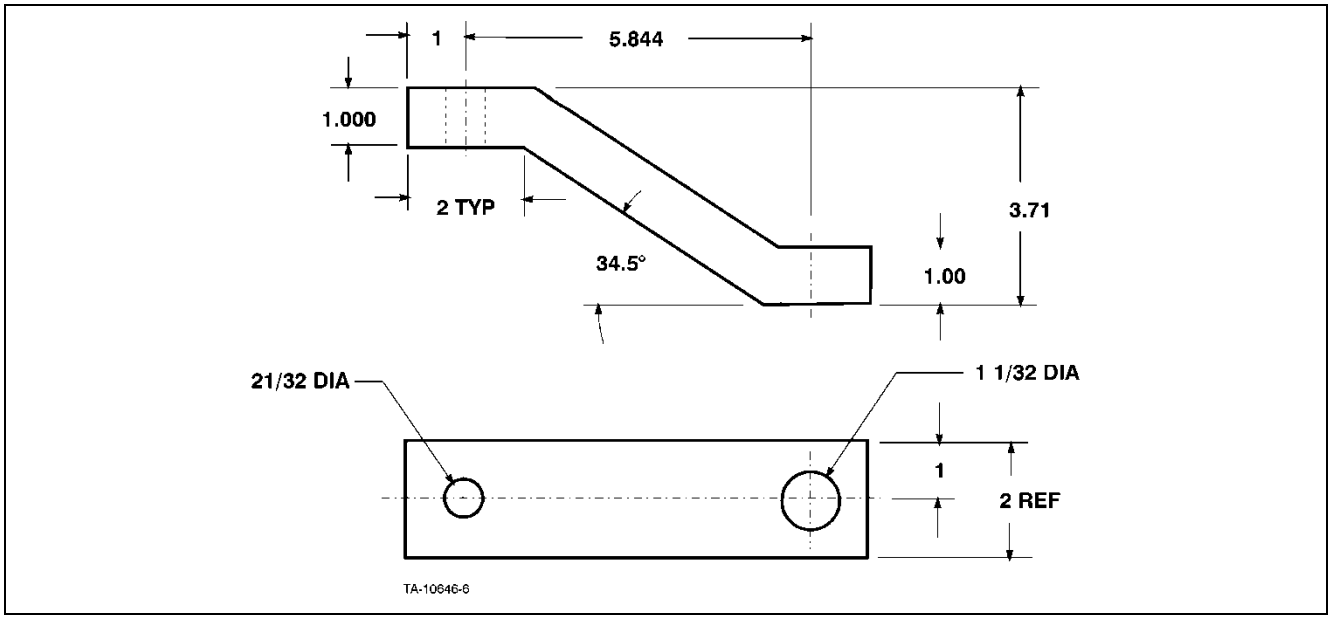
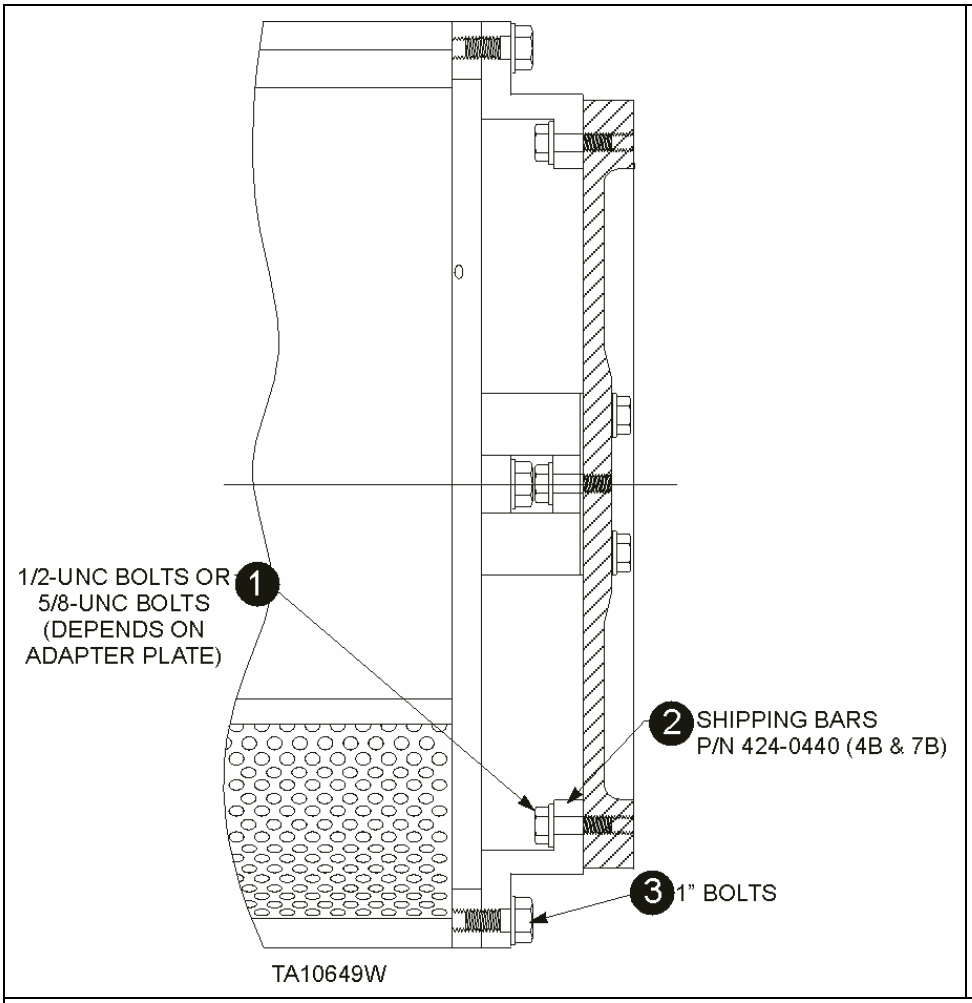


Figure 95. P/N R4250200 shipping bars for 6R – SAE 0 flywheel used on L/D-950



1) 1/2 –UNC Bolts or 5/8-UNC Bolts (Depends on Adapter Plate)

2) Shipping Bars P/N 424-0440 (4B & 7B)

3) 1" Bolts

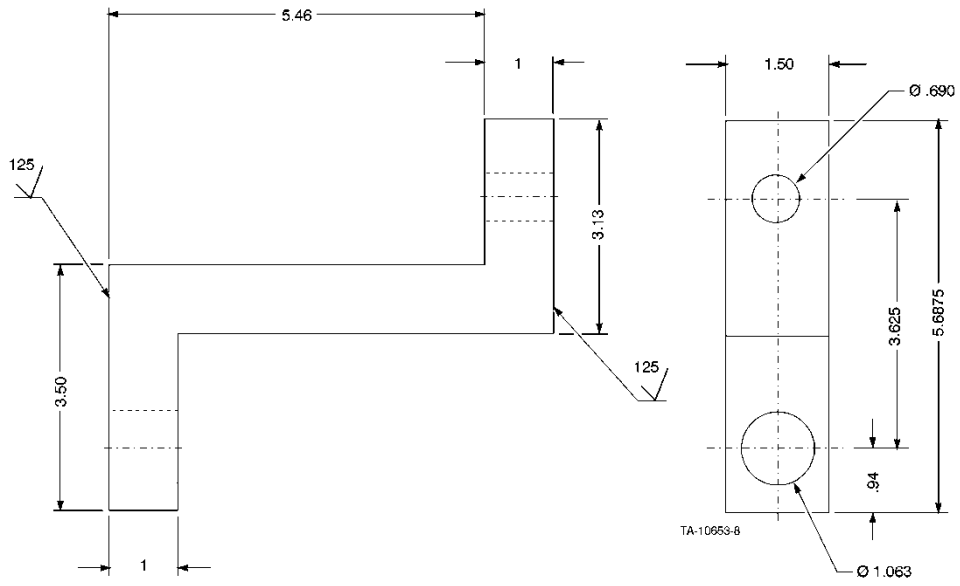


Figure 96. P/N R4240440 – 9B Generator – SAE 00

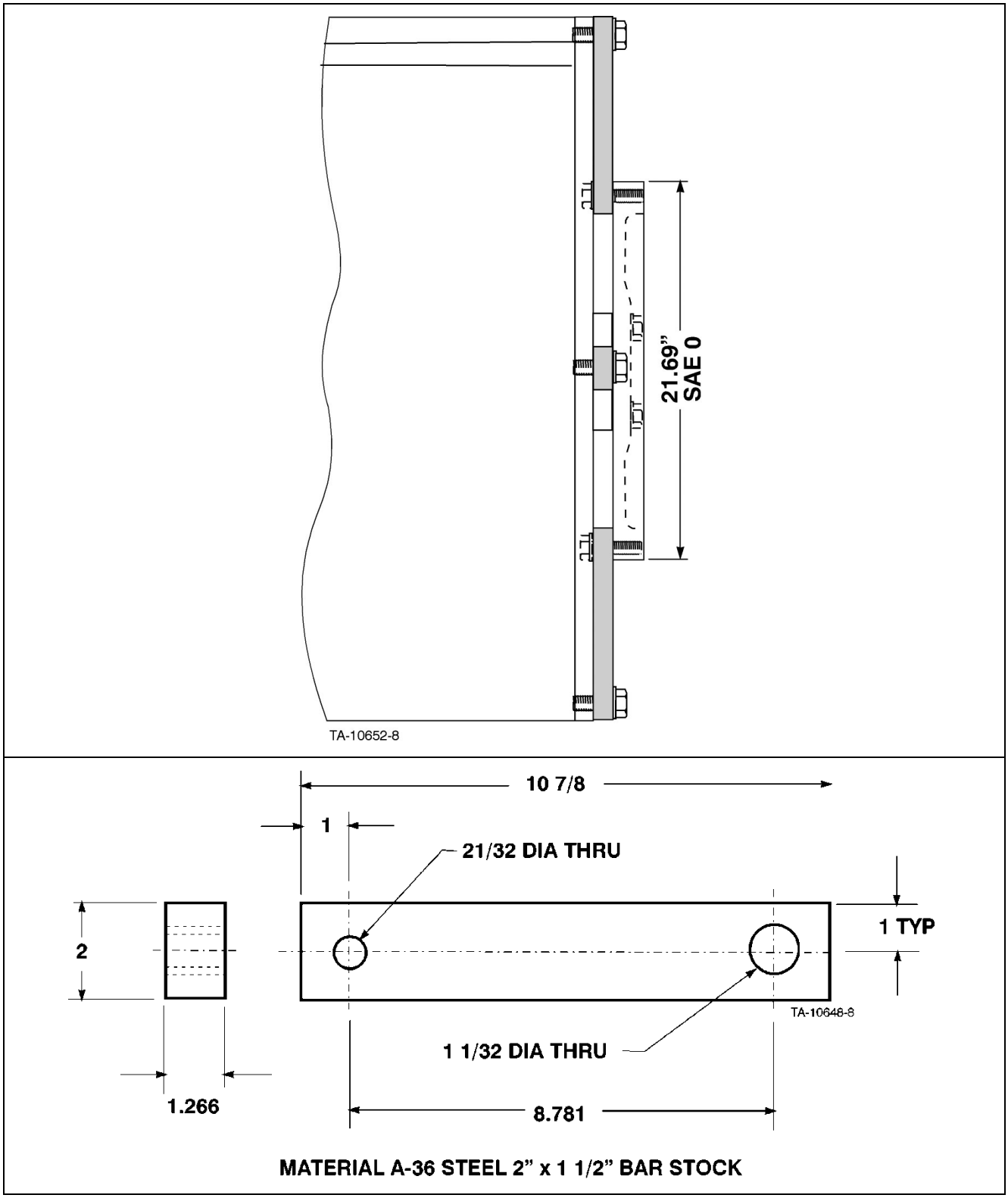


Figure 97. P/N R4132127 shipping bar for 12B – E Generators – SAE 0 used on L-1850

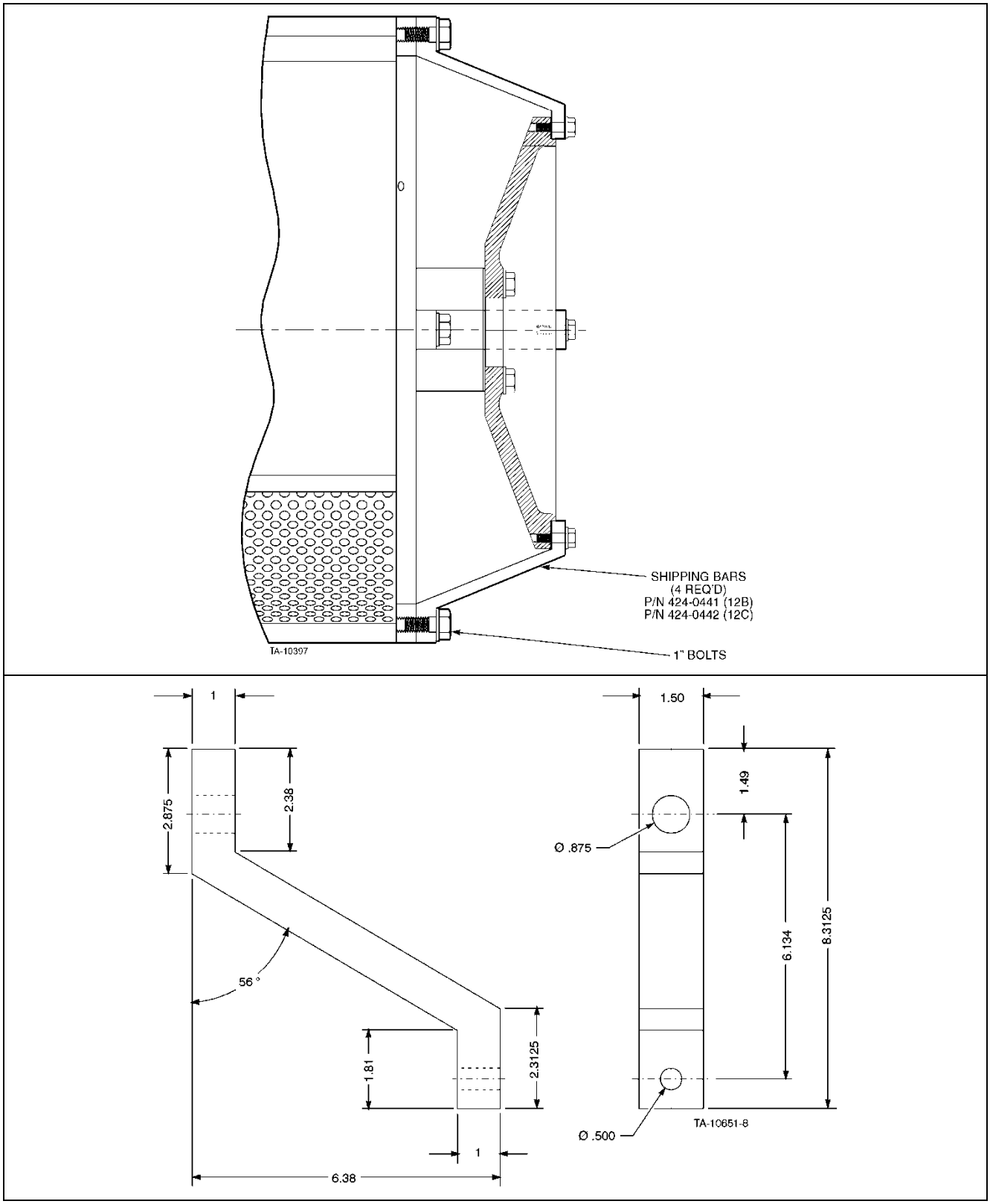


Figure 98. P/N R4240441 shipping bar for 12B Generators – SAE 00 – used on L-1850

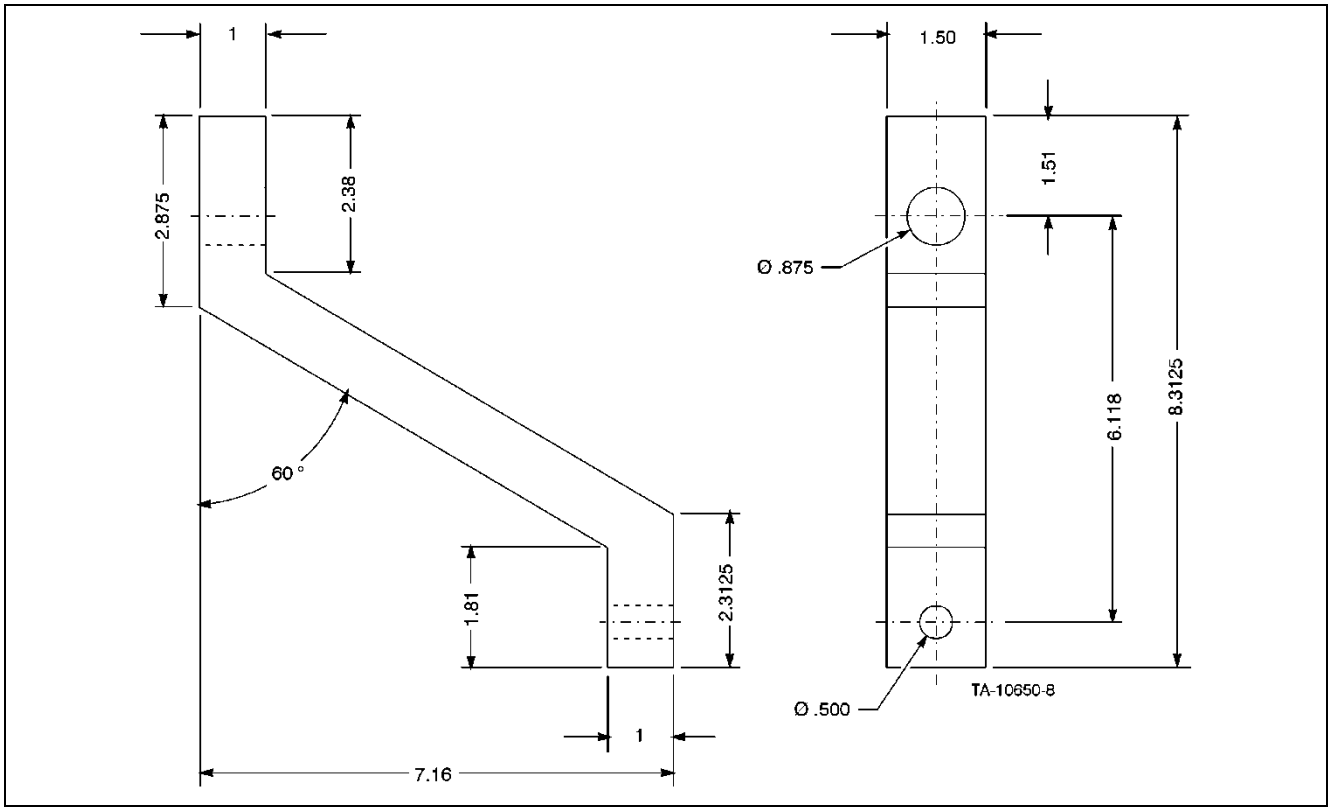


Figure 99. P/N R4240442 shipping bar for 12C Generators – SAE 00 – used on L-2350

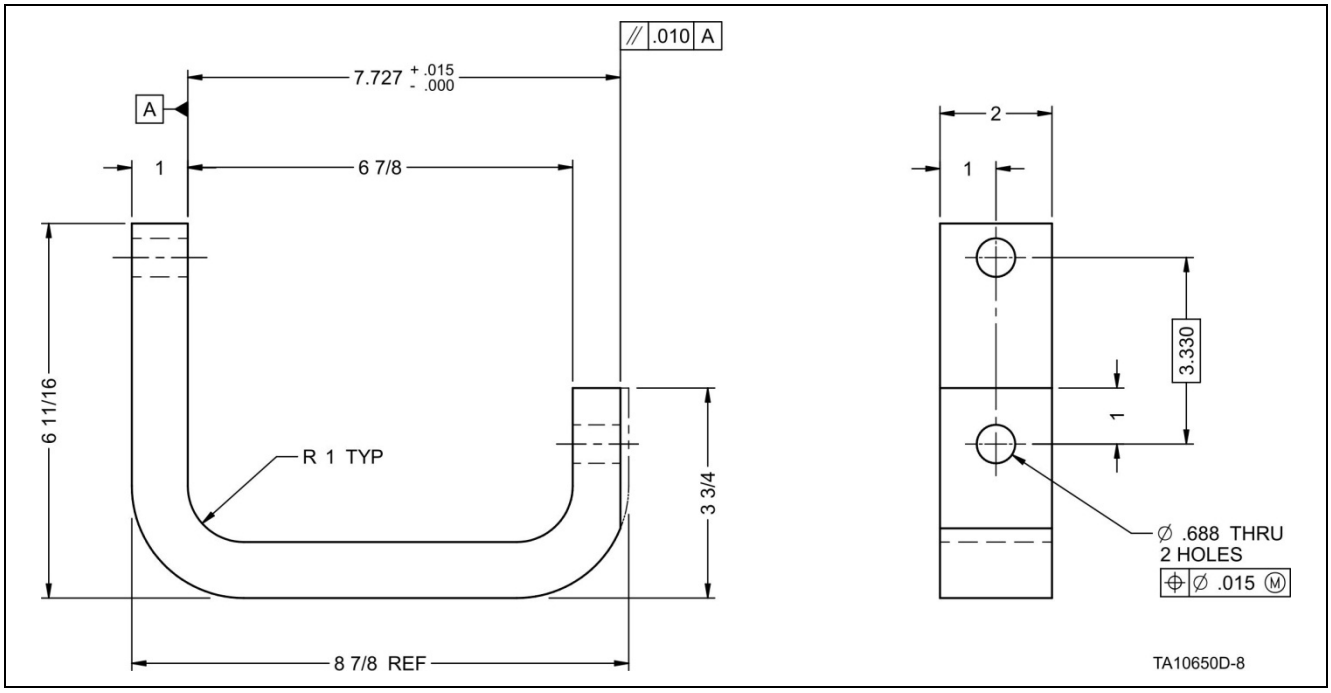


Figure 100. P/N R4273258 shipping bar for G100 Generators – Detroit Diesel T1

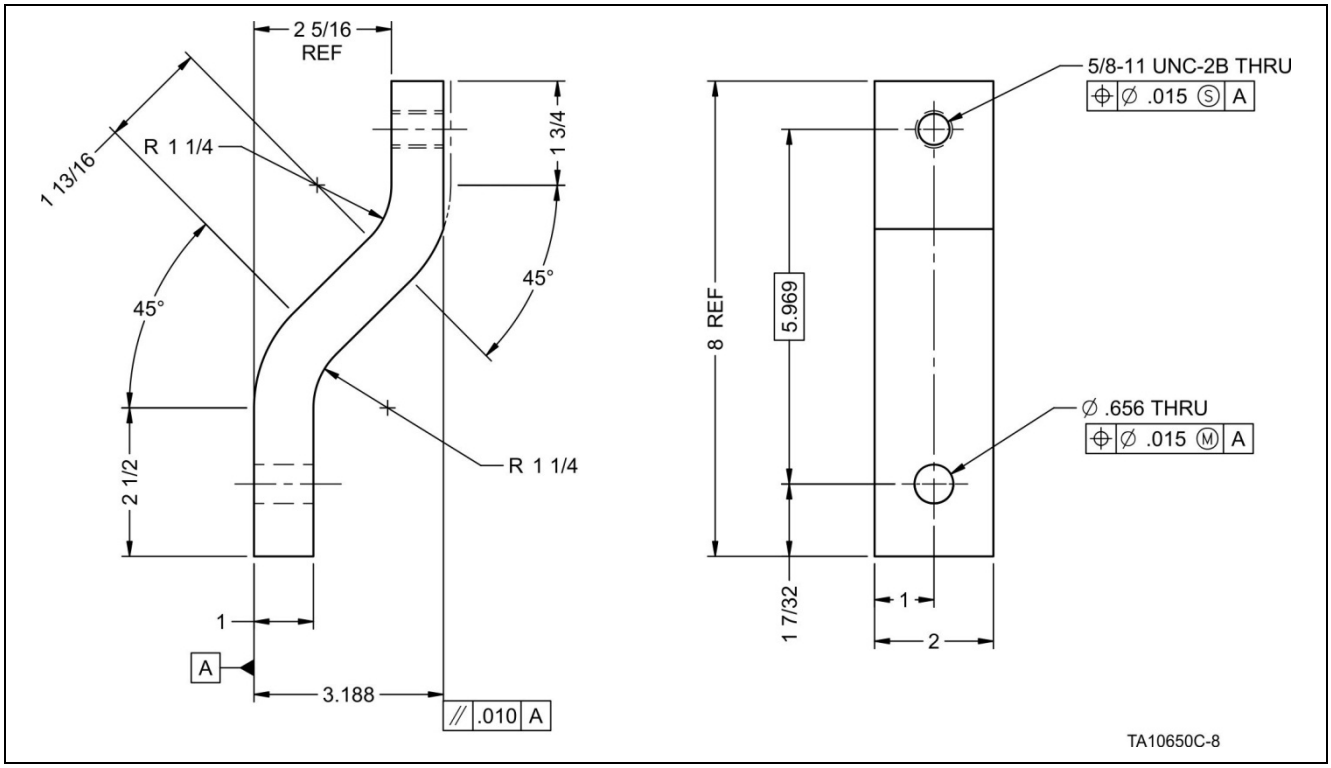


Figure 101. P/N R4264747 shipping bar for G100 Generators –QSK50 T2

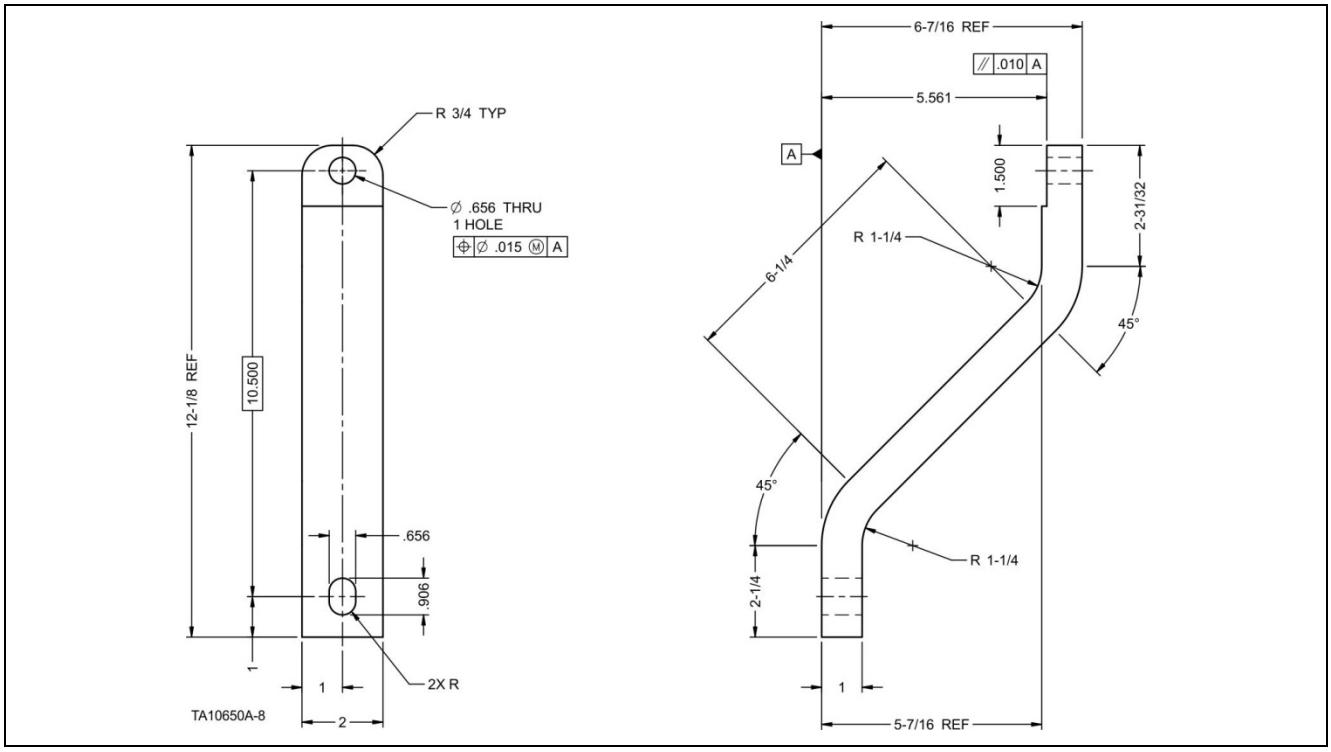


Figure 102. P/N R4278458 shipping bar for G100 & G200 Generators – Detroit Diesel T2

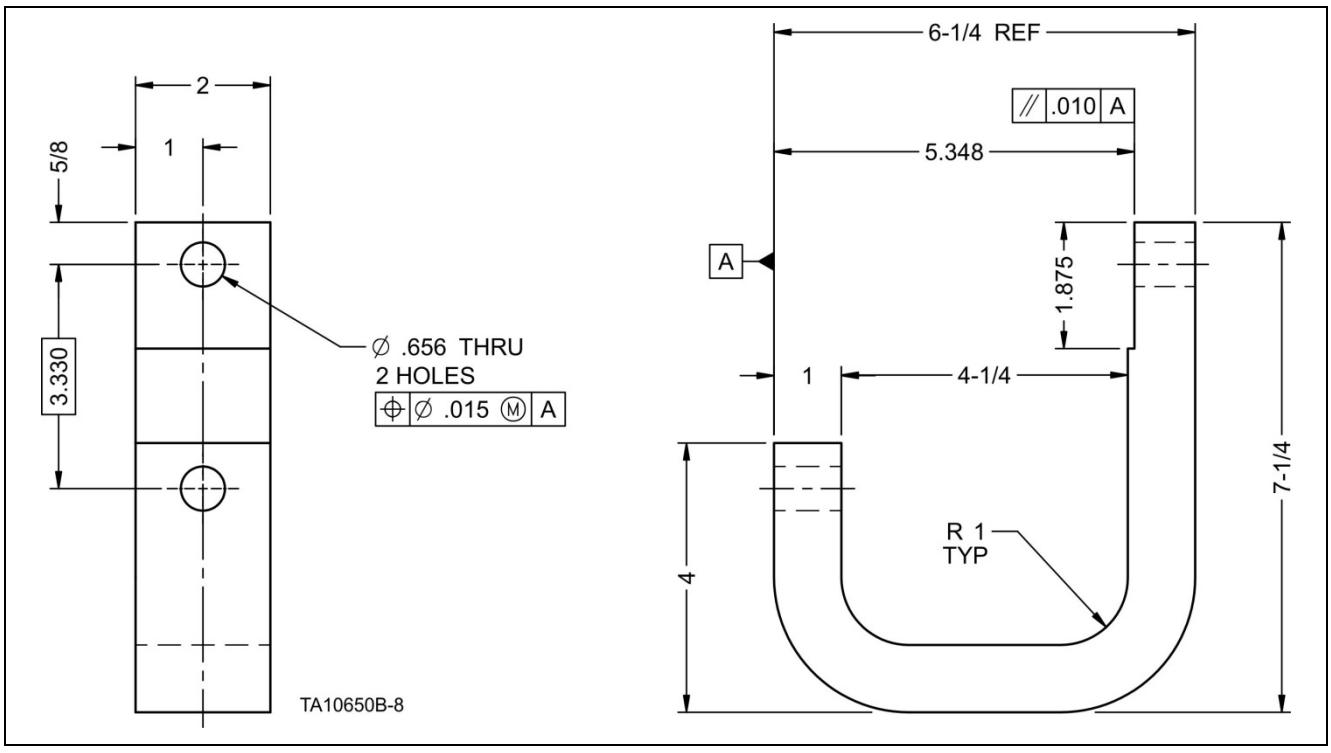


Figure 103. P/N R4278713 shipping bar for G200 Generators – Detroit Diesel, T1 and Cummins T1 and T2

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Installation and Alignment of Generator Selection

Upon installation, the generator has to be aligned to the engine per the instructions as presented in “Gxxx Single Bearing Generator Alignment and Installation”.

L/D950, L1150, L1350

Refer to “G100 Single Bearing Generator Alignment L/D-950, L-1150, L-1350” below.

L1850, L2350

Refer to “G200 Single Bearing Generator Alignment L-1850, L-2350” located after “G100 Single Bearing Generator Alignment L/D-950, L-1150, L-1350” below.

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G100 Single Bearing Generator Alignment L/D950, L1150, L1350

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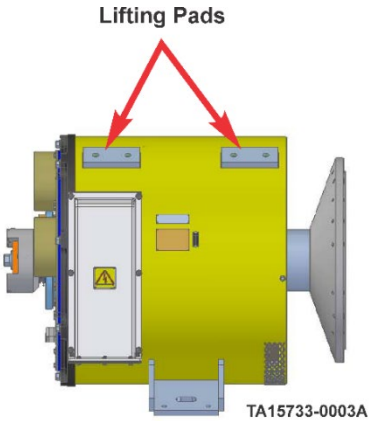


Figure 104. G100 Generator Lifting Pad Locations

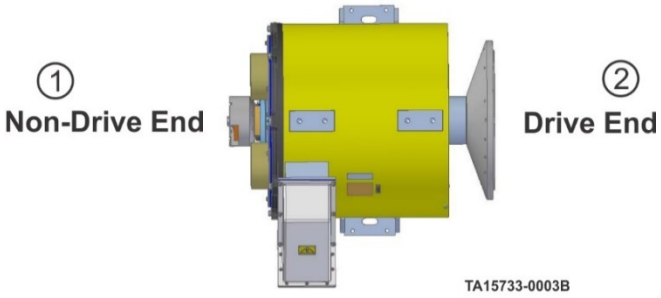
Weights (Approximate)

Generator Type	Generator Assembly	Stator	Rotor
G100	4868 lbs (2208 kgs)	3290 lbs (1495 kgs)	1574 lbs (715 kgs)

Item/Equipment	L-950/D-950	
	LBS.	KGS.
Engine, Cummins - QST30 1050HP T2	7,337	3,328
Engine, Detroit Diesel - 16V2000 1050HP T2	6,984	3,168
Power Unit (Engine/Generator) Cummins	11,800	5,352
Power Unit (Engine/Generator) Detroit Diesel	14,100	6,409

Item/Equipment	L-1150	
	LBS.	KGS.
Engine, Cummins - QSK38 1200HP T2	9,039	4100
Engine, Detroit Diesel - 16V2000 1200HP T2	6,984	3,168
Power Unit (Engine/Generator) Cummins	13,000	5,909
Power Unit (Engine/Generator) Detroit Diesel	15,000	6,818

Item/Equipment	L-1350	
	LBS.	KGS.
Engine, Cummins - QSK50 1600 HP T2	12,575	5,703
Engine, Detroit Diesel 12V4000…1600HP T1	13,382	6,070
Power Unit (Engine/Generator) Cummins	21,491	11,108
Power Unit (Engine/Generator) Detroit Diesel	24,500	11,113



1) Non-Drive End, **2)** Drive End

G100 Generator - Top View - Typical

Introduction

NOTICE

Refer to the parts manual for an exploded view illustration and parts list of the engine/generator installation specific to your machine.

⚠ WARNING

Crush hazards exist when lifting components. The engine/generator assembly weights shown in the tables titled "WEIGHTS" are approximate weights. Always allow a safety margin when selecting lifting equipment. Consult the engine manufacturer for exact engine weights. Failure to allow a safety margin for lifting equipment can cause crush hazards resulting in serious injury or death.

Also supplied in this document are the following:

- Generator alignment worksheet. The worksheet should be copied and filled out to maintain a record of each installation.
- Tools and parts listing.

NOTICE

Dial indicators shown in the various photos and diagrams are representations only. Many types of dial indicators are suitable. A dial indicator with a scale from 1-10 and graduations of .0001” is recommended. It should be noted that a dial indicator with a lever head of some sort will be required for the pilot shoulder O.D. measurements.

These instructions detail the procedures and tool requirements for installing and aligning a single bearing G100 generator onto the engine after removal from the machine. Installation of the power unit into the vehicle is not included in these instructions.

The various components are shown in the following diagram. The size and type of these components will vary depending on the generator and engine. While various configurations of rotor and stator adapters have been shown in this document - it is important to check the parts manual provided with your machine for specific components used on a given machine.

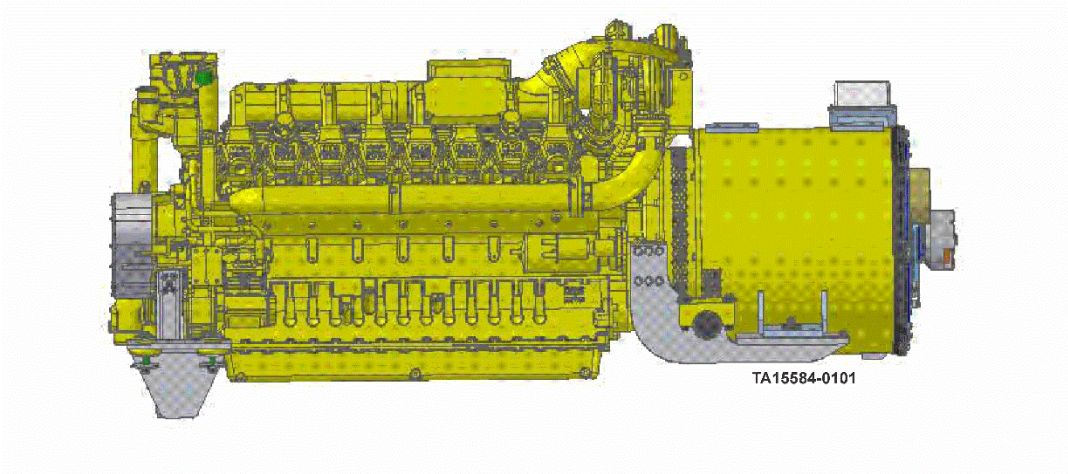


Figure 105. Detroit Diesel Engine with G100 Generator Mounted - Typical

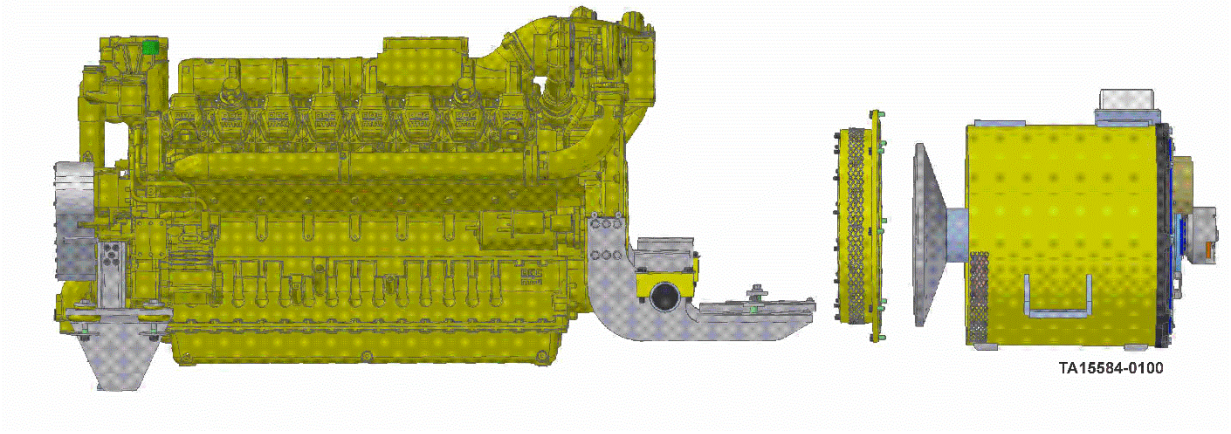
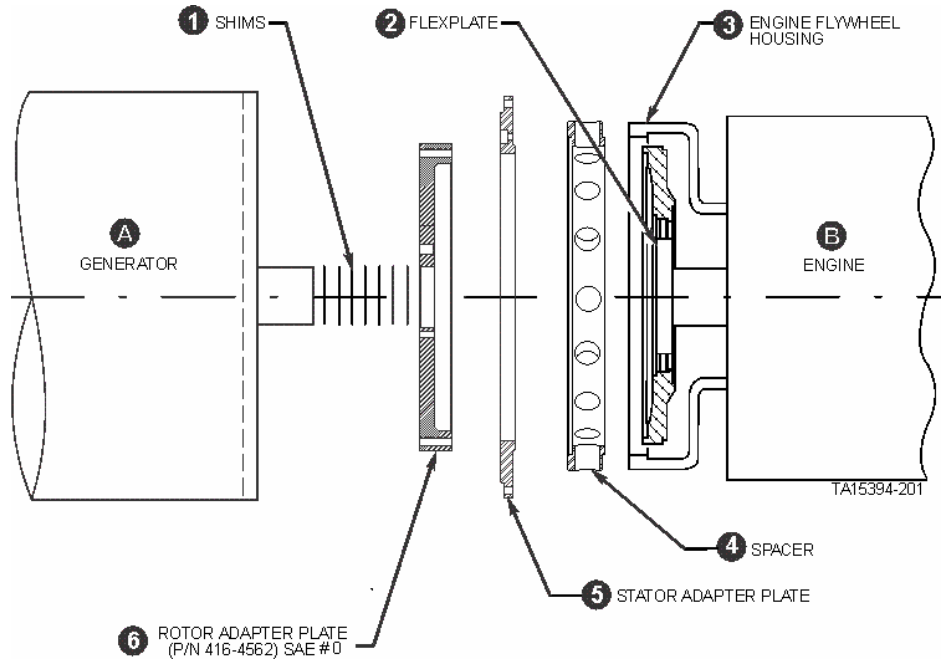


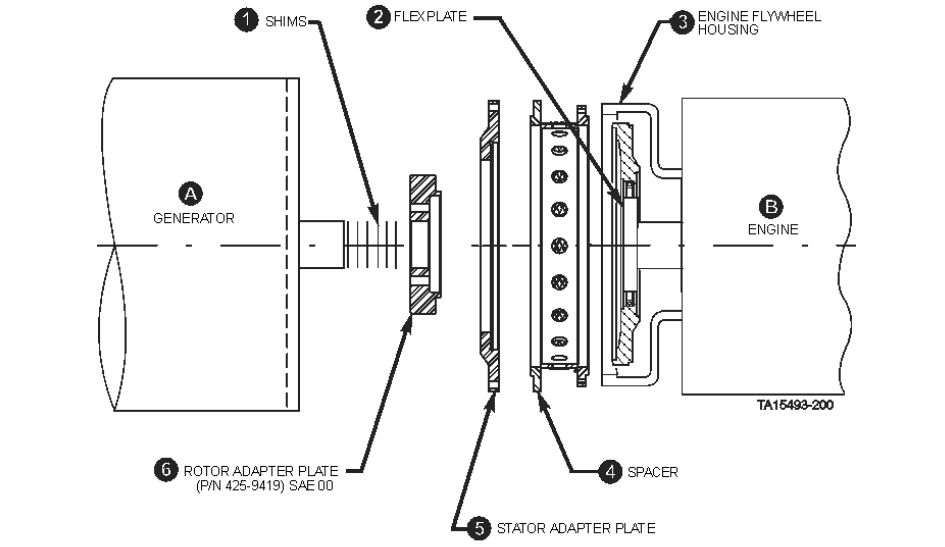
Figure 106. Detroit Diesel Engine with G100 Generator Dismounted - Typical



1) Shims, **2)** Flexplate, **3)** Engine flywheel housing, **4)** Spacer, **5)** Stator adaptor plate, **6)** Rotor adapter plate
A) Generator **B)** Engine

Figure 107. Exploded arrangement of engine to generator coupler components

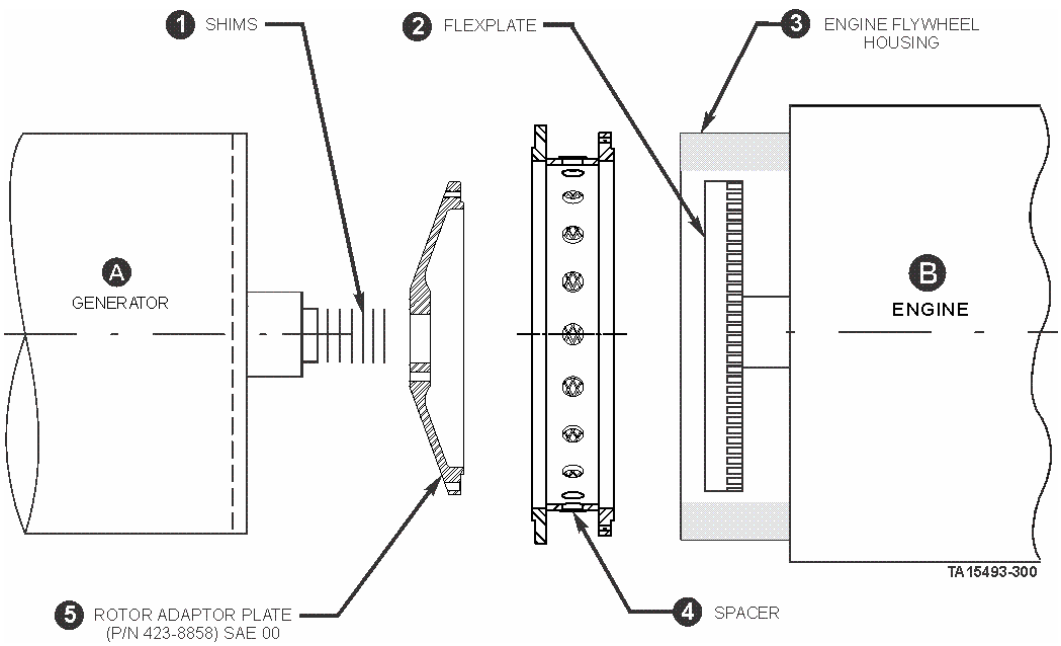
G100 - generator (P/N R4264700)



1) Shims, **2)** Flexplate, **3)** Engine flywheel housing, **4)** Spacer, **5)** Stator adaptor plate, **6)** Rotor Adapter Plate
A) Generator, **B)** Engine

Figure 108. Exploded arrangement of engine to generator coupler components

G100 - generator (P/N R4264712)



1) Shims, **2)** Flexplate, **3)** Engine flywheel housing, **4)** Spacer, **5)** Rotor adapter

A) Generator, **B)** Engine

Figure 109. Exploded arrangement of engine to generator coupling components

G100 generators - (P/N R4264715)

- **Generator** - single bearing size G100 (Tier I and Tier II)
- **Shims** - provide for axial adjustment.
- **Rotor adapter** - connects the generator rotor shaft to the engine flexplate. This can be flat or conical shaped and can be various diameters.
- **Stator adapter(s**) - connects the generator stator to the engine flywheel housing. Depending on the engine and generator combination - this can be either one or two pieces of various diameters.
- **Flexplate** - supplied by engine manufacturer. Uses a pack of thin laminations to provide flexibility between the engine crankshaft and the generator rotor. This can be various diameters depending on the engine.

NOTICE

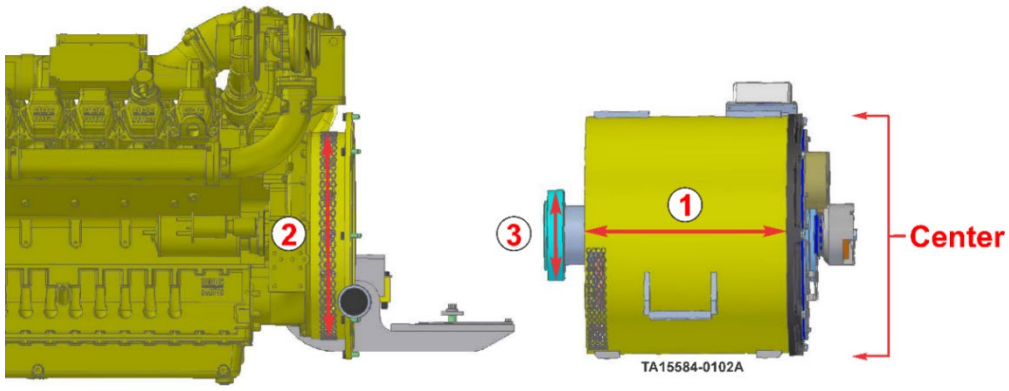
Tier 2, 4000 series engines are provided with a solid plate on the engine. The lamination pack becomes part of the rotor adapter.

- **Flywheel housing** - typically a casting on rear of ending that provides a connecting point for the generator and the engine mount structures. This will vary depending on the engine.

Primary Key Steps

The installation and alignment of a G100 single bearing generator can be broken down into several basic steps.

1. Center the rotor axially so that it does not apply axial load to the engine. This is done with shims.
2. Square up and center the stator axially with respect to the engine so that no loads are applied to the engine bell housing.
3. Center the rotor radially so that the generator rotor is lined up with the engine crankshaft so that it does not cause vibration.



Shown with left engine/generator mount removed for clarity

Generator alignment must be done using an engine/generator stand. The engine/generator stand may be purchased from Komatsu or it may be locally fabricated. Detailed prints for the stand will be provided to use for local manufacture. Contact your local Komatsu Service Center for more details.

CAUTION

Do not align the generator to the engine with the engine mounted in the frame. This can cause engine and generator problems due to misalignment.

Figure 110. Typical engine/generator assembly stand L/D950/L1150 - stand (P/N R1033325)

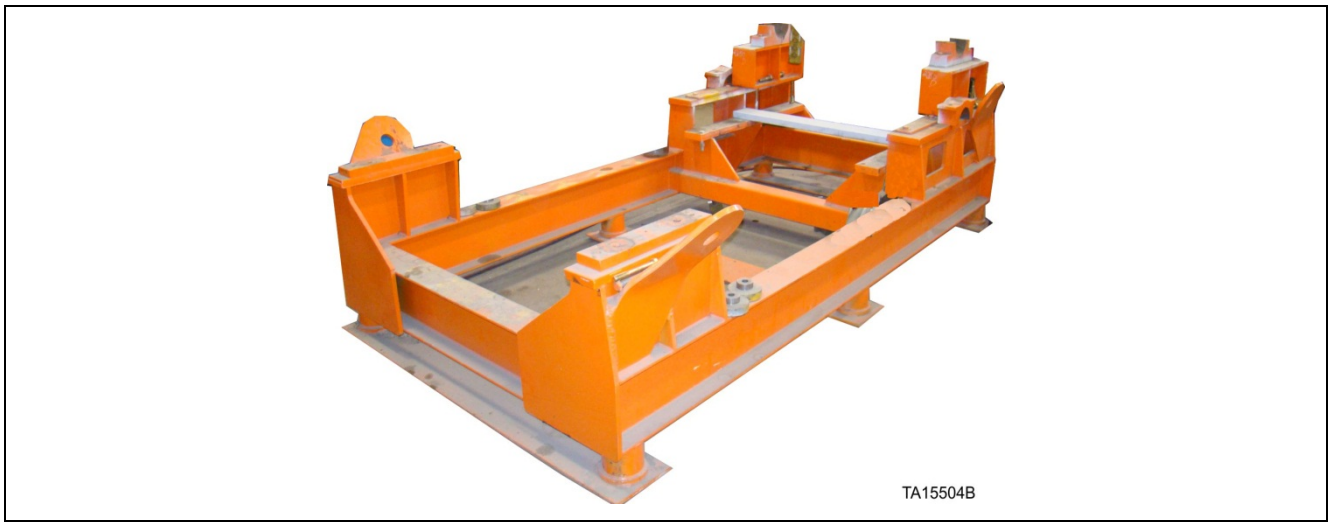


Figure 111. Typical engine/generator stand L/1350 - stand (P/N R1032750)

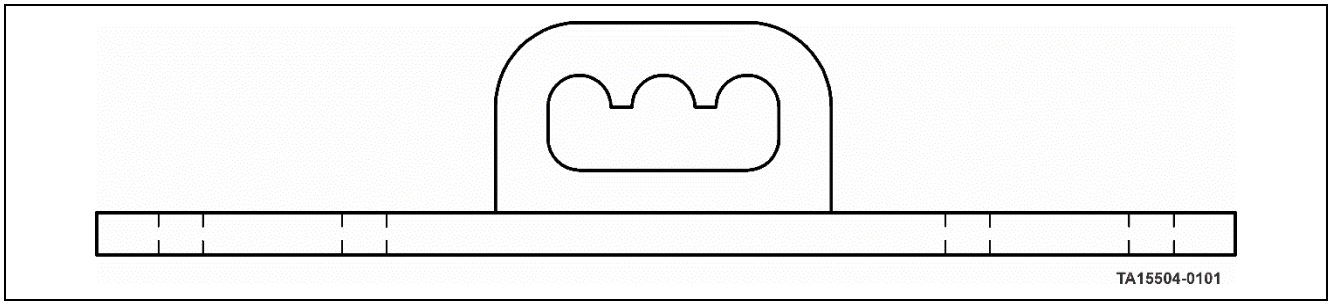


Figure 112. G100 Lifting Fixture - (P/N R1036782)

Alignment Procedure Summary Overview

General Steps that must be followed to Assure Minimal Vibration & Correct Engine & Generator Endplay.

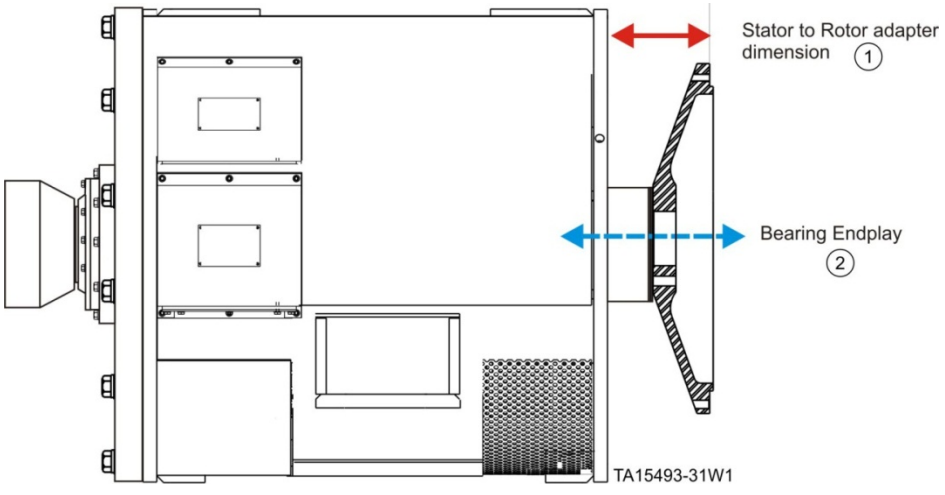
1. Rotor endplay and stator/rotor adapter measurements.

1. Pre installation engine alignment inspections and setup.
2. Alignment of rotor adapter onto flywheel.
3. Set axial endplay.
4. Install generator.
5. Rotor shaft TIR runout.

The following is a brief summary of the generator alignment steps. Details for each step are provided in the following sections/chapters.

Rotor endplay and stator/rotor adapter measurements

- Measure generator bearing endplay.
- Measurement from stator to rotor adapter with bearing in middle of endplay.

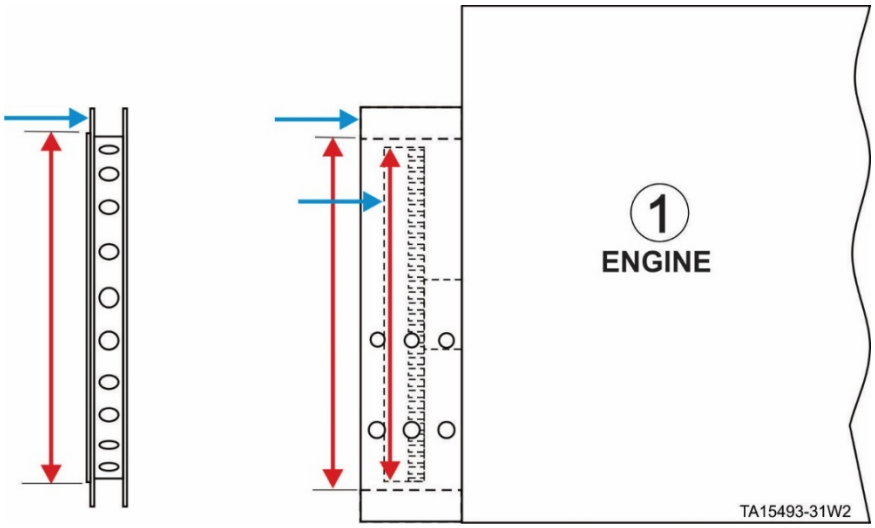


1) Stator to rotor adapter dimension, **2)** Bearing endplay

Figure 113. Generator measurements - (typical)

Pre installation engine alignment inspections and setup

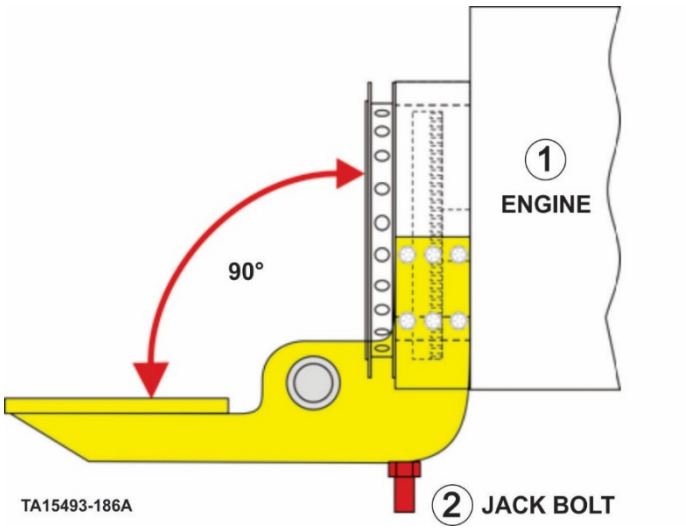
- Structural measurements of flywheel bell housing and stator adapter.



1) Engine

Figure 114. Pre-installation inspections - (1 of 2)

- Install the engine mounts.
- Engine mounts should be square with the flywheel bell housing.
- Install jack bolts to prevent stress on the flywheel bell housing.

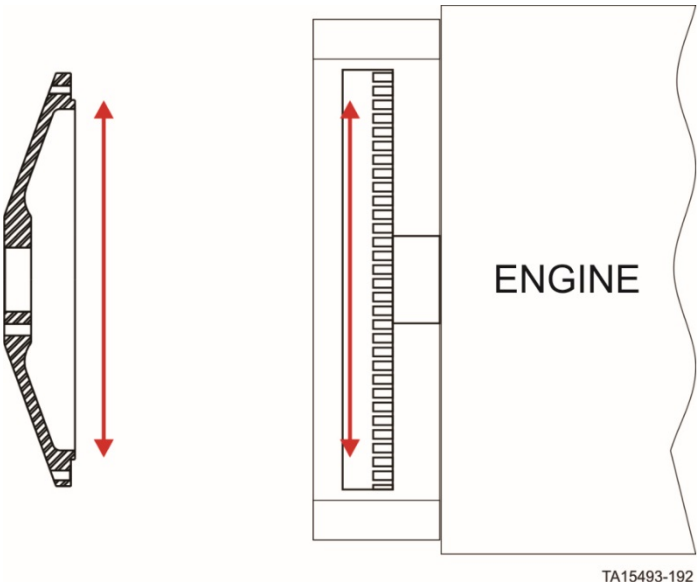


1) Engine, **2)** Jack Bolt

Figure 115. Pre-installation inspections - (2 of 2)

Alignment of rotor adapter onto flywheel

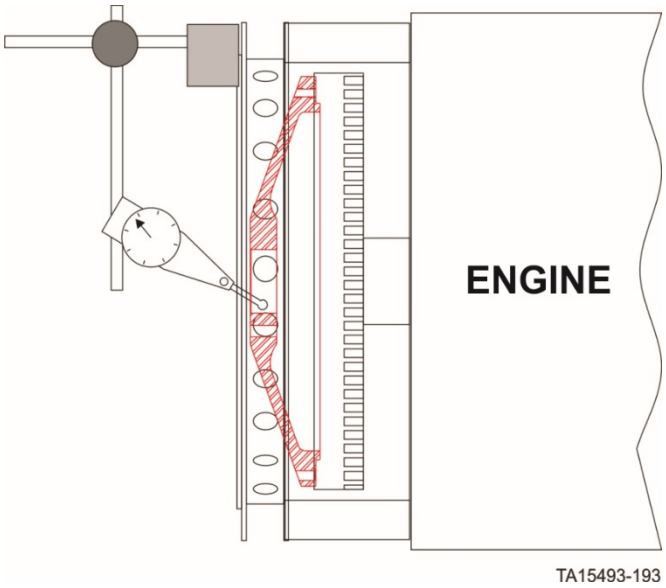
- Must be about .000 - .002. Tight fit.



Engine

Figure 116. Alignment of rotor adapter onto flywheel alignment

- Position the rotor adapter for minimum runout in the inner bore where it mounts to generator shaft.

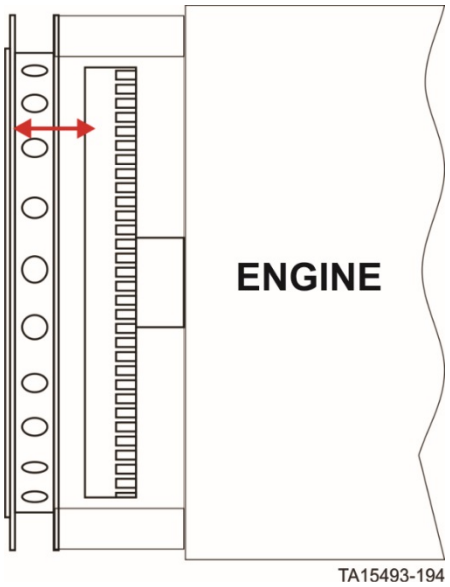


Engine

Figure 117. Alignment of rotor adapter onto flywheel

Set axial endplay

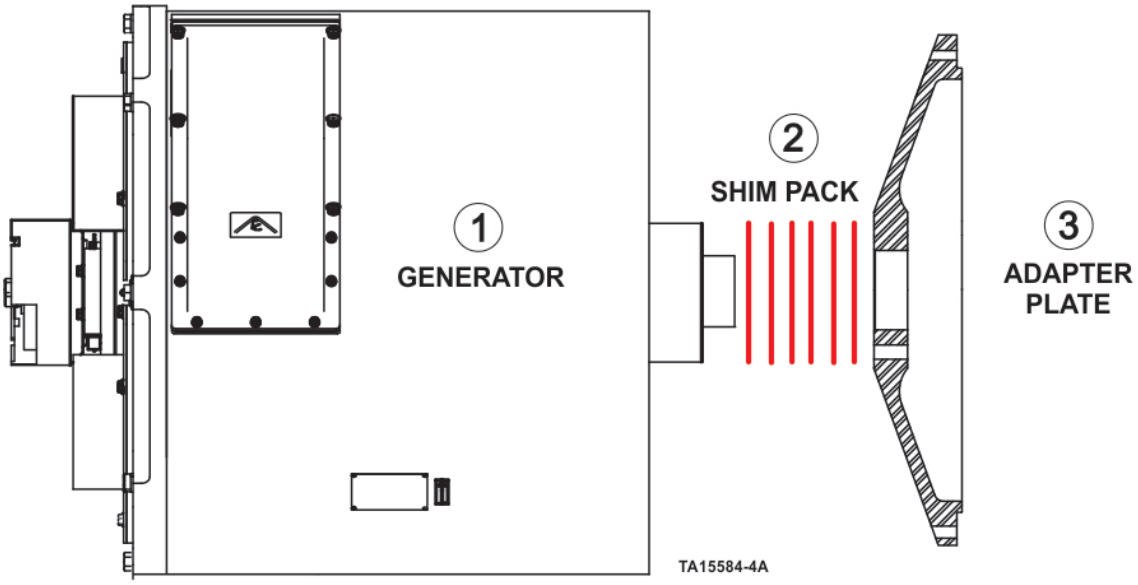
- Measure stator adapter to flexplate.



Engine

Figure 118. Measure stator adapter to flexplate

- Determine the proper shim pack so the generator bearing will be positioned in the middle of the endplay after assembly. This will assure that there is no generator loading on the engine thrust bearings. Use generator worksheet data.

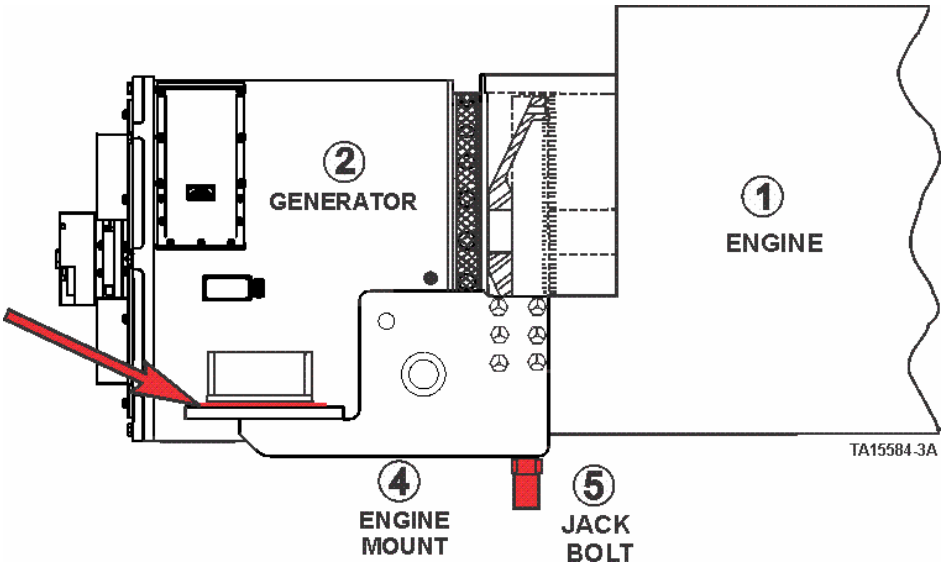


1) Generator, **2)** Shim Pack, **3)** Adapter Plate

Figure 119. Determine proper shim pack

Installation of generator

- Shim feet.
- Install bolts.

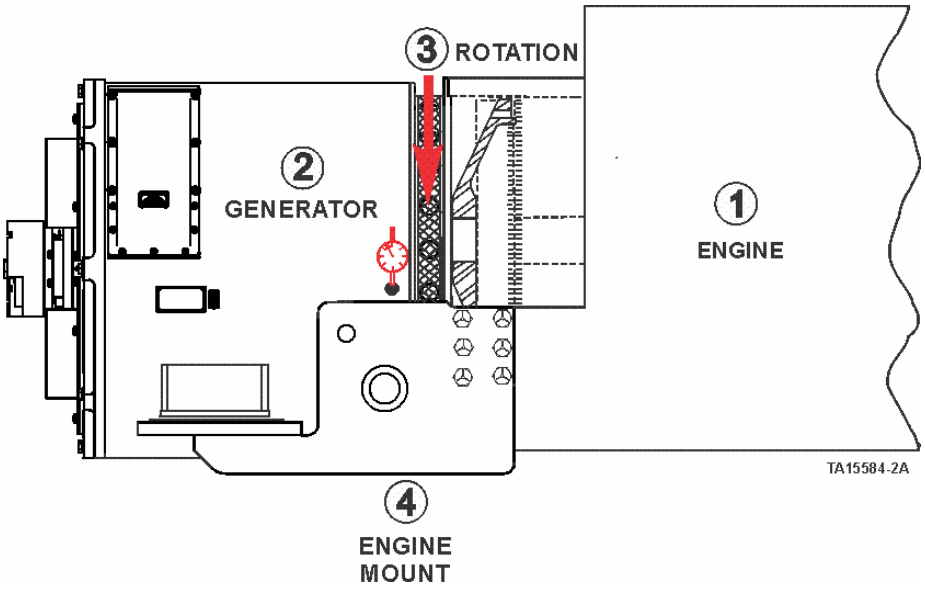


1) Engine, **2)** Generator, **4)** Engine Mount, **5)** Jack Bolt

Figure 120. Shim pack installation - feet

Final rotor shaft runout check

- Use a dial indicator to check rotor shaft runout.

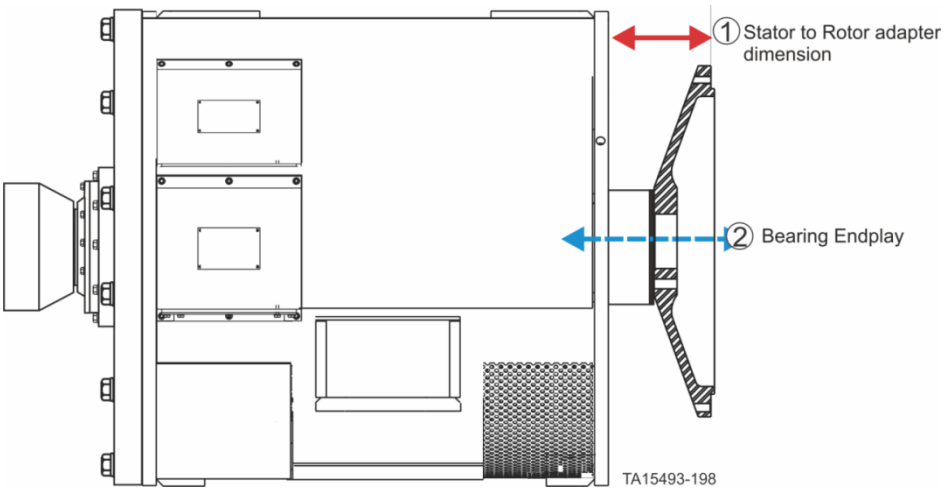


1) Engine, **2)** Generator, **3)** Rotation, **4)** Engine Mount

Figure 121. Rotor shaft runout check

Detailed Step by Step Instructions

Rotor Endplay and Stator/Rotor Adapter Measurements



1) Stator to rotor adapter dimension, **2)** Bearing endplay

Figure 122. Generator measurements

The rotor in a single bearing G100 generator is designed so that it can move approximately .050” maximum axially. This movement will compensate for differences in thermal expansion between the stator and rotor during normal operation of the generator. The endplay is derived from two areas: **1)** the internal clearance of the bearing and **2)** limited axial movement of the bearing in the endbell.

The goal of these measurements is to position the generator rotor in the center of its endplay when connected to the engine.

3. Check the engine end of the rotor shaft, the ID of the rotor adapter and the rotor shims to be sure that all mating surfaces are clean and free from any protective coatings or burrs.
4. Gather the standard number of rotor shims which are positioned between the rotor adapter and the shaft.

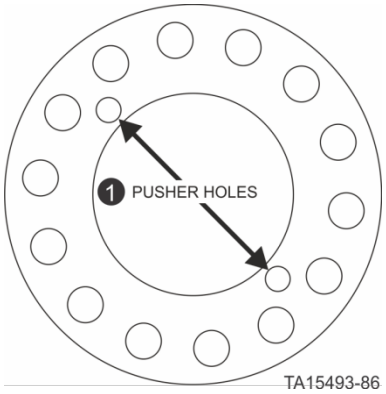
NOTICE

The number of shims in the standard shim pack is a typical average and is just a starting point for measurements and adjustments. This quantity is not critical as the specific quantity of shims required for a given alignment and generator installation will be adjusted at later step in this procedure.

Generator or Flywheel	Standard Shim Pack
G100 (SAE 0 and 00) (Tier 1 & Tier 2)	6 Each - (P/N R4164561) Large Diameter - .007” shims = .042”

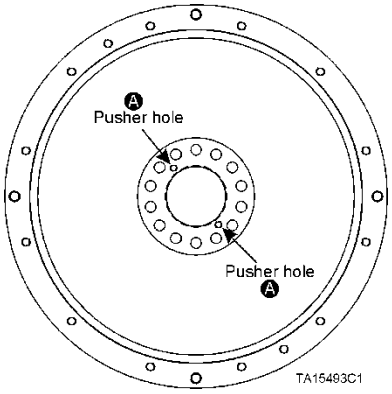
NOTICE

Assure that the two .531” diameter holes in the shim pack lineup with the pusher holes in the rotor adapter. Refer to illustration below for a diagram of the shims. If the holes are not aligned - the shims will be severely damaged when rotor adapter is removed from shaft.



1) Pusher holes - large diameter shims

Figure 123. Pusher holes - large diameter shims



A) Pusher hole locations

Figure 124. Pusher holes in rotor adapter - (typical)

5. Mount the rotor adapter and shims with the pusher holes aligned. This will prevent damage to the shims when the rotor adapter is removed.
6. Torque the 3/4" fasteners to 50 lb.-ft. (68 N ● m)
7. Obtain the rotor endplay and stator to adapter dimension using one of the following methods:

Endplay Measurements

NOTICE

The endplay is measured horizontally - the dimensions between stator and rotor adapter should always be taken horizontally.

1. Orient the generator horizontally.

2. Lift the rotor adapter/shaft slightly with a lifting strap on the drive end with a crane until the rotor is free and centered (not touching the stator bore).

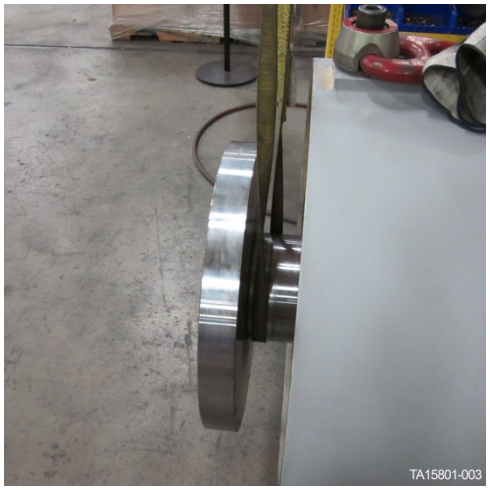


Figure 125. Lifting strap located on Drive End

CAUTION

Do not wrap any type of lifting equipment (chain, for example) around the shaft that might cause damage to the shaft. The shaft surface in this area must be undamaged and unmarked for use in the final checkout.

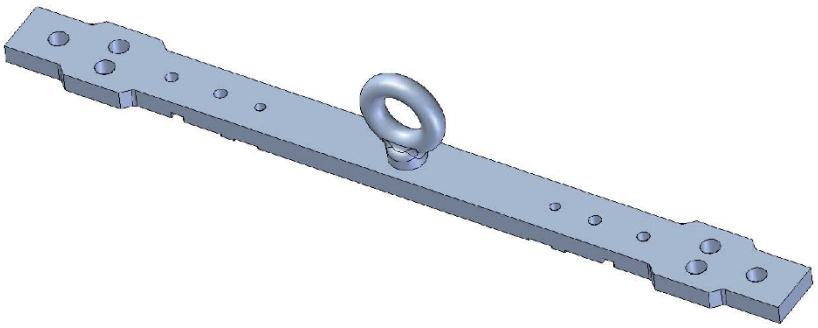
⚠ CAUTION

Crush hazard exists when supporting the rotor. If not properly supported, the rotor can fall. If a crane is not available to support the rotor - it is also permissible (but not required) - to support the rotor with the rotor endplay tools. Failure to properly support the rotor can cause crush hazards resulting in personal injury.

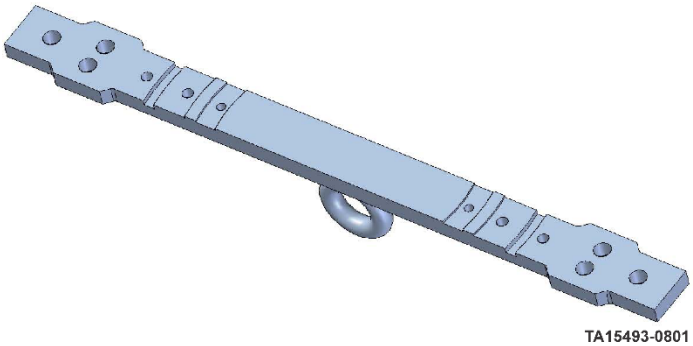
Figure 126. Rotor endplay tools

NOTICE

The current version of the rotor endplay tool (P/N R4186533), shown below, is recommended for use on the G100 generator.

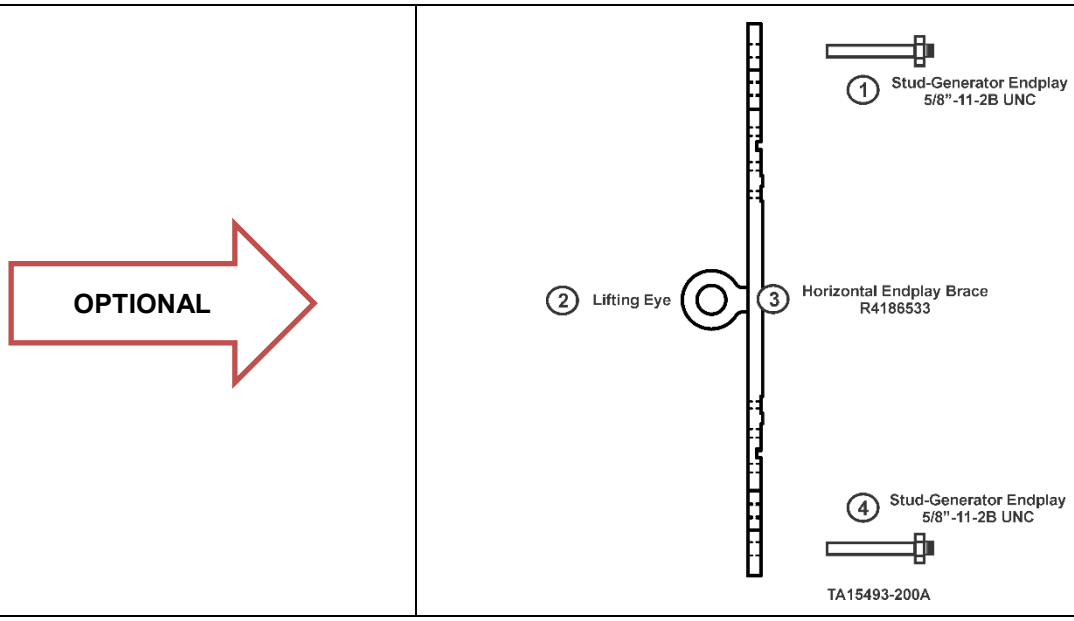


Top View



Bottom View

Figure 127. Horizontal Endplay Brace - 1 of 2



1) Stud - Generator Endplay, **2)** Lifting Eye, **3)** Horizontal Endplay Brace, **4)** Stud - Generator Endplay

Figure 128. Horizontal endplay brace

3. Install a large diameter lifting eye in the end of the rotor shaft on the non-drive end. This requires a lifting eye with 1" X 14 UNS threads.

NOTICE

For this purpose the eyes will NOT be used for lifting, so locally fabricated eyes would be acceptable - these eyes should be clearly marked that they are for rotor shifting only.

⚠ CAUTION

Crush hazards exist when lifting the rotor. Lifting equipment not certified for lifting can fail causing the component to fall. DO NOT use any locally fabricated eyes for lifting. Failure to use certified lifting devices can cause crush hazards from falling objects resulting in personal injury.

4. Remove one endbell bolt that is approximately horizontal or a little above and Install a large diameter eye.

Endbell		
G100	5/8-11 UNC thread	Length depends on endbell thickness
Rotor Shaft		
G100	1 - 14UNS thread	1 -1.5" thread engagement

5. Install a long bar through the eyes.

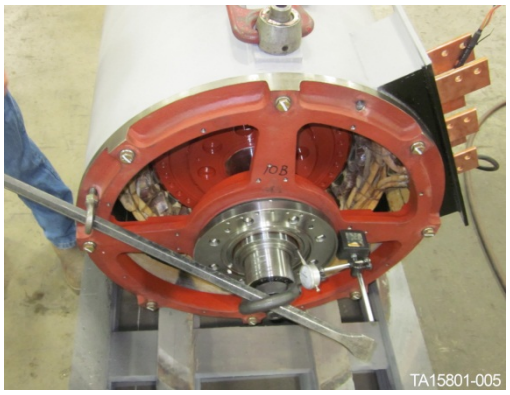


Figure 129. Pry bar

6. Mount a dial indicator on the non-drive end of the generator with the tip or button of the indicator resting against the face of the outer seal race as shown in illustration. Mount the magnetic base on the endbell near the bearing retainer. Adjust so that the dial indicator is measuring movement of the inner race (pressed onto the shaft).

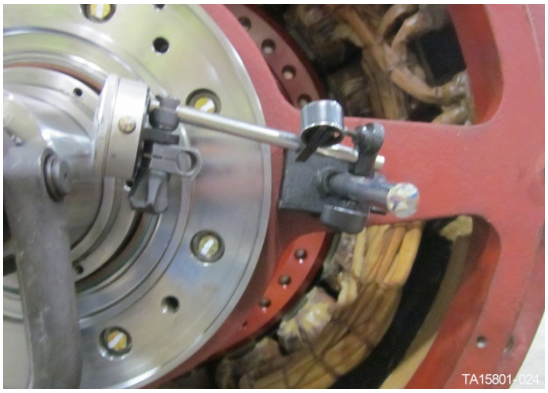
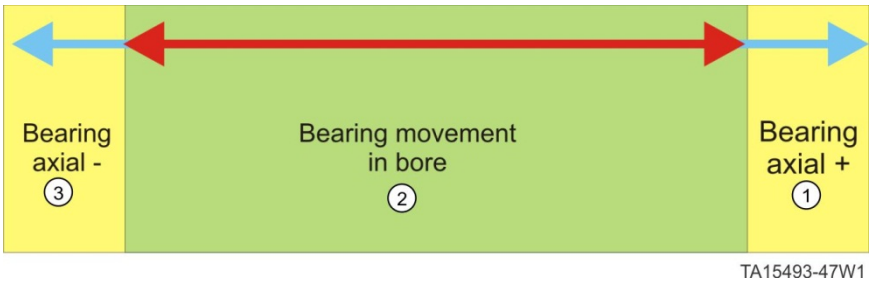


Figure 130. Dial indicator

7. Using the bar - shift the rotor all the way toward the non drive end.
8. Release the load from bar and zero the indicator.
9. Shift the rotor all the way toward the drive end of the generator.
10. Release load from bar and note the dial indicator measurement.
11. Repeat several times to verify that the number obtained is repeatable.

NOTICE

This measurement taken in this step is only looking for the bearing assembly movement in the endbell bore. The bearing has an internal axial endplay of about .020" to .030". It is normal to have a slight amount (.010-.015" maximum) of spring like movement due to the axial internal endplay of the bearing when the rotor has been fully shifted one way or the other. The bearing should center up when the load on the shifting bar is removed.



1) Bearing axial +, **2)** Bearing movement in bore, **3)** Bearing axial -

Figure 131. Bearing endplay - bearing movement plus bearing axial

12. Record the total endplay on line 1.1 of the Generator Installation Worksheet.

NOTICE

GEN 1 - Typical total rotor endplay in the horizontal position should be between .070" and .100".

GEN 2 - (Tier 1 & Tier 2) Typical total rotor endplay in the horizontal position for the G100 should be between .035 and .055.

Possible reasons for variance outside this range could be:

- Incorrect bearing.
- Endbell thickness incorrect.
- Bearing retainers damaged or incorrect.
- Gaskets not installed.
- Gaskets are too thick or too thin.
- Gaskets made from wrong material.

13. Shift the rotor all the way toward the non - drive end of the generator.

Figure 132. Shift rotor toward non drive end

14. Continue to support the rotor with the strap, or with the horizontal endplay brace, so that the rotor is centered in the stator.

15. Measure the distance between the face of the rotor adapter and the stator mount face using an inside micrometer and appropriate straight edge as shown in the illustrations.

NOTICE

The straight edge used for this inspection must have a perfectly flat surface and must not be bent or damaged.

CAUTION

<u>DO NOT</u> measure to the horizontal endplay brace as it typically will not have a flat surface. The horizontal endplay brace is not a straight edge.

Figure 133. Do not measure between endplay brace as it is most likely not a straight edge

Figure 134. Measurement between a straight edge and generator stator

16. Measure the gap at the top and bottom

17. Calculate the average.

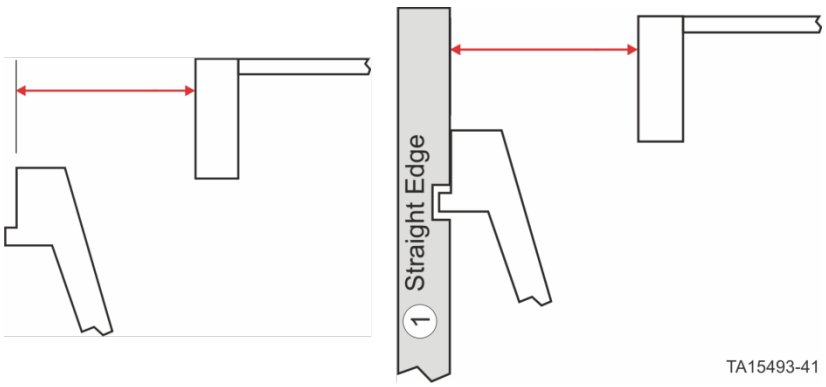
- (Top measurement + bottom measurement)/2

18. Record the average number on line 1.2 of the Generator Installation Worksheet labeled “Adapter to Stator Dimension”.

Figure 135. Measure "adapter to stator dimension" between face of rotor and face of generator pole ring

NOTICE

This dimension is from the mounting face surface to the flange on the stator. Some rotor adapters will have a mounting face as shown that can be checked with a standard flat edge. Others will have a face that is recessed behind a shoulder and will require either a special straight edge or extra math calculations.

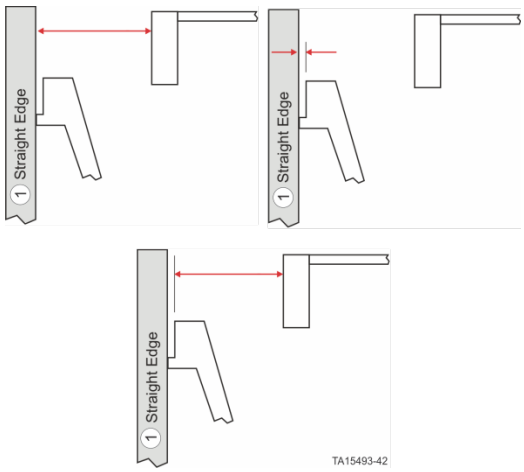


1) Straight edge

Figure 136. Measure "adaptor to stator dimension" between face of rotor adapter and face of generator pole ring- cone type rotor adapter with special straight edge tool

19. If the special straight edge tool is not available, the same measurement can be taken with a common straight edge - it just takes several steps. See the next figure.

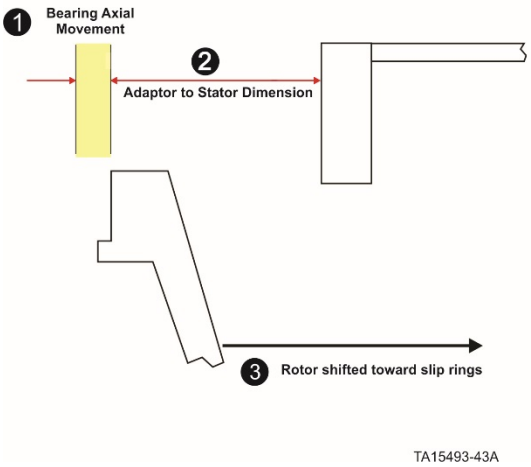
- Measure from the generator flange to the straight edge.
- Measure the gap between the straight edge and the mounting face of the rotor adapter.
- Subtract step b from step a.
- This is the desired measurement from the face of rotor adapter to face of generator flange.



1) Straight edge

Figure 137. Measure "adaptor to stator dimension" between face of rotor adapter and face of generator pole ring - cone type rotor adapter with common straight edge. Three steps required.

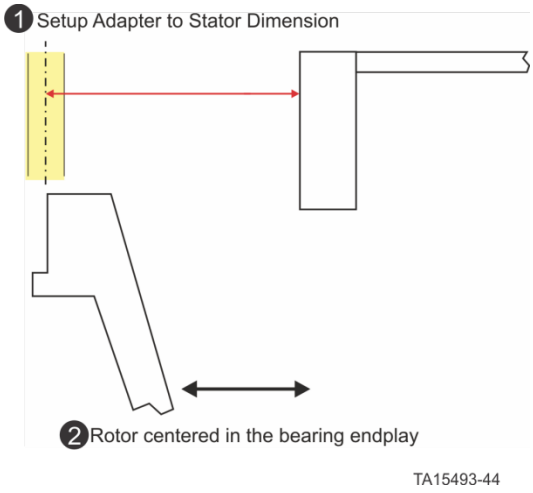
20. Add one-half of the total rotor endplay to the “Adapter to Stator Dimension” dimension.



1) Bearing axial movement, **2)** Adapter to stator dimension, **3)** Rotor shifted toward non drive end.

Figure 138. Adapter to stator dimension and bearing endplay

21. Record this “new” dimension on line 1.3 of the Generator Installation Worksheet labeled “SETUP ADAPTER TO STATOR DIMENSION”. This dimension is the distance between face on generator stator and rotor adapter - when the generator rotor is centered in middle of bearing movement.



1) Setup adapter to stator dimension, **2)** Rotor centered in the bearing endplay

Figure 139. Setup adaptor to stator dimension = "adapter to stator dimension" + 1/2 bearing endplay

Pre-installation Engine Checks and Setup

Pre-Installation Engine Checks and Setup

a. Remove the rotor adapter plate from the generator. The pilot diameter shown on the generator worksheet is for reference. Record the CMM (co-ordinate measuring machine) number on line 2.1 of the Generator Installation Worksheet.

b. Check the pilot diameter on the flexplate. Refer to the generator worksheet for the proper dimensions. Record the measurement obtained on line 2.2 of the Generator Installation Worksheet.

c. It is important that the rotor adapter plate bore and flexplate pilot shoulder be within tolerance. A slight interference fit is needed between these two parts to ensure proper alignment between rotor and crank. If the fit is within specifications, pulling the adapter plate onto the pilot shoulder with the bolts will typically be necessary (and push it off with the pusher holes). The pilot shoulder on the flexplate is designed to carry the weight of the rotor. The two dowel pins in the face of the flexplate are a loose fit in the rotor adapter for guidance purposes only. If these pieces do not have the correct tight fit - replace the defective component - or correct the fit.

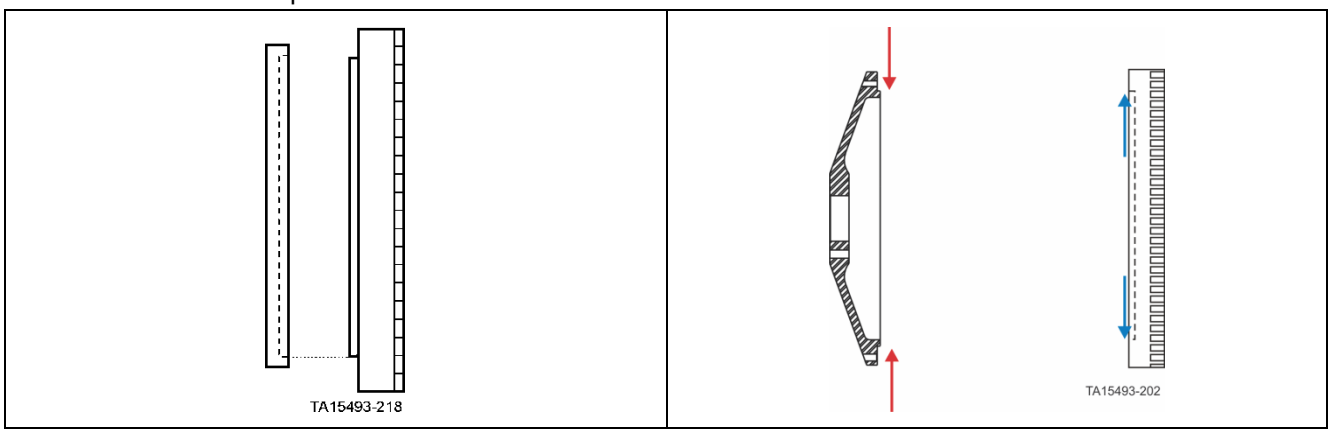


Figure 140. Measure diameter on rotor adapter and flexplate - (1 of 2)

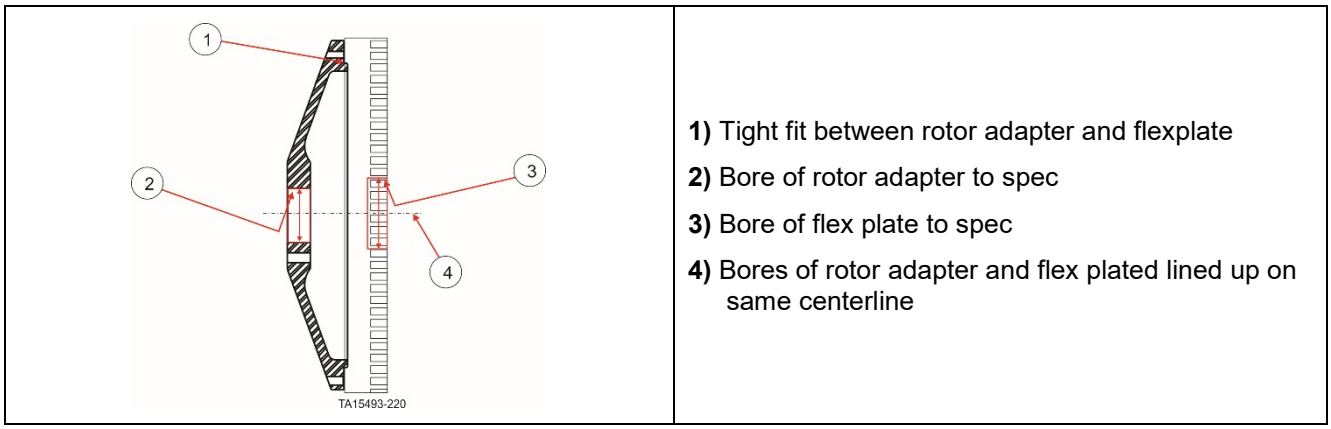


Figure 141. Measure diameter on rotor adapter and flexplate - (2 of 2)

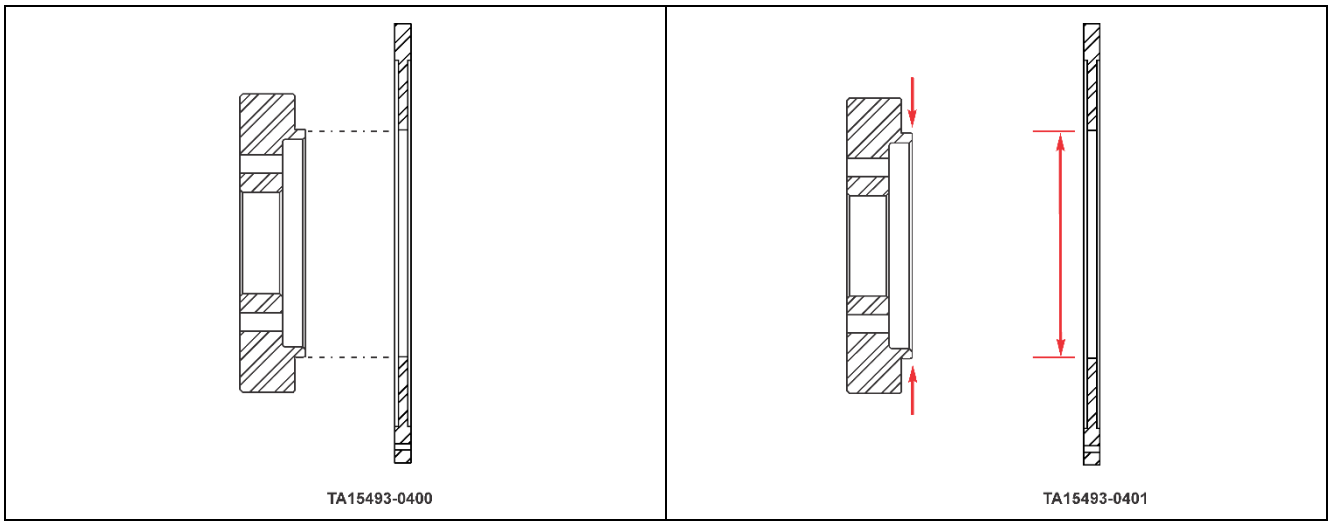
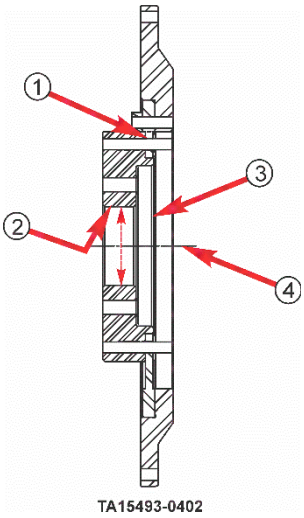


Figure 142. Measure Diameter on Rotor Adapter and Flexplate - MTU Tier 2 - 1 of 2



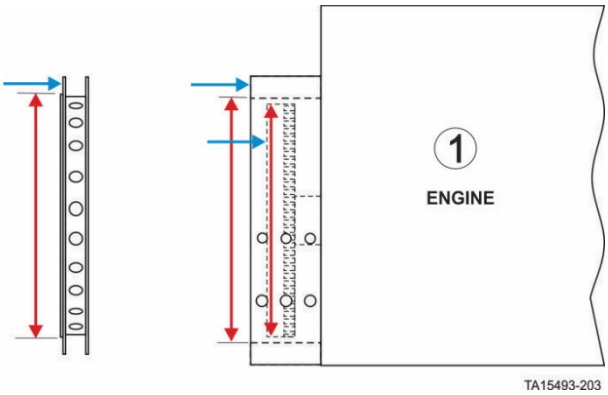
1) Tight fit between rotor adapter and flexplate

2) Bore of rotor adapter to spec

3) Bore of flex plate to spec

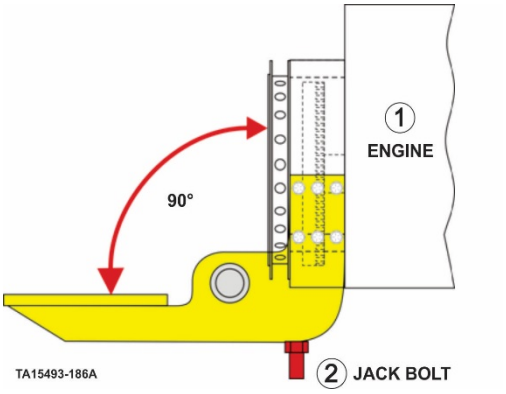
4) Bores of rotor adapter and flex plated lined up on same centerline

Figure 143. Measure Diameter on Rotor Adapter and Flexplate - 2 of 2



1) Engine

Figure 144. Pre-installation inspections - (1 of 2)



1) Engine, **2)** Jack Bolt

Figure 145. Pre-installation inspections - (2 of 2)

NOTICE

It is recommended that all steps be followed each time a generator is installed to assure that job is done properly.

d. Ensure that the engine flexplate, flywheel housing, stator adapter plate, stator frame mounting face and rotor adapter face are clean and free from any dirt or protective coating. Pay particular attention to the various pilot diameters to ensure that they are free from nicks and burrs.

Figure 146. Clean all mounting faces and shoulders

e. Ensure that the mating faces on the engine mounts and the flywheel housing are clean and free from paint and oil. Run a tap through each of the tapped holes on the flywheel housing.

f. Ensure that the face on the engine mounts arm and flywheel housing are flat and free from machine marks.

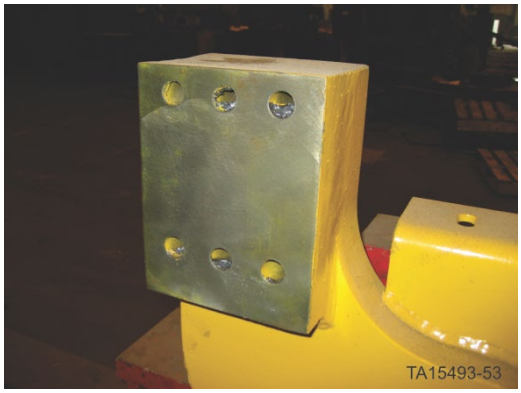


Figure 147. Clean mounting faces on the engine mounts and flywheel housing

g. If you have an engine support stand - the engine mounts and the front engine support can be mounted to the stand.

h. Support the engine at the front - near the front mount and at the rear - near the mounts at the flywheel housing.

i. Install both rear engine mounts. The engines have a flat clamp surface. There are no precision shoulders that the mounts sit against.

j. Ensure that the mounts are pushed tight against the shoulders provided on the flywheel housing and the bolts are properly torqued. This only applies to engines that have a shoulder as shown.

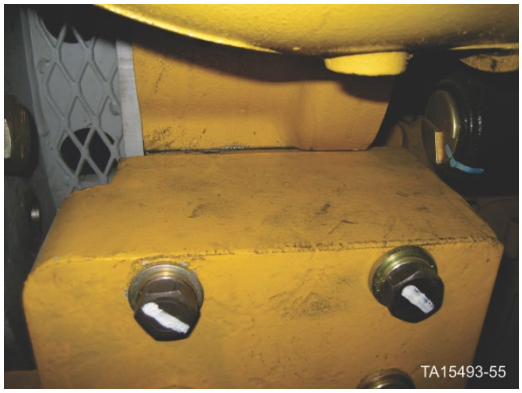


Figure 148. Mounts pressed tight against the shoulders on flywheel housing

k. Tighten bolts

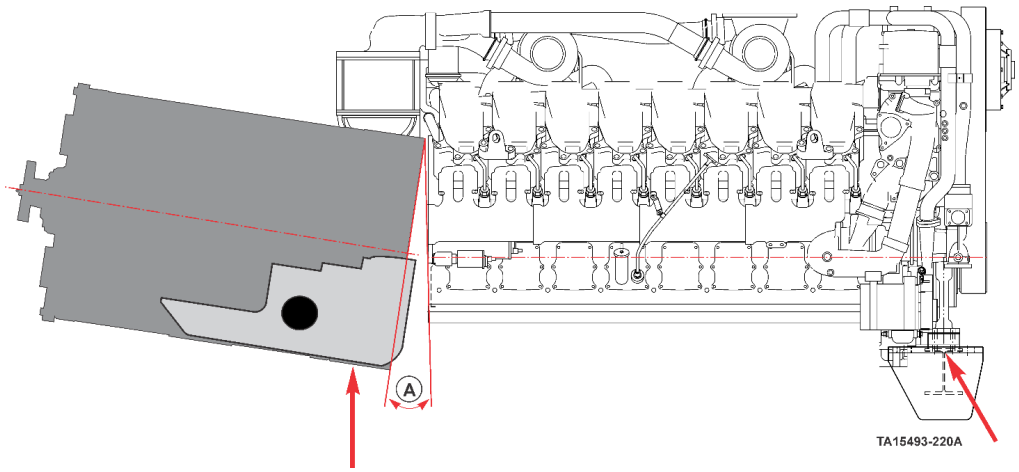
		Torque Dry		Torque lubricated	
MTU 2000/4000	M16-6 mm x 10.9	230 lb-ft	313 N●m	173 ft-lb	235 N●m
Cummins QST30, QSK45, QSK 60 MTU 16V 4000 Stiffener	M20-20 mm x 10.9	450 lb-ft	610 N●m	338 ft-lb	456 N●m
Cummins QSK38	3/4-10 G8	376 lb-ft	510 N●m	282 ft-lb	383 N●m

I. Position a jack bolt directly under each engine mount. These jack bolts are required to support the load on the flywheel housing until the generator has been installed. Continue to support the rear of the engine in this fashion throughout the installation. This should be accomplished in all cases of generator installation - those completed on a stand and also, those completed in the machine.

Figure 149. Jack bolt placed directly under the engine mount

NOTICE

Failure to support the mounts/engine with jack bolts will cause problem with alignment and can cause flywheel housing oil leaks particularly on MTU/Detroit series 4000 engines.



Red arrows indicate where supports should be located

A) Distance greatly exaggerated in illustrations

Figure 150. Misalignment problem caused by failure to properly support the engine and generator

m. Check the runout of the pilot diameter on the flexplate. Use a dial indicator mounted on the flywheel housing. Rotate the flexplate from the front of the engine. Refer to the Generator Installation Worksheet for the maximum allowable T.I.R. Record the measurement obtained on line 2.3 of the Generator Installation Worksheet.

n. If the flexible T.I.R. is higher than the limit, the problem should be corrected before proceeding with the alignment procedure. Contact your local engine distributor to obtain another flexplate. Most engines will be rotated from the starter end. This is done with a rotation tool.

Installation of Engine Rotation Tool

Rotating Engine Crankshaft from the Front of the Engine

NOTICE

Early versions of the Tier 1 engines allowed for the rotation of the engine crankshaft from the front of the engine. With the newer model engines this is no longer an acceptable practice because of the factory installed cover.

NOTICE

Rotating from the front of the engine is the preferred method for the earlier vesion of the tier one engine. The engine must be rotated in the direction that will tighten the bolt. Forward engine rotation will require a torque multiplier, and this method will reduce the flexplate distortion that occurs when the engine is rotated via the manual drive gear typically provided (refer to illustration "Rotate engine crankshaft with manual drive gear").

a. Remove the crankshaft grounding strap from the front of the engine.

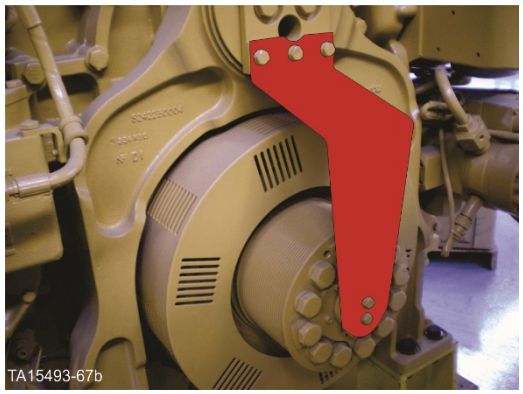
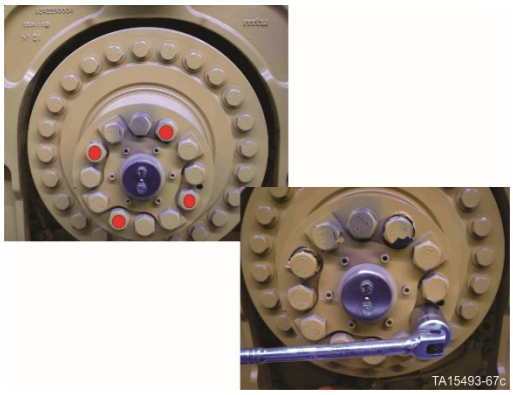


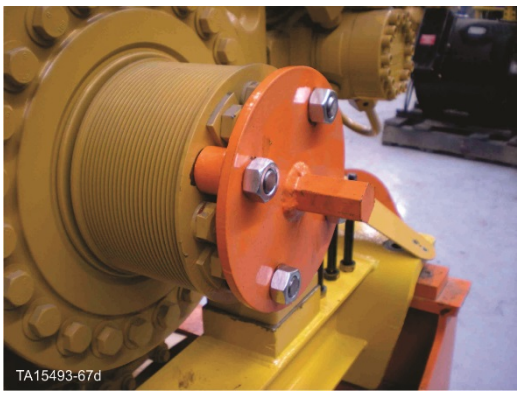
Figure 151. Crankshaft grounding strap - typical

b. Remove four of the 10.9 M20-2.5 bolts from the engine's crankshaft pulley, one every 90°.

c. Leave the engine grounding strap adapter on the engine's crankshaft pulley.



d. Install the indexing tool LET (P/N 1037405); using four 250mm long M20-2.5 bolts or M20-2.5 all thread studs and nuts, as illustrated in the graphic below.



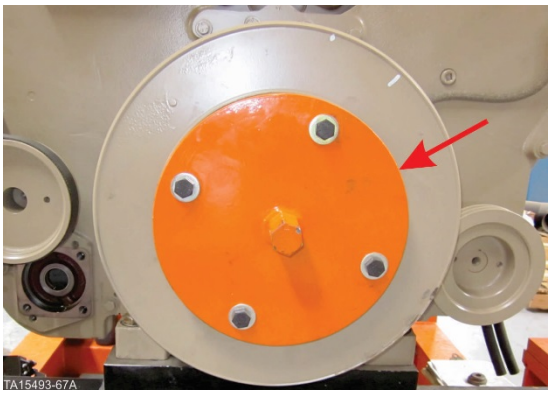
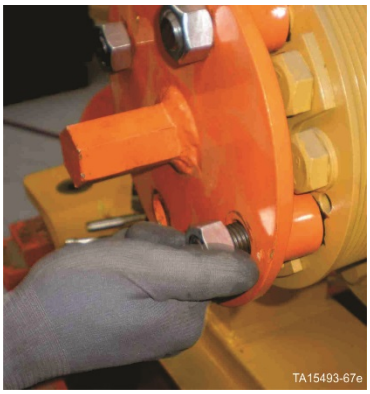


Figure 152. Rotating engine crankshaft from front of engine

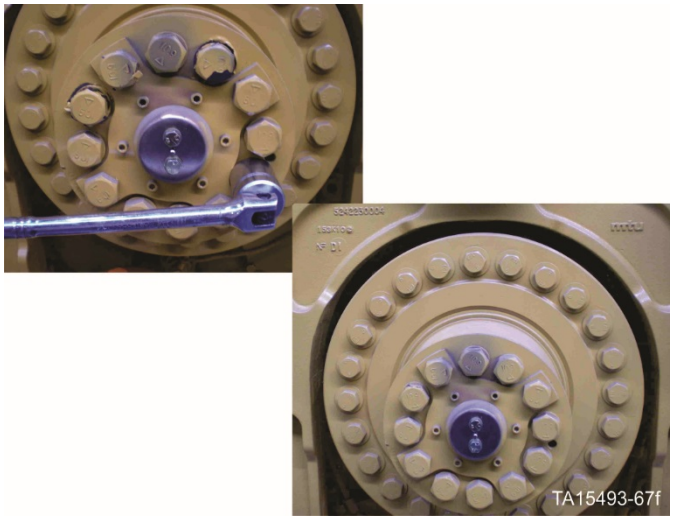
NOTICE

Remove tool after engine rotation process is no longer required.

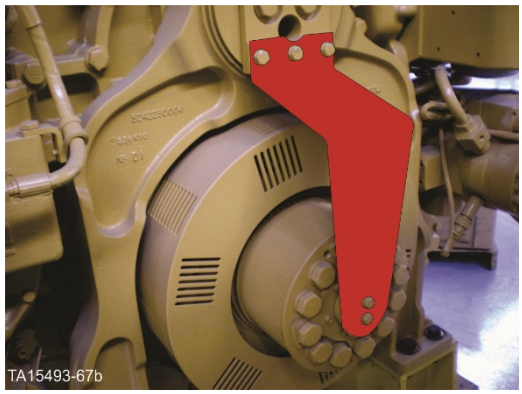
e. Remove the four 250mm long M20-2.5 bolts or M20-2.5 all thread and nuts and remove the tool.



f. Reinstall the original 10.9 M20-2.5 bolts and torque to the specified torque called for from the Detroit Diesel service manual. (500-550 N•m - none lubed)



g. Reinstall the crankshaft grounding strap on the front of the engine.



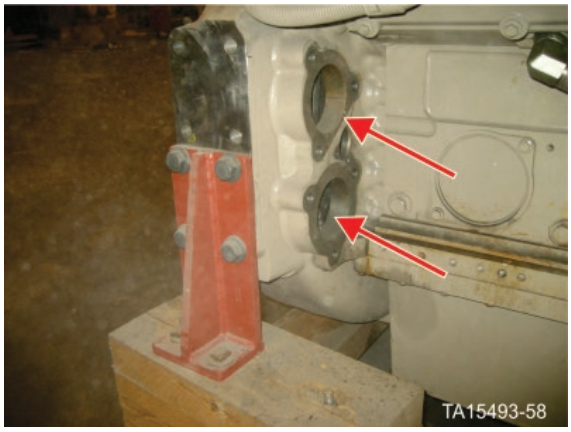
Rotating the Engine Crankshaft with Manual Drive Gear

While it is not recommended, some engines might be rotated from the starter end. This is done with an engine rotation tool that engages the teeth of the flywheel.

NOTICE

Rotating from starter end can cause the flexplate to "flex" and affect the axial and radial readings.

a. Remove the cover from the rear of the engine that allows access to the clearance holes in the flexplate. Where necessary, also remove the starter.



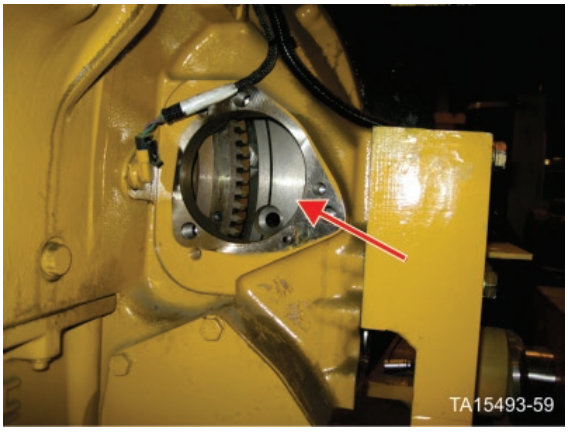


Figure 153. Remove cover/starter to access back side of flexplate

b. Cummins engines are normally provided with a rotation tool.

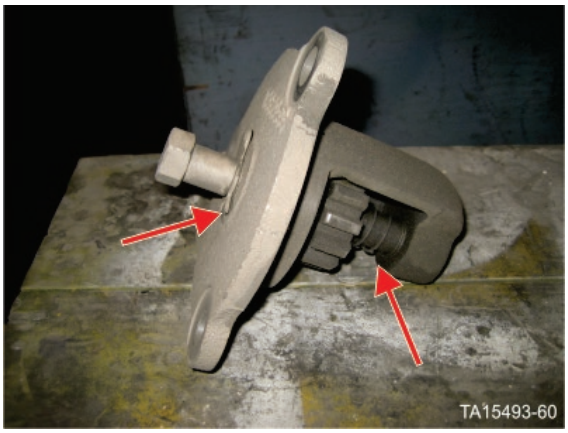


Figure 154. Cummins engine rotation tool - retainer and spring

c. The tool is normally held in the out position with a retainer ring so it does not contact the flexplate gear. It is also spring loaded to keep it away from the flexplate gear.

CAUTION

Put the retainer ring on the engine rotation tool back in place after using.

d. The bolt has to be pushed in and held in place when rotating. This will typically require a small spacer inside the socket to assure it is fully pressed in.

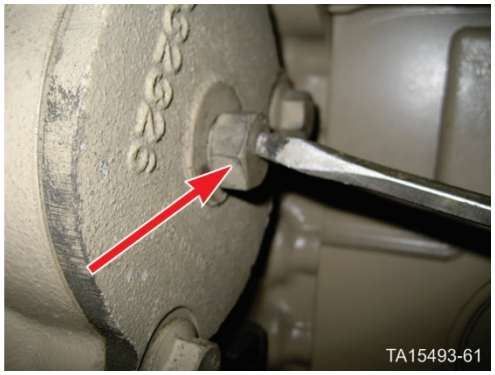


Figure 155. Cummins engine rotation tool

e. Commercial tool is available from Detroit dealers that will turn both Cummins and Detroit engines. Contact your Detroit dealer for more information.

CAUTION

The engine rotation tool must be removed from the engine after each use.

Figure 156. Engine rotation tool

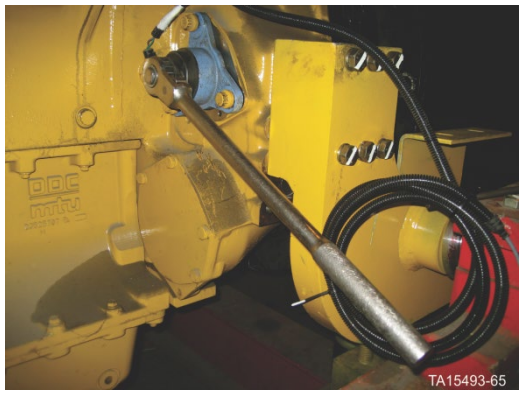
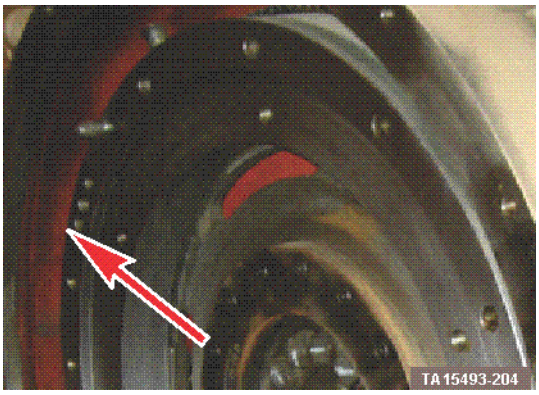


Figure 157. Rotating engine crankshaft with manual drive gear

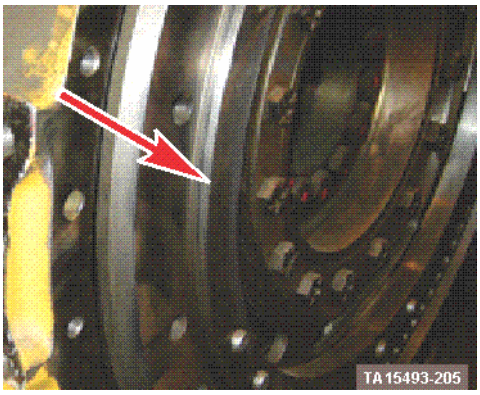
f. Check the radial runout of the flexplate shoulder.

NOTICE

This could be either an external or internal shoulder depending on type of flexplate.



Internal shoulder



External shoulder

Figure 158. Flexplate with either an internal or external shoulder

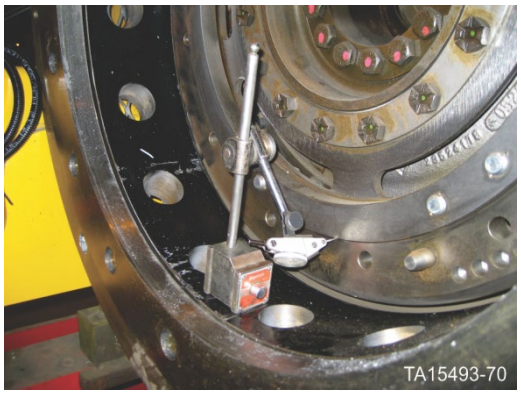


Figure 159. Measurement of radial runout of engine flexplate

NOTICE

The Tier 2 DD/MTU engine has a different flywheel setup from previous engines. The flywheel is a solid piece of steel with no flex package. The steps for alignment are the same as you must check the ID diameter and runout of the shoulder. You must also check the axial runout.

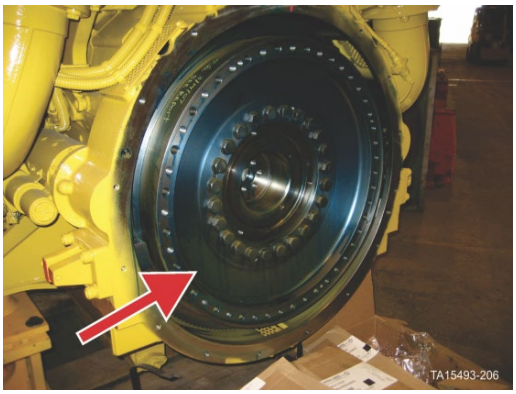
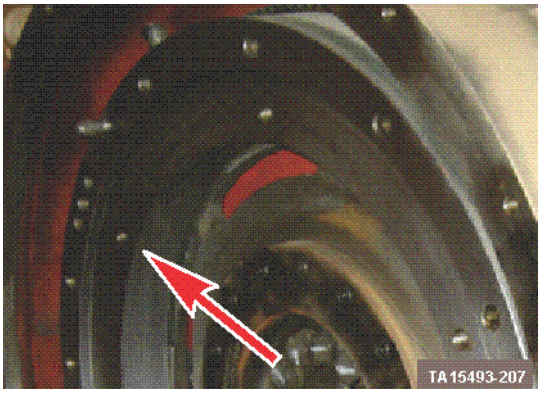


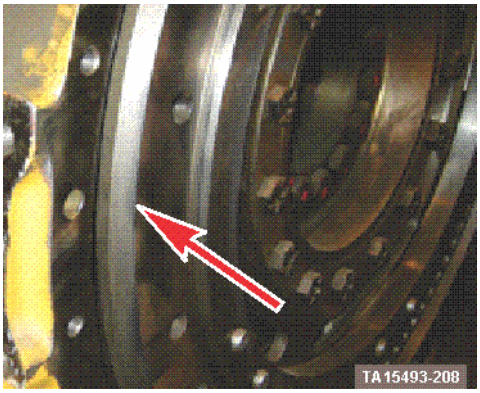
Figure 160. Measurement of radial runout of engine flywheel - Tier 2 DD/MTU

g. A mirror may be required in order to read the dial indicator depending on the type of dial indicator that is used.

h. Check the axial runout of the mating face (the surface that mates with the rotor adapter) of the flexplate. Simultaneously monitor the axial endplay of the crankshaft to ensure a true axial runout is being taken. This is done by placing a second indicator on the front of the engine block and measuring to the front of the crankshaft.



Internal shoulder



External Shoulder

Figure 161. Flexplate with either an internal or external shoulder

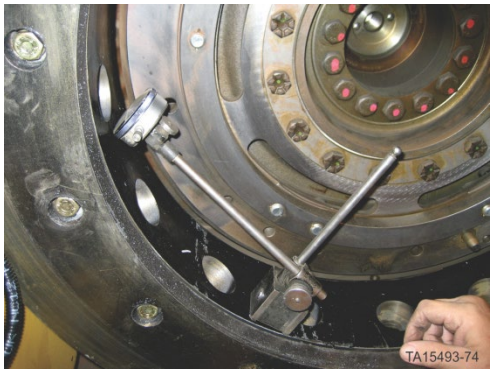


Figure 162. Measurement of axial runout of engine flexplate mating surface

i. Add the two dial indicator readings as the maximum and minimum readings are taken. Refer to the generator installation worksheet for the maximum allowable axial runout. Record the measurement obtained on line 2.4 of the Generator Installation Worksheet.

NOTICE

This number can be high for various reasons: Flex package permanently flexes or movement of flexplate from using flywheel turn tool. Data must be analized to know if flexplate is bad or simply sprung.

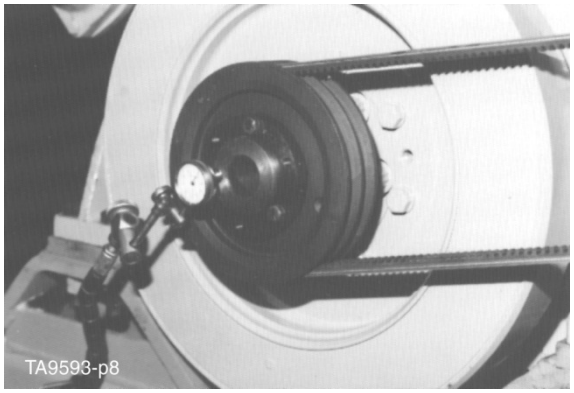


Figure 163. Dial indicator on front of crankshaft

Example: Both dial indicators were set to zero at the starting position and the crankshaft was rotated. Illustration "USING TWO DIAL INDICATORS FOR AXIAL CHECKS" summarizes the readings of both dial indicators.

Crankshaft Rotation	Crankshaft Indicator Reading	Flexplate Indicator Reading	Actual Flexplate Axial Runout
start	.000	.000”	.000”
1/8 revolution	.001”	-.002”	-.001“
1/4 revolution	.000”	-.002”	-.002”
3/8 revolution	-.001”	-.003”	-.004” (min)
1/2 revolution	-.002”	-.001”	-.003”
5/8 revolution	-.003”	-.001”	-.002”
3/4 revolution	-.003”	.003”	.000”
7/8 revolution	-.004”	.005”	.001” (max)
1 revolution	-.004”	.004”	.000”

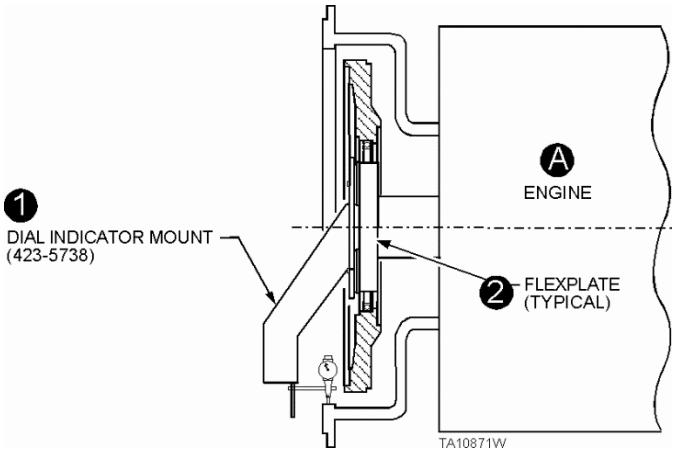
In this example, the minimum reading was -.004” at 3/8 revolution, and the maximum reading was .001” at 7/8 revolution. The total axial runout is .005”.

NOTICE

If the sum of the dial indicators after one full revolution of the crankshaft does not add to zero, one of the indicators has moved and the axial runout must be checked again.

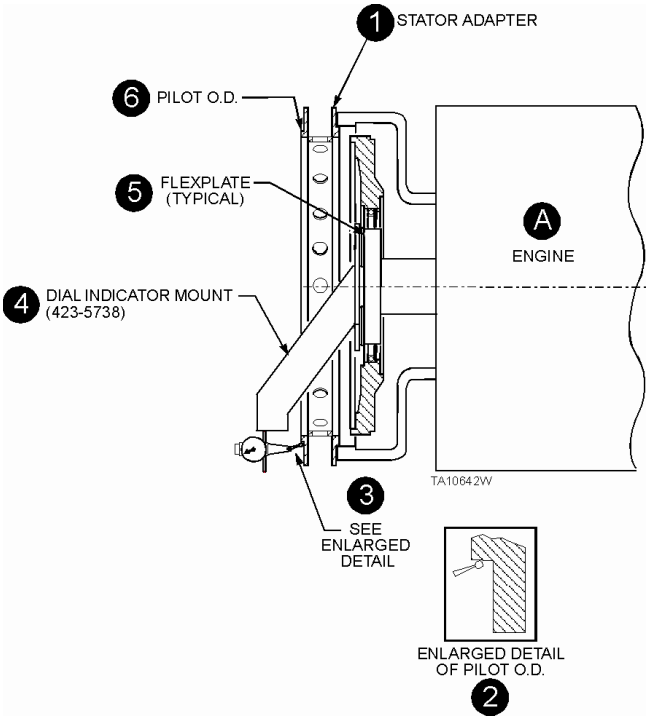
Figure 164. Using two dial indicators for axial runout

j. Fasten the dial indicator-mounting fixture to the face of the crankshaft. Position the dial indicator button so that it rests against the bore I.D. on the flywheel housing, and manually rotate the engine crankshaft from damper end of engine. The maximum radial runout should not exceed the value listed on the Generator Installation Worksheet. Record the radial measurement obtained in this step on line 2.5 of the Generator Installation Worksheet.



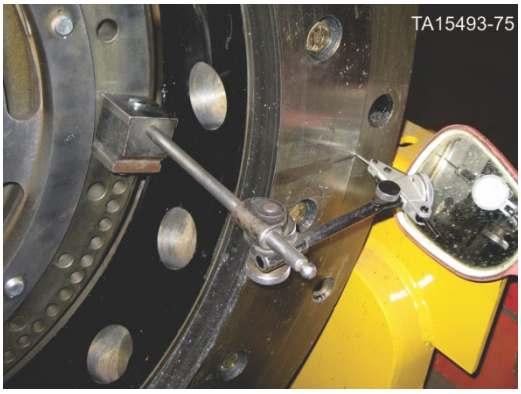
1) Dial indicator mount, **2)** Flexplate – typical, **A)** Engine

Figure 165. Radial runout of adapter - (1 of 3)



1) Stator adapter, **2)** Enlarged detail of pilot outside diameter, **3)** See enlarged detail, **4)** Dial indicator mount, **5)** Flexplate – typical, **6)** Pilot outside diameter, **A)** Engine

Figure 166. Radial runout of adapter - (2 of 3)



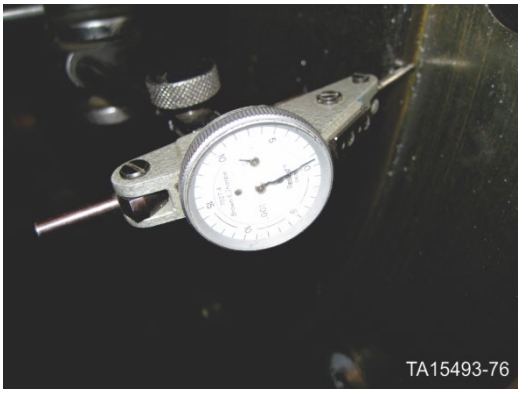
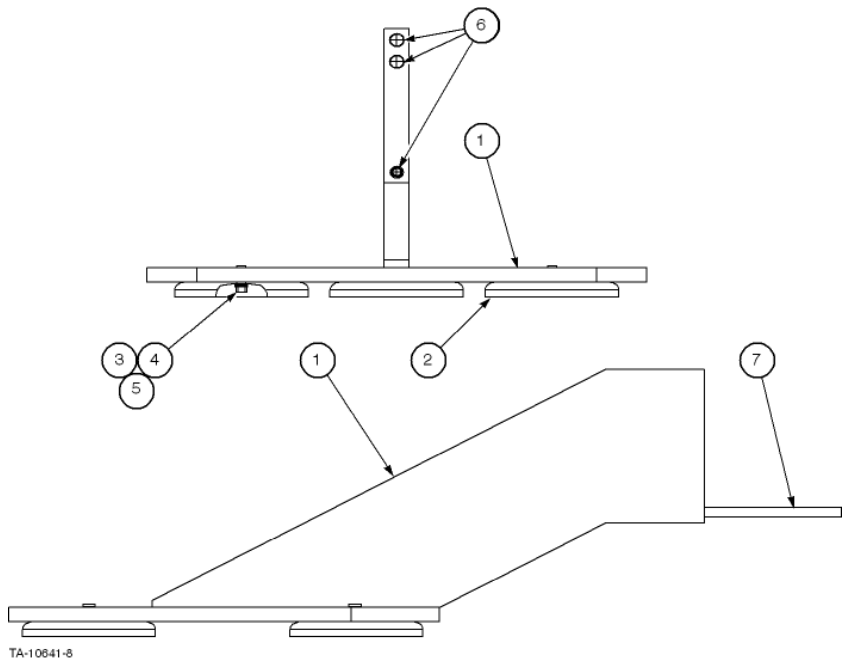


Figure 167. Radial runout of adapter - (3 of 3)



1) Structure
2) Magnet typical three (3) places
3) Bolt
4) Flatwasher
5) Lockwasher
6) E-Z Lok insert
7) Mounting post

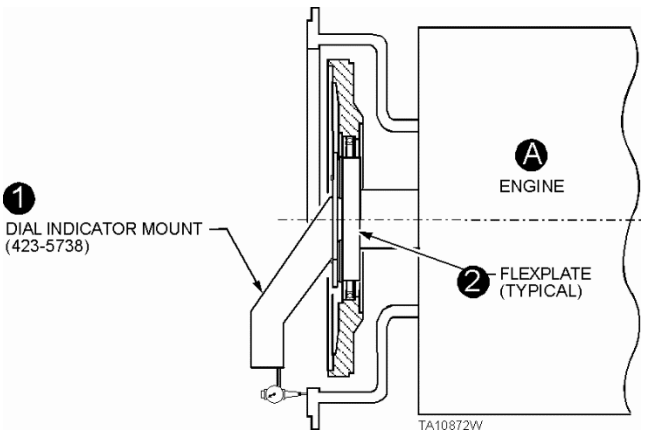
k. Reposition the button so that it rests axially against the mounting face of the flywheel housing. Locate another dial indicator at the front of the engine positioned with the button as close to the center of the crankshaft as possible. Rotate the engine in the same manner as discussed in paragraph “j”. Verify that the maximum axial runout is less than the value listed on the Generator Installation Worksheet, line 2.6. Monitor both indicators to detect how much the crankshaft is moving axially (“walking”) and how much of the reading is true runout. Record the axial measurement obtained in this step on line 2.6 of the Generator Installation Worksheet.

l. Mount the stator adapter and properly torque the bolts. Visually verify that there is no interference between the adapter and the rear engine mounts.

m. Repeat Steps “k” and “l”. for the stator adapter plate and record the readings on lines 2.7 and 2.8 on the Generator Installation Worksheet. Rotate the adapter as required to obtain readings that are within tolerance.

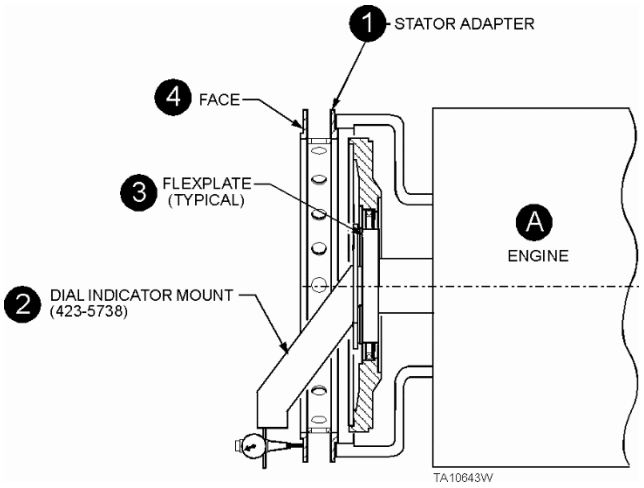
NOTICE

This number can be high for various reasons: Flex package permanently flexes or movement of flexplate from using flywheel turn tool. Data must be analized to know if flexplate is bad or simply sprung.



1) Dial indicator mount, **2)** Flexplate – typical, **A)** Engine

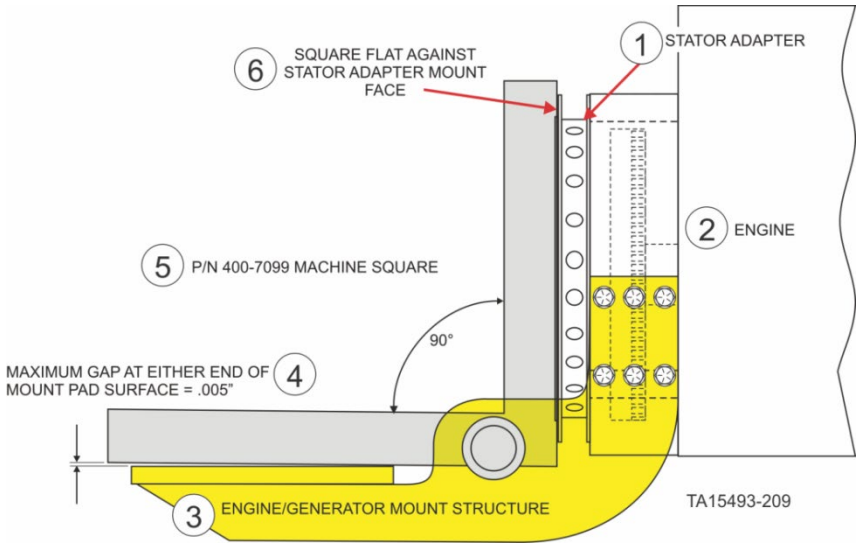
Figure 168. Axial runout of adapter



1) Stator adapter, **2)** Dial indicator mount, **3)** Flexplate, **4)** Face, **A)** Engine

Figure 169. Axial runout of stator adapter

n. Check the perpendicular alignment of the rear engine mount to the stator adapter plate as shown in illustration. Place a large square against both mounting surfaces. Using a feeler gauge, check for any gaps larger than .005” between the square and the mounting surfaces. If a gap of over .005” exists, the engine mounts must be shimmed or machined. This measurement is critical, as excessive angular misalignment between engine and generator will cause excessive vibration. Record the measurement obtained for left and right mount on line 2.10 of the Generator Installation Worksheet.

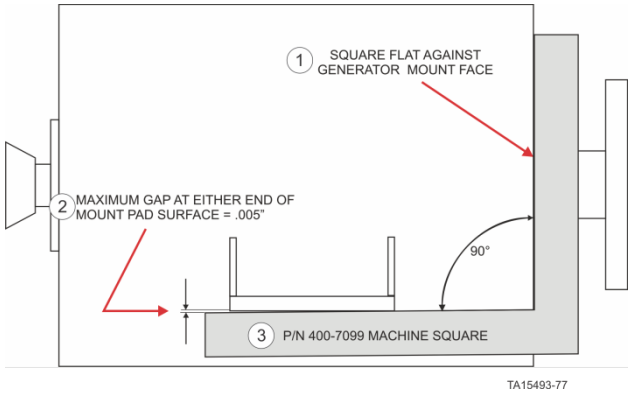


1) Stator adapter, **2)** Engine, **3)** Engine/Generator mount structure, **4)** Maximum gap at either end of mount pad surface = .005”, **5)** Machine square, **6)** Square flat against stator adapter mount face

Figure 170. Check perpendicular alignment of mount feet and stator adapter - (1 of 2)

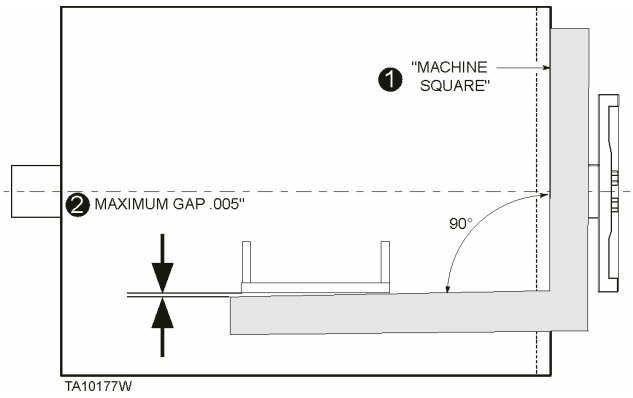
Figure 171. Check perpendicular alignment of mount feet and stator adapter - (2 of 2)

o. Remove all burrs from generator feet with a file. Check the alignment of the generator mount feet and the stator mount face as shown in. Place a large square against both mounting surfaces. Using a feeler gauge, check for any gaps larger than .005” between the square and the mounting surfaces. If a gap of over .005” exists, the generator mount foot must be machined. Record the measurement obtained for the left and right mount feet on line 2.6 of the Generator Installation Worksheet.



1) Square - flat against generator mount face, **2)** Maximum gap at either end of mount pad surface = .005”

Figure 172. Checking alignment of generator feet - (1 of 2)



1) Machine square, **2)** Maximum gap .005”

Figure 173. Checking alignment of generator feet - (2 of 2)

Alignment of Rotor Adapter onto Flywheel

NOTICE

A tight fit (approximately .001” interference) is required between the engine flexplate and the rotor adapter to ensure proper alignment between rotor and crank. If the fit is within specifications, pulling the adapter plate onto the pilot shoulder with the bolts will typically be necessary (push it off with the pusher holes). If it fits together easily - it is probably too loose. The pilot shoulder on the flexplate is designed to carry the weight of the rotor.

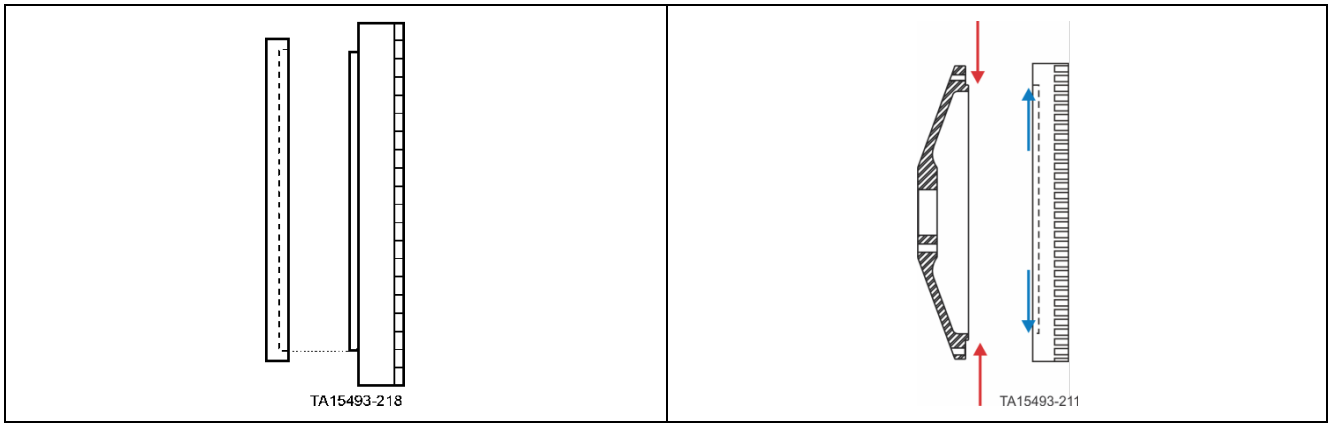


Figure 174. Tight fit

1. Install the rotor adapter to the flexplate using four evenly spaced fasteners. Carefully apply a small amount of SAE 30W motor oil to the pilot bores of stator adapter plate and the rotor adapter plate. Be sure that the face of the rotor adapter is free from protective coatings, nicks and dirt and will fit tightly against the face of the flexplate. Note that there are four possible orientations of the rotor adapter relative to the flexplate because there are four holes in the adapter to accept the two dowel pins in the flexplate. Distinctively mark the orientations on the rotor adapter with a grease pencil (“1”, “2”, “3”, and “4”) with reference to one of the flexplate dowel pins.

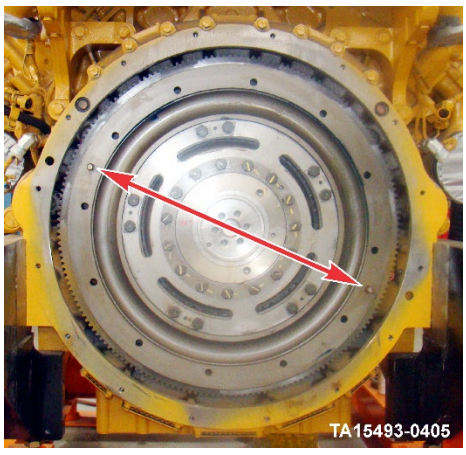


Figure 175. Dowel Pin Locations in Flexplate - Typical

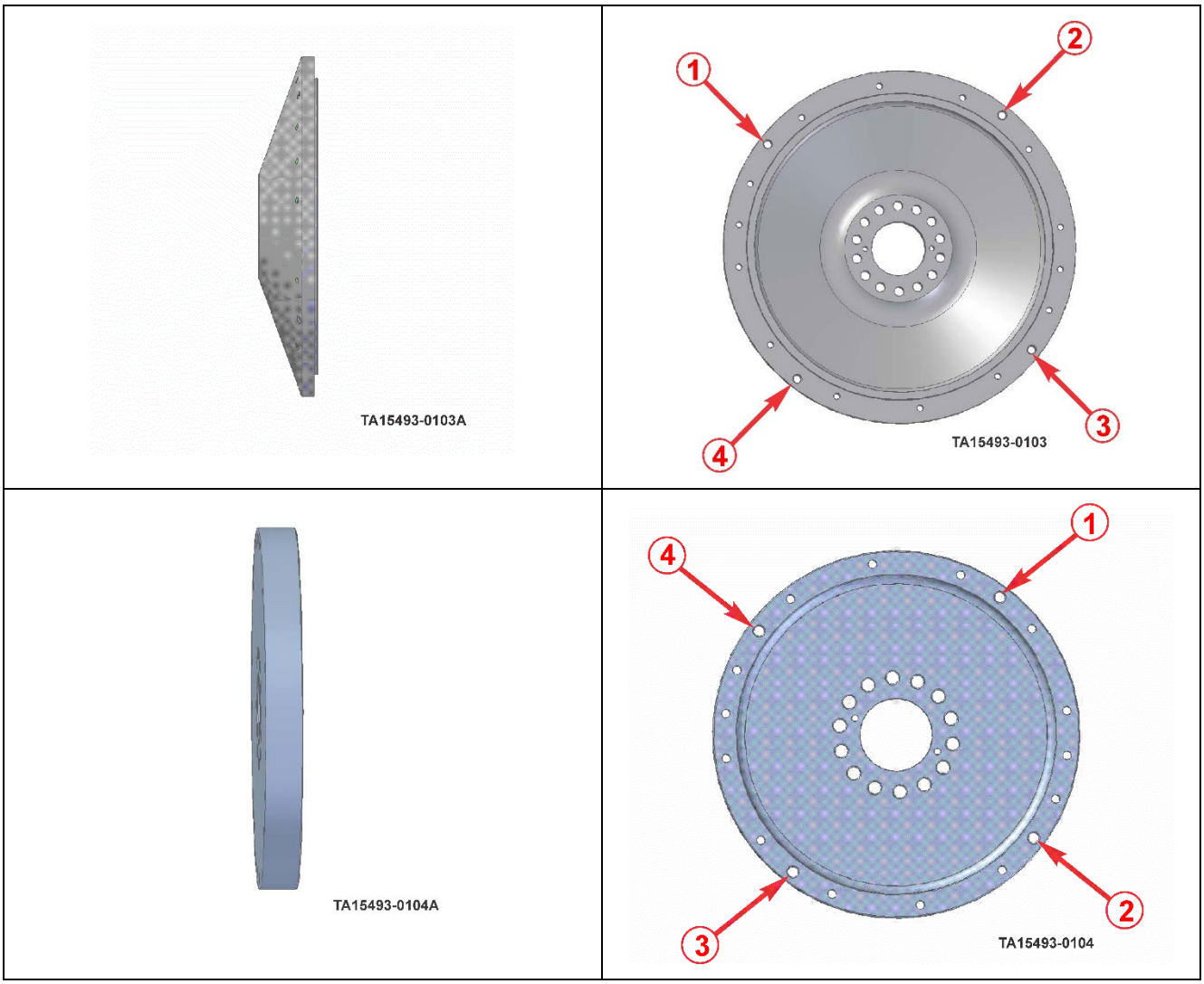


Figure 176. Dowel Pin Locators in Rotor Adapters

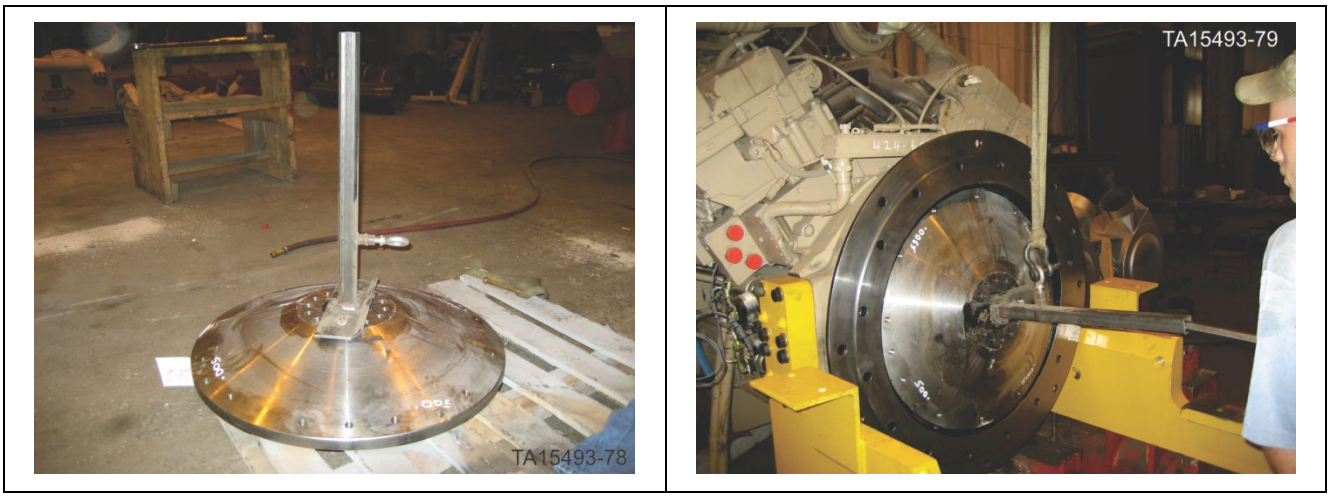


Figure 177. Lift and install rotor adapter

2. Check the runout of the I.D. of the rotor adapter. Mount a dial indicator on an extension bar bolted to the stator adapter plate. When possible, rotate the flexplate from the front of the engine. Record the measured T.I.R. on the rotor adapter by No. 1 and also on the worksheet. Record the measurement obtained in this step on line 3.1 of the Generator Installation Worksheet.

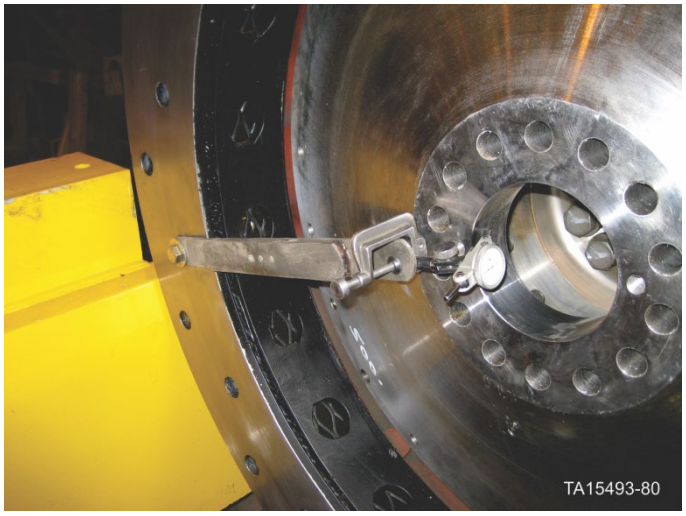
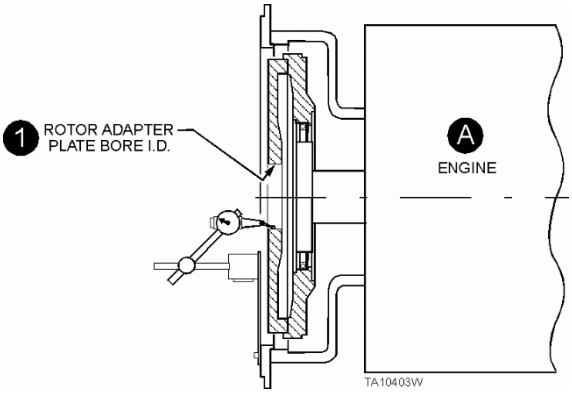
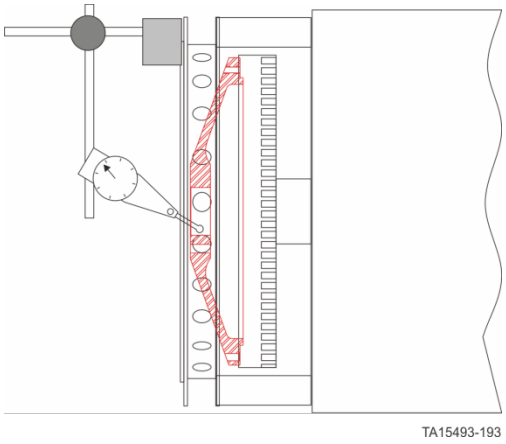


Figure 178. Checking I.D. runout of rotor adaper plate





1) Rotor adapter plate bore internal diameter, **A)** Engine

Figure 179. Checking I.D. runout of rotor adapter plate

3. If the runout is greater than .001 inches, rotate the rotor adapter 90º relative to the reference dowel pin on the flexplate to the No. 2 position. Repeat the previous step. Be sure to record this new T.I.R. by No. 2 and on line 3.1 of the Generator Installation Worksheet.

4. Repeat above step for the next two orientations (position “3” and position “4”), as required. Record the measurements obtained in these steps on line 3.1 of the Generator Installation Worksheet.

5. If none of the four orientations produce a radial runout of less than .001 inches, then choose the orientation that produced the least amount of runout lower than .003 inches. If none of the orientations produced a runout of less than .003 inches, then either a different rotor adapter plate must be used or the flexplate and rotor adapter must be modified. If another plate is available, then repeat the above steps (“a” to “d”) with the new rotor adapter. The goal is to minimize runout and subsequently to reduce vibration.

CAUTION

If a new rotor adapter plate is not available, then the flexplate and rotor adapter plate must be checked to determine the source of the problem. The problem must be corrected before continuing with installation.

6. Once the orientation is selected, manually rotate the engine so that the high side of the bore is at the 12 o’clock position. (This will cause the weight of the rotor to relieve any clearance between rotor adapter and flexplate in a direction which will minimize the final radial runout.) Punch mark the rotor adapter and the flexplate at the 12 o’clock position. This will provide a permanent record and will aid in future alignments. Remove the rotor adapter from the flexplate.

Rotor Adapter Shimming

The rotor adapter is shimmed so that the generator bearing will be in the middle of its axial movement when bolted to the engine (also in middle of its axial movement.).

Figure 180. Stator adapter straight edge tools

1. Bolt the stator adapter plate straight edge in place on the stator adapter plate.

2. Mount a dial indicator as shown in illustration "MEASURING ENGINE ENDPLAY" so that the button rests on the center part of the flexplate.

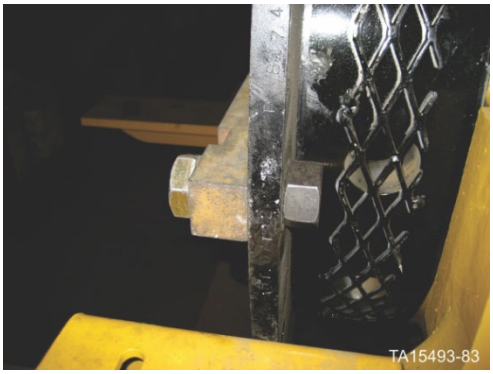
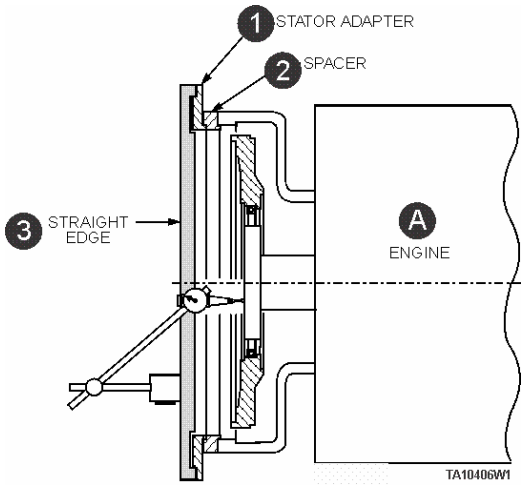


Figure 181. Straight edge installation



1) Stator adapter, **2)** Spacer, **3)** Straight edge, **A)** Engine

Figure 182. Measure engine endplay

3. Remove the crankshaft inspection cover from the side of the engine. Measure the engine endplay by prying the crankshaft “IN” (toward the front of the engine) as far as possible; then zero the indicator and pry the crankshaft “OUT” as far as possible, using a steady even push on the pry bar (pry on counterweight only). Record the measurement obtained on line 4.1 of the Generator Installation Worksheet.

4. C enter the crankshaft in the middle of the engine endplay.

5. Using an inside micrometer, measure the distance between the stator adapter straight edge and the face of the flexplate as shown. Measure the distance at the other end of the straight edge. Add these two dimensions and divide by two for an average dimension. Record all measurements on line 4.2 of the Generator Installation Worksheet.

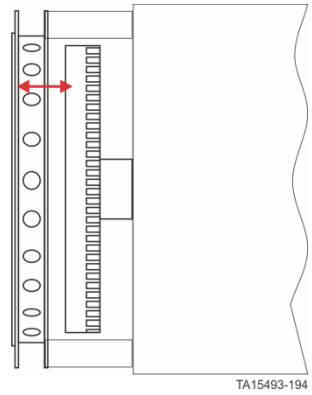


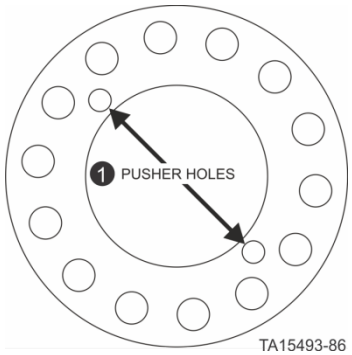
Figure 183. Measure distance between stator adapter and flexplate

6. Record the average number as dimension “A” on line 4.3 of the Generator Installation Worksheet.

7. Record the dimension from Generator Installation Worksheet line 1.3 labeled “Set-Up Adapter to Stator Dimension” as dimension “B” on line 4.3 of the Worksheet.

8. Subtract dimension “B” from dimension “A”. If the difference is less than 0.007” (0.1778 mm), then proceed to Step 9.

9. If the difference is negative, then remove the appropriate amount of shims from between the rotor adapter and the rotor shaft (remove an amount approximately equal to the difference). If the difference is positive, then add the appropriate number of shims in the same manner.



1) Pusher holes - large diameter shims

Figure 184. Pusher holes - large diameter shims

10. Ensure that the ground portion of the generator shaft (where the long stem dial indicator rides for the final checkout) is free from burrs and epoxy.

11. Properly torque all fasteners. Hex bolts should be torqued to Grade 8 values (use SAE engine oil on treads and under bolt heads). Twelve (12) point capscrews should be torqued as follows:

    - 100 ft-lbs. using a crossover pattern.
    - 200 ft-lbs. using a crossover pattern.

- 300 ft-lbs. using a crossover pattern.
- 375 ft-lbs. using a crossover pattern.

12. Twelve-point capscrews must be used with a hardened flatwasher.

Figure 185. Fasteners

Install Generator and Shim Generator Feet

1. Carefully apply light coat of SAE engine oil to the pilot bores of stator adapter, rotor adapter, and flat adapter plate. **DO NOT APPLY SAE 30W OIL** to the mounting faces of these adapters.

2. Install the two alignment studs opposite one another, in the horizontal plane, in the rotor adapter. Be sure to thread them in as far as possible.

NOTICE

Alignment studs not needed on SAE 00 engine/generator installations.

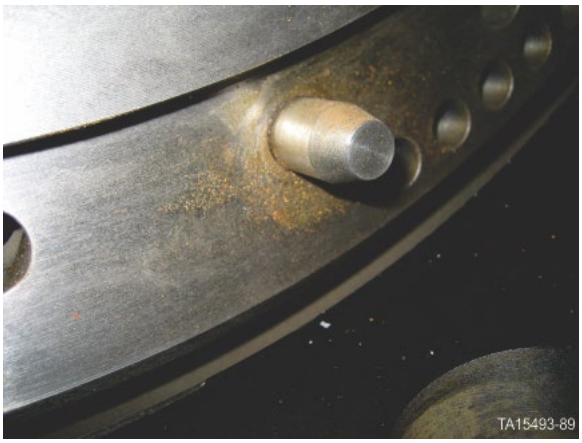


Figure 186. Alignment studs are built into the flexplate

3. Install the G100 lifting bar fixture and rigging to the top of the generator to support the weight of the generator.

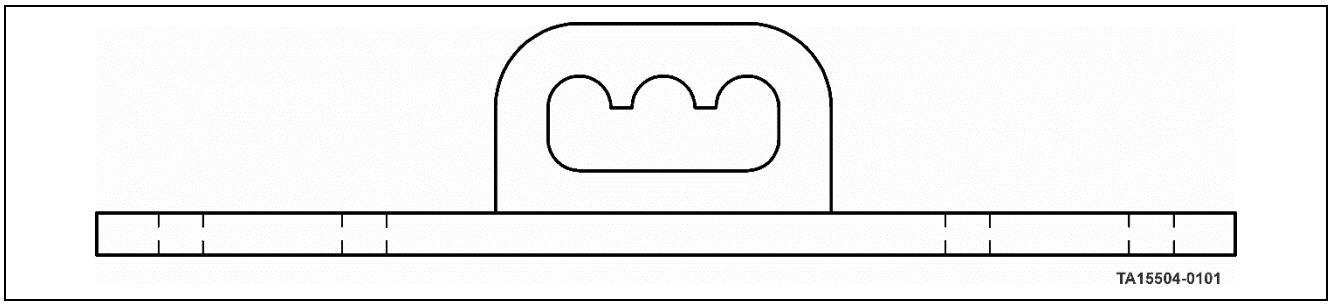


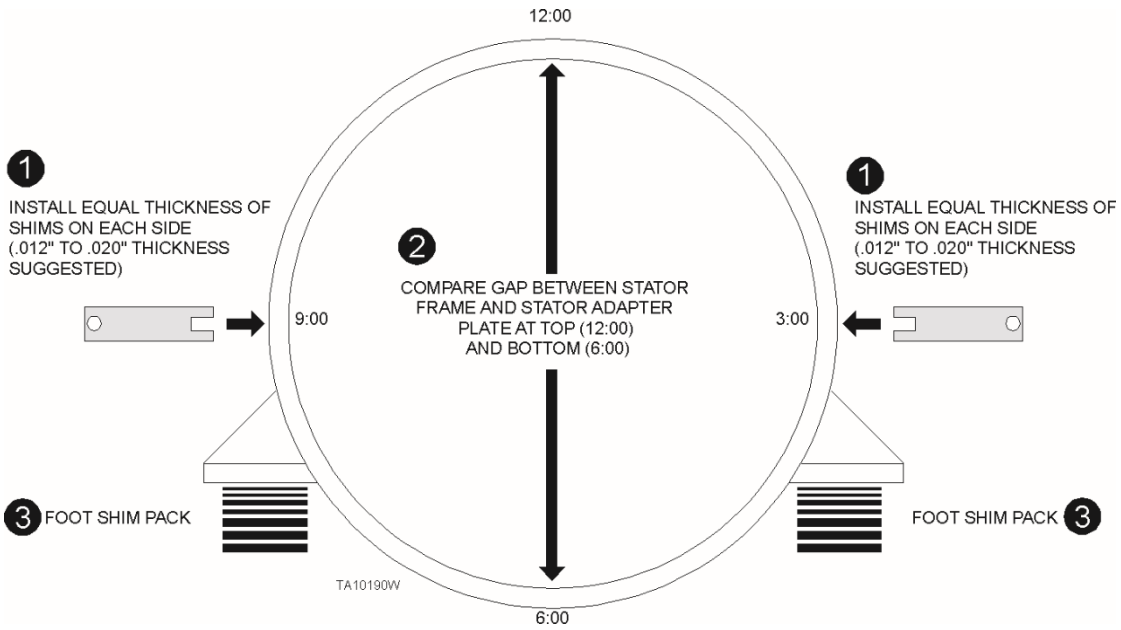
Figure 187. G100 Generator Lifting Fixture - P/N R1036782

4. Utilizing a hoist, advance the generator to the engine with its horizontal centerline in line with the centerline of the engine. Note the position of the alignment stud. Make sure that the permanent mark on the rotor adapter is oriented correctly with respect to the mark on the flexplate at the 12 o'clock position. If a slight adjustment is required, rotate the flexplate.

5. Advance the generator toward the engine. Current Engines: Have alignment studs as part of the flex plate. Older engines: The alignment studs in the rotor adapter should enter their respective holes in the flexplate. When the stator frame is touching the stator adapter plate, adjust the frame so that the pilot boss is inside the pilot bore.

6. Insert the top and bottom mounting bolts into the stator frame through the corresponding stator adapter holes. (SAE 00 flywheel with "U" shaped housing adapter, install all bolts). Tighten these bolts a sufficient amount so that the boss cannot disengage from the bore.

7. Install shims of equal thickness (0.012" - 0.020" [0.305mm - 0.508mm]) thick is suggested) between the stator frame and adapter plate at the three o'clock and nine o'clock positions (refer to illustration "INSTALLATION OF SHIM AT 3 O'CLOCK and 9 O'CLOCK POSITIONS"). Secure these shims with two bolts installed into the stator frame, in the same positions. The shims can be leftover shims from feet with end cut out.

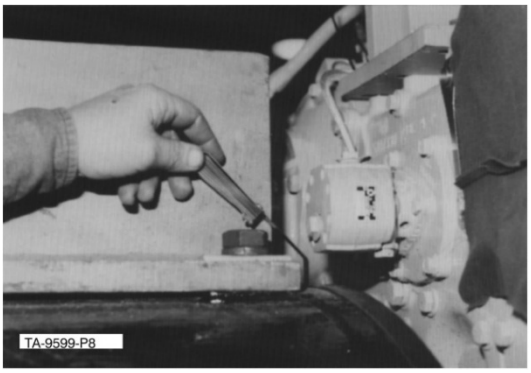


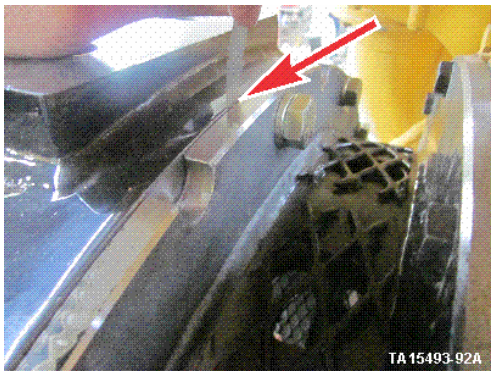
1) Install equal thickness of shims on each side (.012” o .020” [0.305mm - 0.508mm] thickness suggested),
2) Compare gap between stator frame and stator adapter plate at top (12:00) and bottom 6:00),
3) Foot Shim Pack

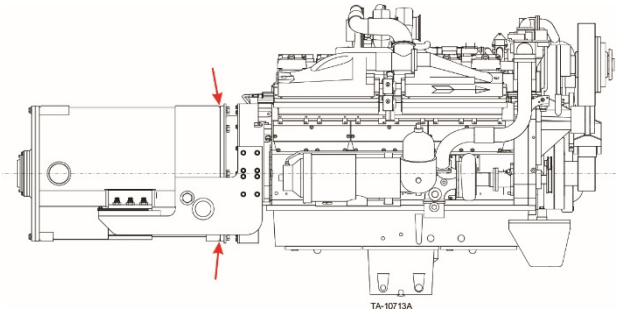
Figure 188. Installation of Shims at Three O'clock and Nine O'clock Positions

Figure 189. Install shims on both sides

8. Retract the top and bottom mounting bolts about 1/4” (6.35 mm). Check the angular alignment of the generator relative to the engine by using a feeler gauge between the stator adapter and frame, in the six o’clock and twelve o’clock positions.







Measure gap at top and bottom

Figure 190. Gap measurement between generator mount base and stator

9. Install shim stock under each of the generator mounting feet until a difference of 0.004” (0.010 mm) or less is attained between feeler gauge readings at the six o’clock and twelve o’clock positions (**SAE 00 flywheel with “U” shaped flywheel housing adapter**, .010” [0.254 mm] clearance). Tighten the bolts on the mount feet and recheck the feeler gauge readings on the top and bottom. The .004” (0.101 mm) tolerance must be held when the mount feet are properly secured. Record the final gap at top and bottom on line 5.1 of the Generator Installation Worksheet. Record the thickness of shims required under each mounting foot on line 5.2 of the Generator Installation Worksheet.

Figure 191. Installation of the shim pack at the generator mount foot

Figure 192. Shim pack installed at the generator mount foot

10. Loosen the generator mount feet bolts. Loosen the two mounting bolts in the three o'clock and nine o'clock positions and remove the shims. Verify that the gaps remain equal in the three o'clock and nine o'clock positions to ensure that the generator is not misaligned side-to-side. Install the remaining four mounting bolts in the generator adapter plate and properly torque all bolts to the specifications listed on the capscrew torque chart

11. Properly torque the mount feet bolts (some generators have one bolt on each foot, while others may have three bolts on each foot). An offset adapter may be required to torque bolts on some generators. For part number, refer to the "Appendix".

Figure 193. Offset adapter may be required to torque the bolts on the generator

Install Flexplate Fasteners

1. Using the hole created by the absence of the cover or the starter, install and torque the flexplate coupling bolts as described in 3-8 below. Torque to specs on the capscrew torque chart, located in the appendix of this manual.

2. For the following steps, the directions given will be from the front of engine to the rear of engine. Adherence to this procedure is required to ensure that the rotor adapter mates evenly (is not “misaligned”) with the flexplate.

3. Using the hole created by absence of cover on bell housing on the left side of engine, lube and insert first flexplate coupling bolt and torque to 25% of rated torque.

4. Rotate engine counter-clockwise so that flexplate rotates 180º, lube and insert second bolt and torque to 50% of rated torque.

5. Rotate engine counter-clockwise so that flexplate rotates 90º, lube and insert third bolt and torque to 50% of rated torque.

6. Rotate engine counter-clockwise so that flexplate rotates 180º, lube and insert fourth bolt and torque to 50% of rated torque.

7. Rotate engine clockwise so flexplate rotates 90 degrees, torque first bolt to 50% of rated torque.

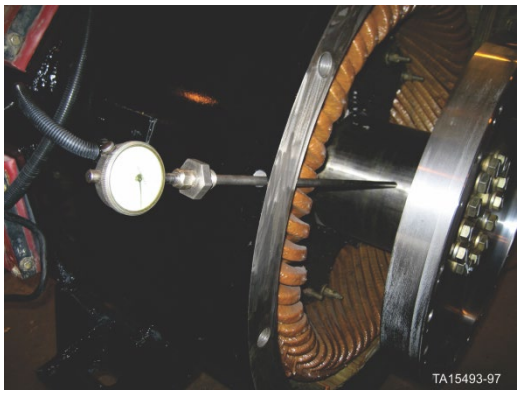
8. Remove alignment studs and insert remaining bolts, torque all bolts to 100% of full rated torque.

9. Remove the alignment studs while installing the bolts (not necessary on SAE 00 engine/generator installation).

Final Checkout

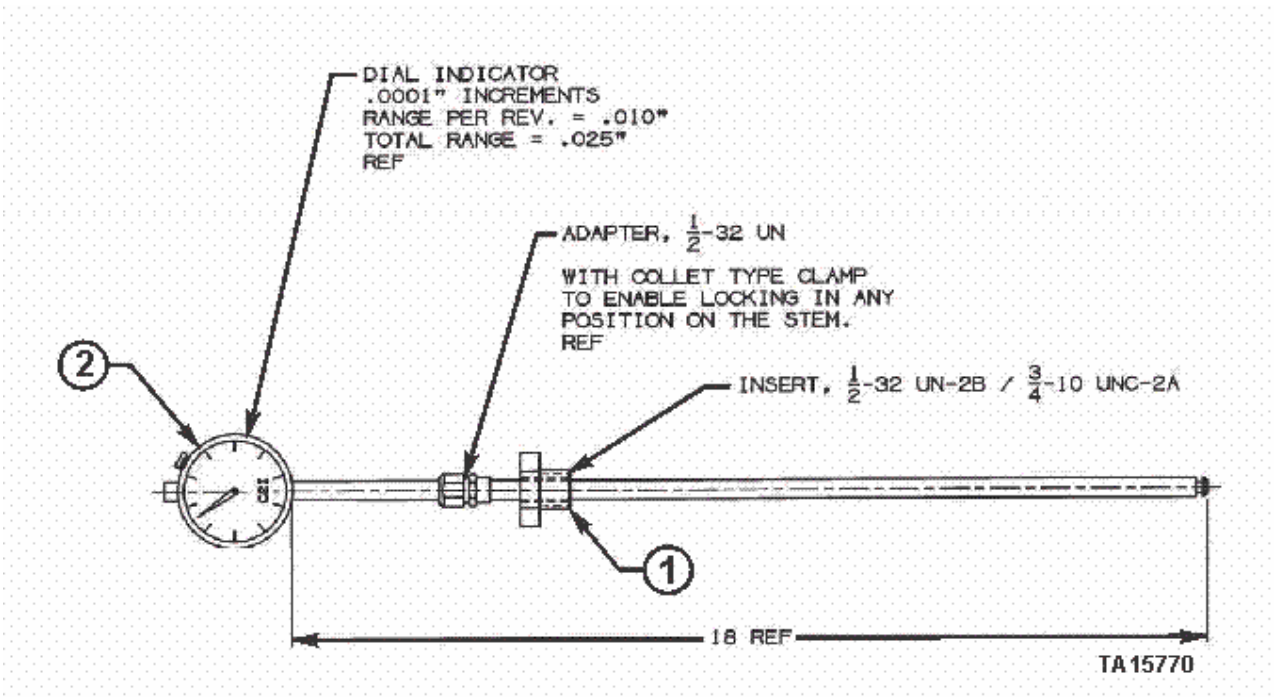
a. Recheck engine endplay as described in “Rotor Endplay and Stator/Rotor Adapter Measurements” (previously explained in this document), and recorded on line 6.1 (check to ensure that this matches the endplay recorded on line 4.1 of the Generator Installation Worksheet).

b. Using a long-stem dial indicator, measure the radial runout of the rotor shaft as shown in illustrations.



NOTICE

The picture on the left is an open view of the generator showing where the dial indicator makes contact with the shaft while measuring for radial runout.



1) Insert, **2)** Dial Indicator

Figure 194. Long stem dial indicator

NOTICE

Some generators have fine threads, current generators have coarse threads and require a thread adapter. Refer to figure “TOOLS AND SUPPLIES” part number of dial indicator and thread adapter.

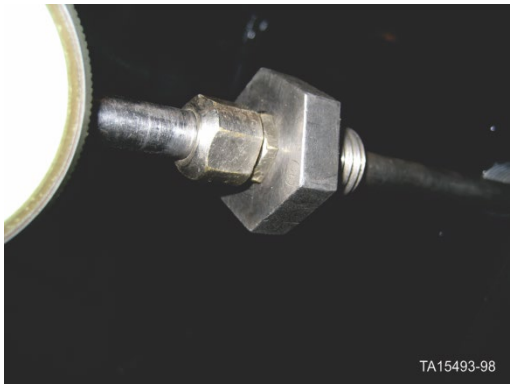
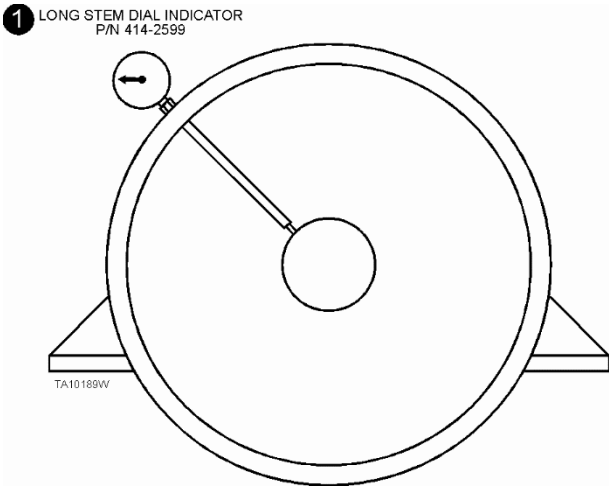


Figure 195. Thread adapter

c. Mount the indicator, in the threaded hole in the stator bolt flange, and manually rotate the engine (from the front). The maximum runout should not exceed the value shown in the Generator Installation Worksheet. Record the measurement obtained on line 6.2 of the Generator Installation Worksheet.

d. Remove the dial indicator and reinsert the threaded plug.

e. Place the worksheet in the proper machine or component file for future reference.



1) Long stem dial indicator

Figure 196. Final radial runout check

Pre-Start and Operational Checks

Prestart Check-out Procedures

The following inspection, checks and tests should be conducted after the initial installation of a new or rebuilt generator. While some of these may have been checked during the fabrication or rework of the generator – they should be checked again prior to starting the engine.

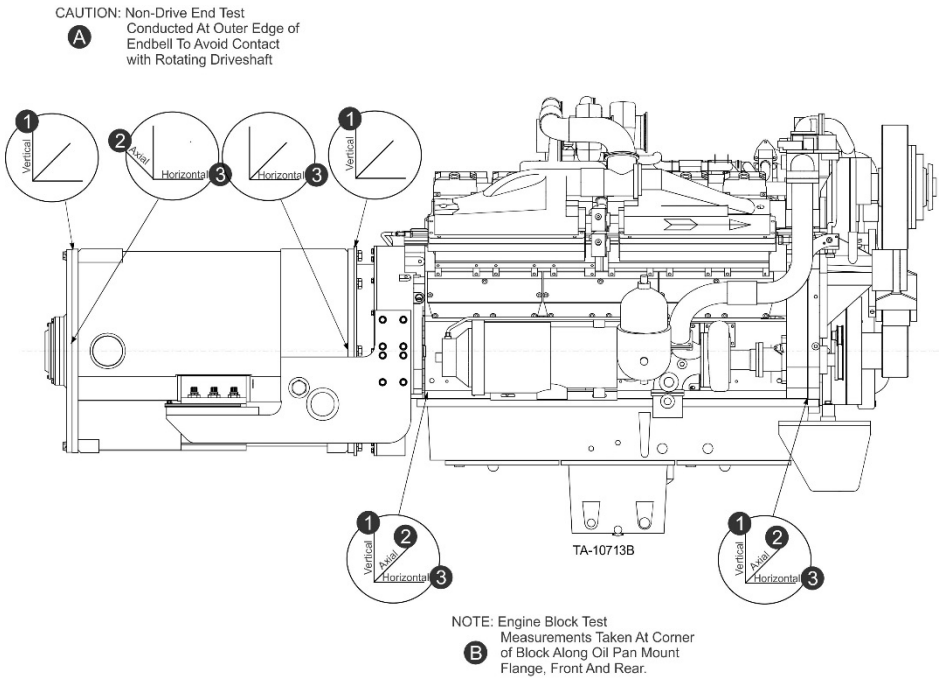
NOTICE

It is assumed that the installation has been properly conducted and that the alignment to the engine has been thoroughly checked. The generator alignment worksheet should be completely filled in and all values should be within the specifications listed.

a. Inspect Bearing Temperature

- Bearing check will involve the main generator bearing.
- After operating the generator for several hours continuously – check the temperature of the ball bearing assembly on the non drive end of the generator.
- Use a contact type temperature probe and place it on the outer bearing retainer. The maximum bearing temperature should not exceed 70°F (39°C) above ambient.

b. Inspect Vibration Levels



1) Vertical, **2)** Axial, **3)** Horizontal, **A)** CAUTION Non Drive test conducted at outer edge of endbell to avoid contat with rotating driveshaft, **B)** NOTE: Engine block test measurements taken at corner of block along oil pan mount flange, front and rear.

Figure 197. Typical loader power unit vibration test locations

⚠ WARNING

Entanglement hazard exists if attempting to work on rotating equipment. Use extreme caution when conducting vibration tests on operating power unit. KEEP CLEAR OF ROTATING SHAFTS. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities may cause an entanglement hazard that results in serious injury or death.

⚠ CAUTION

Burn hazard exists when conducting vibration tests on operating equipment. Components in surrounding areas will be hot and can cause burns. Wear all appropriate personal protective equipment (PPE) to prevent burns. Failure to wear appropriate PPE can cause burn hazards resulting in personal injury.

c. The vibration levels at the following measurement points should be measured and recorded as a baseline measurement. An example record sheet is located at the end of this section and can be used to record all measurements. All measurements should be taken as close to the rotational centerline as possible with the engine at high throttle and no load, with the machine on tires, and bucket (loaders) one to three feet off of the ground. Refer to figure "TYPICAL LOADER POWER UNIT VIBRATION TEST LOCATIONS" for vibration testing locations.

1. Generator non-drive end vertical on the endbell.
2. Generator non-drive end horizontal on the endbell.
3. Generator non-drive end axial on the endbell.
4. Generator drive end vertical on the endbell.
5. Generator drive end horizontal on the endbell.
6. Generator drive end horizontal on the endbell.
7. Rear engine horizontal on engine block.
8. Rear engine axil on engine block.
9. Front engine vertical on engine block.
10. Front engine horizontal on engine block.
11. Front engine axial on engine block.

NOTICE

- **The readings should be within .5 mil max displacement at the vertical and horizontal locations and .2 mil max displacement at axial locations.**
- **Any high readings indicate a problem which should be corrected.**
- **Excessive vibration on the non drive end could be indicating a bearing problem or incorrectly balanced rotor.**
- **Vibration on the engine end may be due to misalignment between engine and generator or engine problem.**

d. Inspect performance - load bank test

- When provided on the machine - the generator can be load banked and checked for proper horsepower output.
- Generator voltage.

Generator Vibration Test Record Sheet						
Item		**Test #1**	**Test #2**	**Test #3**	**Test #4**	**Test #5**
Date of Test						
Machine S/N						
Hourmeter Reading						
Generator Axial Vibration	NDE					
Generator Horiz. Vibration	NDE					
Generator Vert. Vibration	NDE					
Generator Horiz. Vibration	DE					
Generator Vert. Vibration	DE					
Engine Rear Vert.	Engine Block					
Engine Rear Horiz.	Engine Block					
Engine Rear Axial	Engine Block					
Engine Front Vert.	Engine Block					
Engine Front Horiz.	Engine Block					
Engine Front Axial	Engine Block					
Test Conducted By:		By:	By:	By:	By:	By:
Date:		Date:	Date:	Date:	Date:	Date:
NDE = Non Drive End DE = Drive End						

Figure 198. Vibration test record

Bearing Temperature Testing

Checking the temperature of the outer bearing retainer of the SR generator is one method for determining the condition of the bearing and grease. By taking bearing temperature measurements, on a consistent periodic basis, under consistent conditions, a temperature history can be generated, which is advantageous in developing a bearing temperature baseline. As a result, future readings will be conclusively indicative of bearing condition. The recommended test interval is every 500 hours as part of the 500 hour Electrical Preventative Maintenance.

Temperature monitoring can be done during normal material handling operations, and should not require the machine to be out of service for more than a few minutes. A standard contact pyrometer is required to conduct bearing temperature monitoring.

⚠ WARNING

Entanglement hazard exists if attempting to work on rotating equipment. Never conduct bearing temperature on an operating machine. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities can cause an entanglement hazard that results in serious injury or death.

NOTICE

The maximum allowable temperature rise over ambient of the outer bearing carrier should never exceed 100° F (56° C), under any operating condition. Contact your distributor, if bearing shows sustained temperatures outside this range.

Following bearing replacement, it is essential to perform the above bearing temperature check, after one hour of operation.

To conduct temperature monitoring of the generator's bearing, perform the following procedure:

a. Operate the machine for 2 to 3 hours.
b. Record ambient temperature.
c. Shut down the machine and lock out starting capability.
d. As quickly as possible following shutdown, place the pyrometer probe against bearing retainer (inside and outside-see picture below). Allow reading to stabilize and record temperature on Generator Bearing Temperature Record Sheet.

Figure 199. Typical temperature bearing testing

Generator Bearing Temperature					
Item	**Test #1**	**Test #2**	**Test #3**	**Test #4**	**Test #5**
Date of test					
Machine S/N					
Hourmeter reading					
Ambient temperature°F					
Bearing retainer temperature °F					
Comments:					
Test conducted by:					
NOTE! Maximum allowable temperature rise over ambient is 100°F (37.7°C). To convert °F TO °C, (°F - 32) x 5/9 e.g., 100° F would calculate as: (100 - 32) X 5/9 = 37.78°C.					

Figure 200. Bearing temperature test data record

Appendix

(1) Shaft Size Dimensions

(2) Shims

(3) Rotor Adapter Dimensions

(4) Rotor Adapter P/N Cross Reference

(5) Rotor Adapter Fasteners

(6) Tools and Supplies

(7) Insulated Bearing Components

(8) Generator Installation Worksheet

(9) Generator Vibration Test Record

(1) Shaft Size Dimensions

The G100 has a large diameter shaft and a large bolt circle for 14 pt capscrews and a long shoulder. Check the parts manual for the correct part number for your machine.

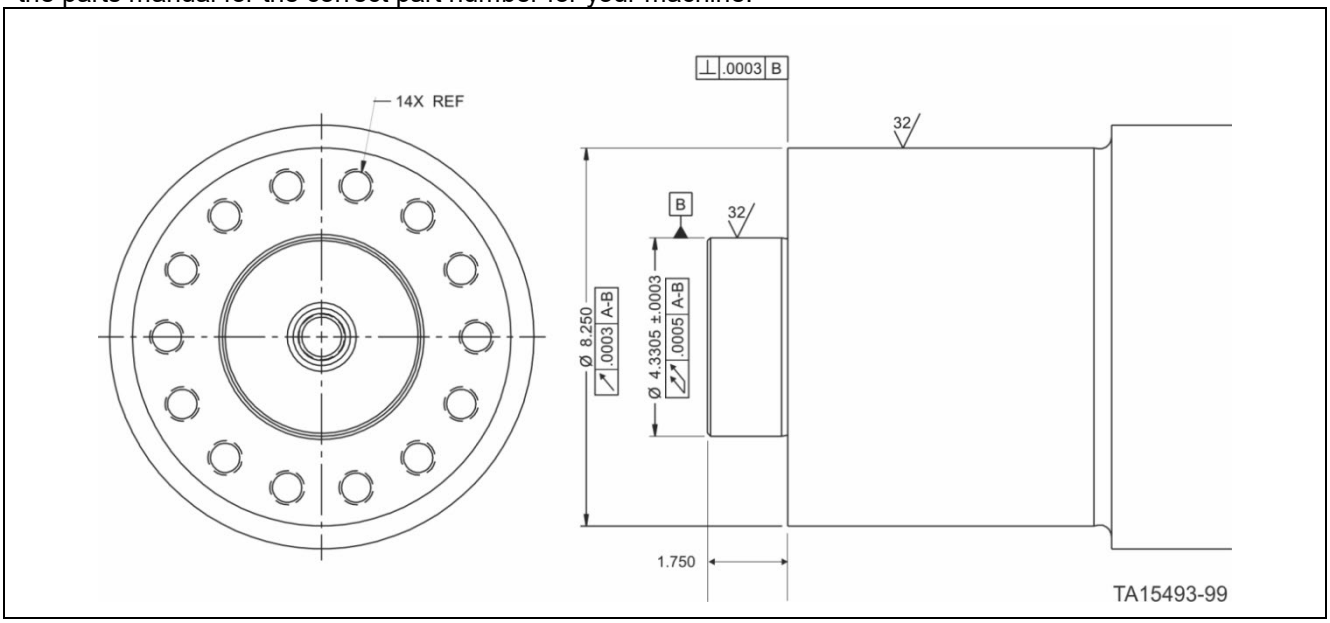


Figure 201. Generator shaft with 14 bolts

(2) Shims

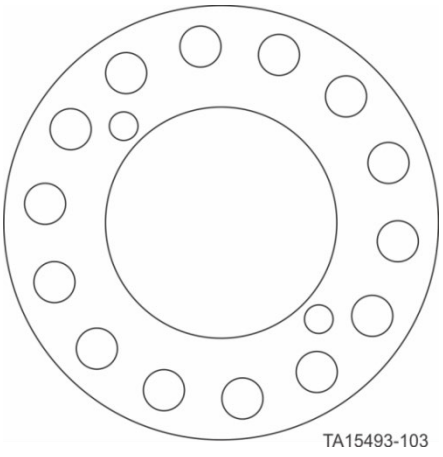
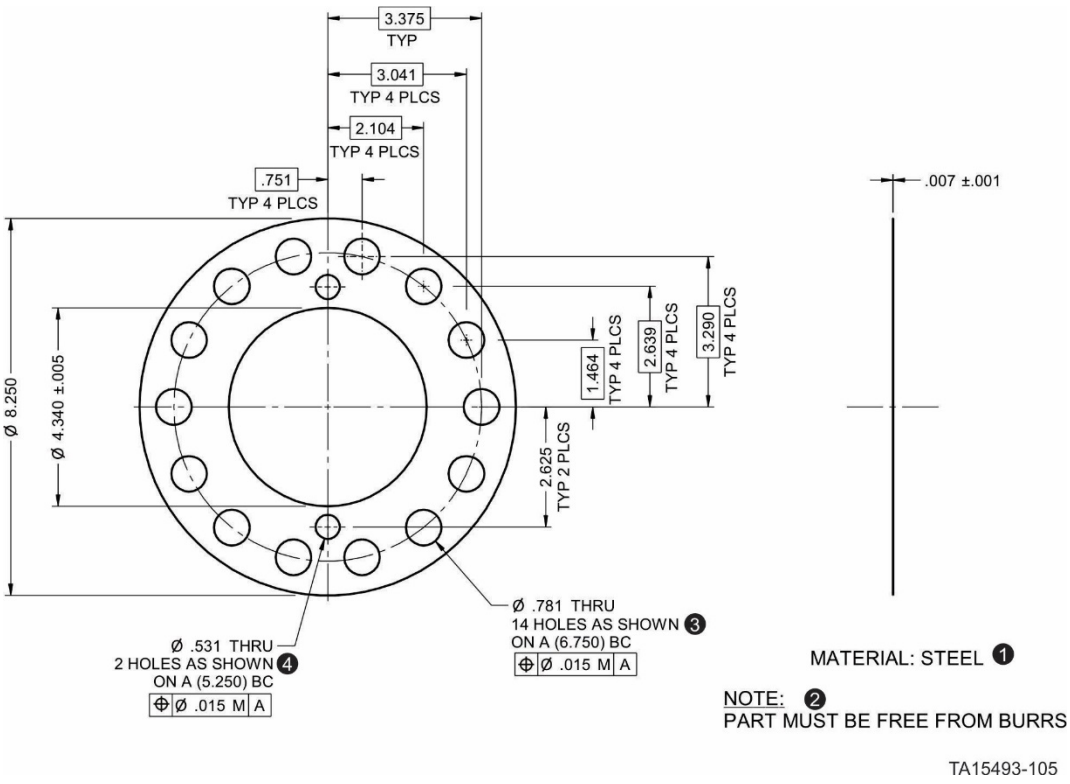


Figure 202. P/N R4164561 with 14 bolt circle (.007 thick)

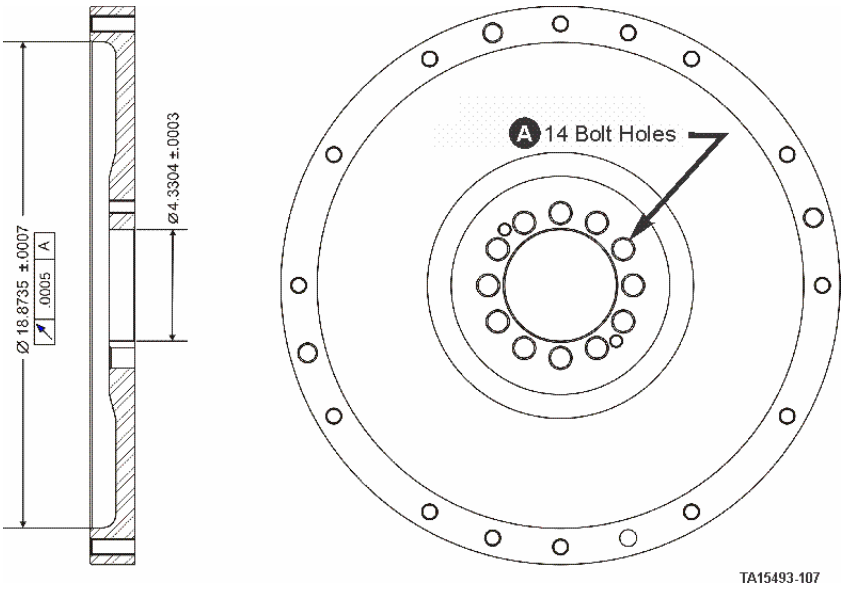


1) Steel, **2)** Part must be free from burrs, **3)** .781” diameter thru-14 holes as shown on a 6.750” bolt circle, **4)** .531” diameter thru 2 holes as shown on a 5.250” bolt circle

Figure 203. Shim (P/N R4164561) dimensions

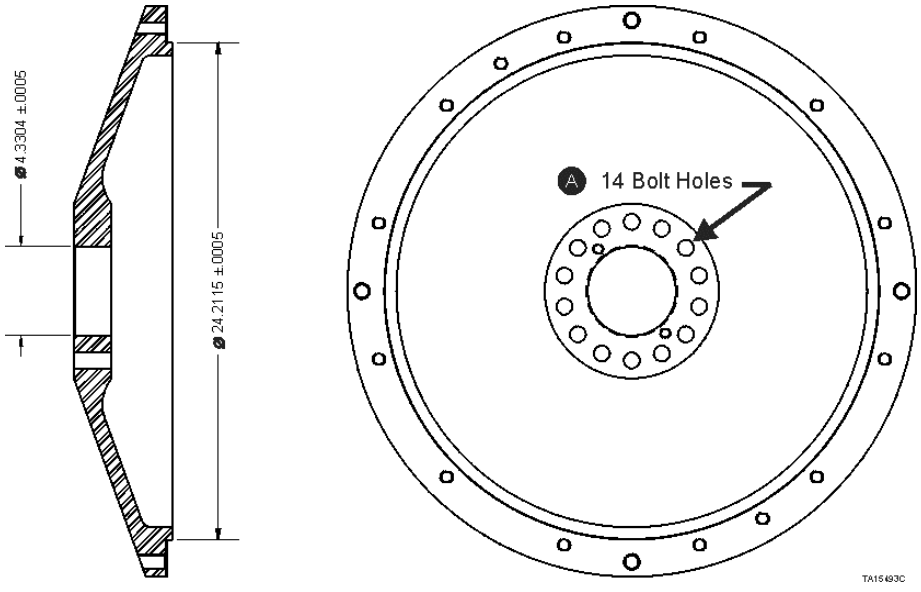
(3) Rotor Adapter Dimensions

There are several types of rotor adapters. Flat adapters are for the SAE 0 flywheel and conical adapters are for the SAE 00.



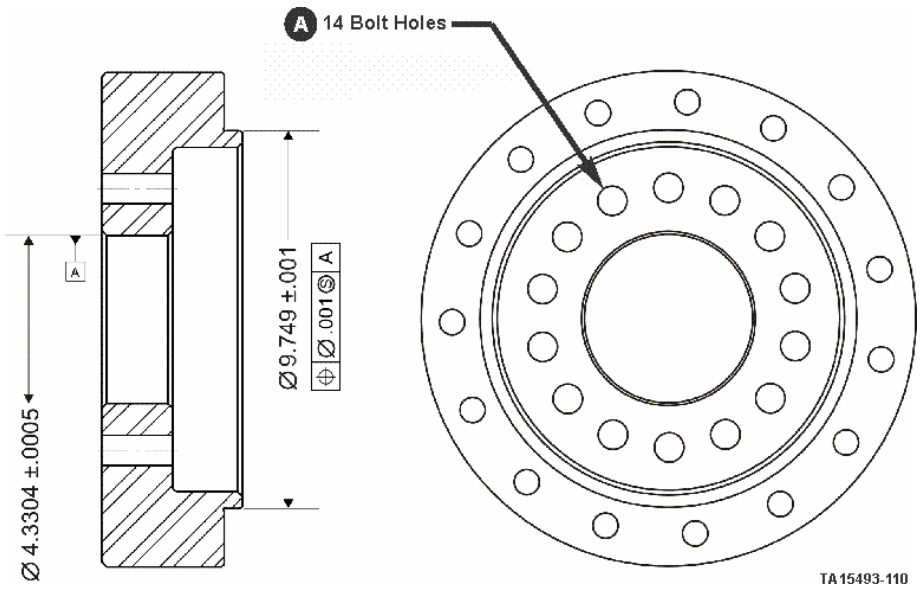
A) 14 Bolt holes

Figure 204. SAE 0 rotor adapter - (flat)



A) 14 Bolt holes

Figure 205. SAE 00 adapter - (conical)



A) 14 Bolt holes

Figure 206. SAE T2 rotor adapter

(4) Rotor Adapter P/N Cross Reference

Type	14 Bolt Circle
SAE 0 (flat)	416-4562
SAE 00 (conical)	423-8858
SAE T2	425-9419

Figure 207. Rotor adapter part number cross reference

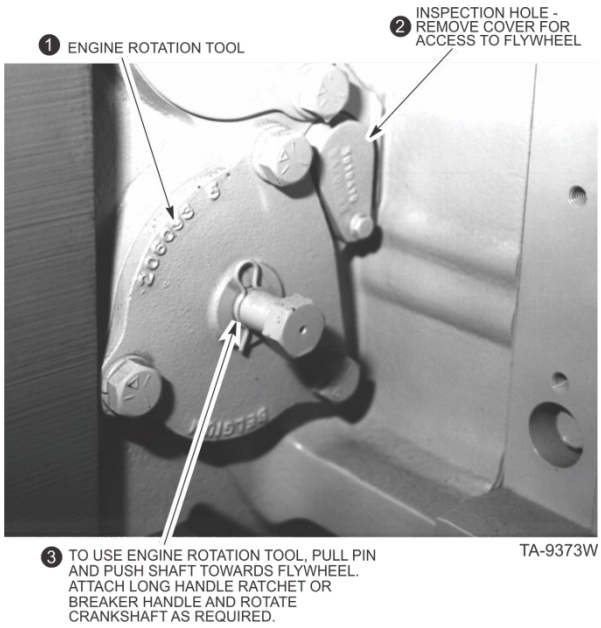
(5) Rotor Adapter Fasteners

- Flat rotor adapters typically use 6 point Grade 8 bolts due to clearance between the flexplate bolts and the rotor adapter bolts.
- Conical rotor adapters have more clearance in this area and use 12 pt capscrews.

(6) Tools and Supplies

Tools and Supplies for Generator Installation and Alignment						
Tool or Supply			**Part Number**			**Quantity**
Hoist - Power Unit/Generator Removal/Installation. Refer to chart "ENGINE AND POWER UNIT COMBINATION WEIGHTS" for weight.			N/A			1
Lifting Slings/Chains/Hooks, as required to handle weights.			N/A			1
Generator Lifting Fixture 4B/7B/9B (Eye Bolt 1”-14 UNS)			N/A			2
Generator Lifting Fixture G100. Required if moving generator only			R1036782			1
Generator Lifting Fixture G200. Required if moving generator only			R1036777			
Engine Lifting Structure			R4188747			1
Engine rotation tool (Cummins Engine - MFG. Supplied)	Rear Engine		R4213898 (Detroit)			1
	Front Engine Rotation Adapter		R4242617			1
Engine rotation tool Locally Fabricated	Front Engine		R1037426 (Cummins)			1
	Front Engine Rotation Adapter		R1037405 (Detroit Diesel)			1
			NC	**NF**	**NS**	
Miscellaneous Alignment Tools	Large Square		R4097099			1
	Straight Edge-(SAE 0/SAE 00) - 12B-E (refer to illustration "STRAIGHT EDGE").		R409-7097			1
	Straight Edge (SAE 0/SAE 1) 4B, 7B, & 9B.		R4180730			1
	SAE 0/00 Alignment Stud (refer to illustration "ALIGNMENT STUD - SAE 0/SAE 00").		R4142674			1
	SAE 1 Alignment Stud (refer to illustration "ALIGNMENT STUD - SAE 1		R4214472			1
	Long-stem Dial Indicator		R4142599 (*includes thread adapter below)			1
	*Thread Adapter for Long Stem Dial Indicator - Fine to course threads.		R4238797			1
	Lever-actuated Dial Indicator		N/A			1
	Dial Indicator Mount Assembly		R4235738			1
	Offset Adapter Wrench Structure (for foot mount bolt installation)		R4080984			1
Miscellaneous Parts and Supplies	Shim, rotor .007”	G100	R4164561			A/R
	High Temp. Thread Lock		R4099390			A/R
	Loaders	Foot Shim, 0.187	R4170911			A/R
		Foot Shim, 0.007	R4170912			A/R
		Foot Shim, 0.036”	R4170913			A/R

Figure 208. Tool and supplies



1) Engine rotation tool, **2)** Inspection hole - remove cover for access to flywheel, **3)** To use engine rotation tool, pull pin and push shaft toward flywheel. Attach long handle ratchet or breaker handle and rotate crankshaft as required.

NOTICE

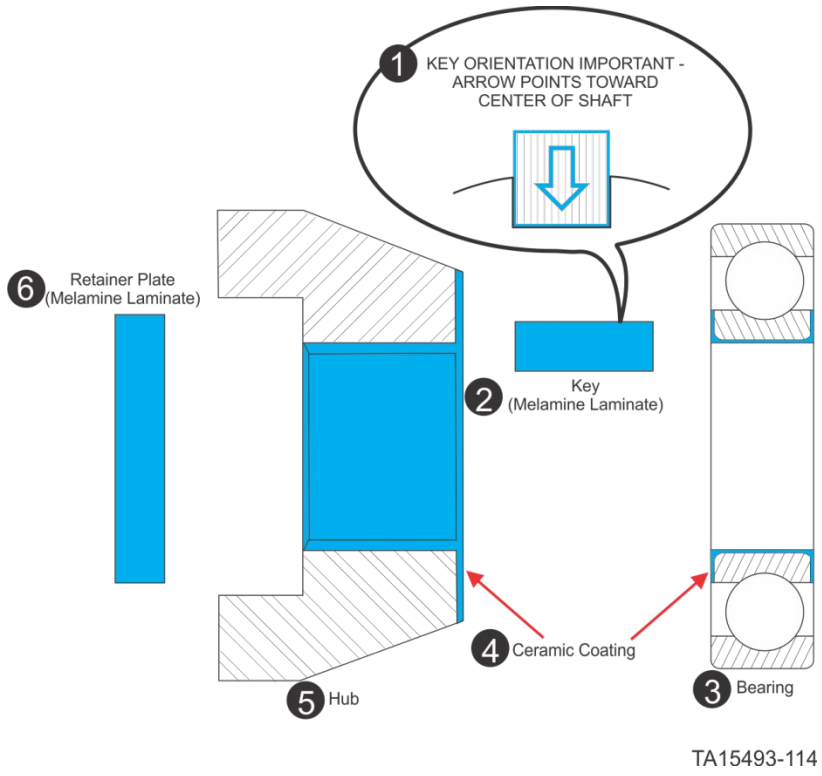
Cummins engine rotation tool shown. Engine rotation tool for Detroit works in a similar manner. For Detroit, remove starter and install the tool (P/N R421-3898) in its place.

Figure 209. Engine rotation tool

(7) Insulated Bearing Components

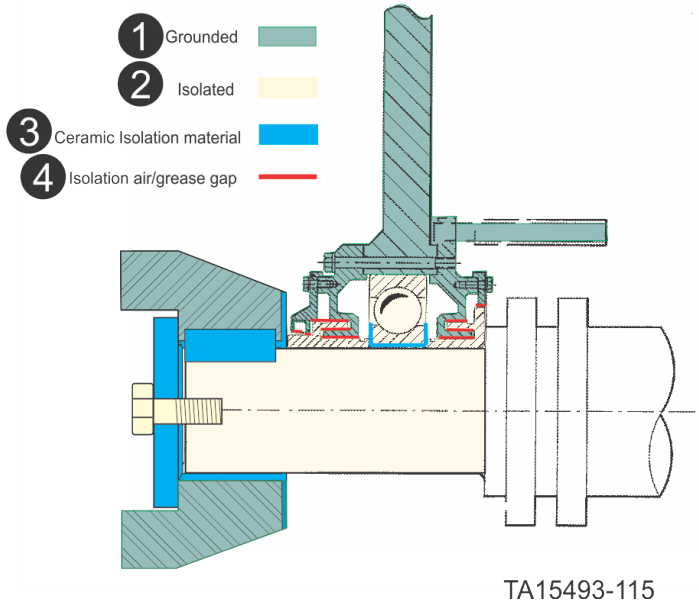
NOTICE

Generators utilize insulated components at the non drive end of the generator to break the circuit and prevent any current path. At the time of power unit installation into the machine, it is CRITICALLY IMPORTANT that these components be installed in the correct orientation. Refer to illustrations "GENERATOR INSULATED COMPONENTS" and "INSTALLED COMPONENTS CROSS SECTION".



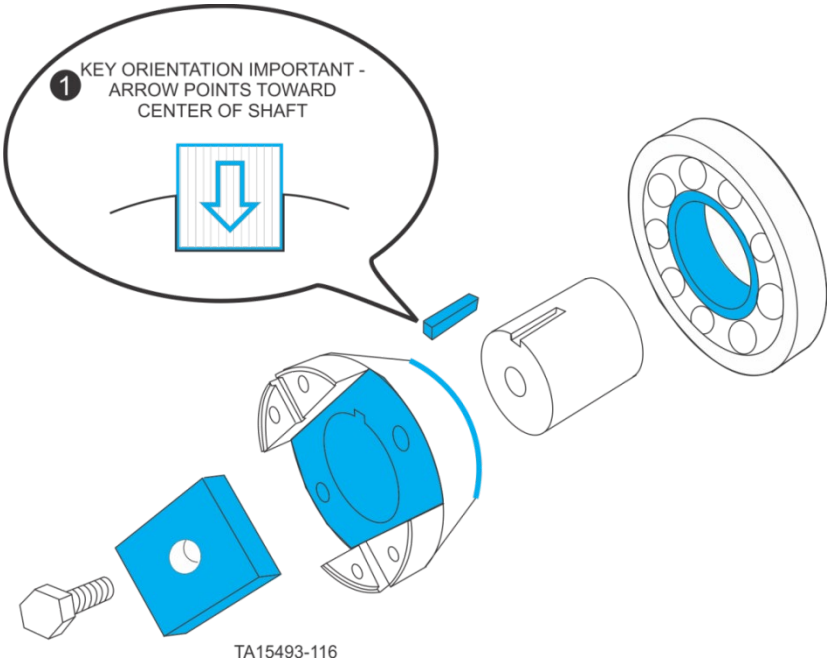
1) Key orientation important - Arrow points toward center of shaft, **2)** Key - melamine laminate, **3)** Bearing, **4)** Ceramic coating, **5)** Hub, **6)** Retainer plate - melamine laminate

Figure 210. Generator insulated components



1) Grounded, **2)** Isolated, **3)** Ceramic isolation material, **4)** Isolation air/grease gap

Figure 211. Installed components cross section



1) Key orientation important - Arrow points toward center of shaft.

Figure 212. Key orientation

(8) Generator Installation Worksheet

Engine Model & S/N	Supervisor Approval:	Date:
Engine Model & S/N:	Generator Model & S/N	Machine Model & S/N:

1) Generator Rotor Endplay Checks	
1.1 Total rotor endplay:	
1.2 Adapter to stator dimension Position 1:_____ Position 2:_____ Average:	1.3 Setup adapter-to-stator dimensions (distance between stator mount face and rotor mount face with rotor in middle of endplay). [Typical dimensions listed below]. 4B/7B: (5.433 - 5.499 w/.070 shim pack [SAE 0 FWH] 5.932 - 5.988 w/ .195 shim pack [SAE 1 FWH]) 9B: (5.433 - 5.499 w/.070 shim pack [SAE 0 FWH] 5.308 - 5.374 w/ .070 shimpack [SAE 00 FWH]) 12B: (2.971- 3.037 w/ .042 shim pack [SAE 0 FWH] 5.314 - 5.377 w/ .042 shimpack [SAE 00 FWH]) 12C: (5.314 - 5.377 w/ .042 shim pack [SAE 00 FWH]) G100: (7.69 - 7.760 w/ .042 shim pack [SAE 00 FWH]) G200: (5.314 - 5.377 w/ .042 shim pack [SAE 00 FWH]) * MTU T2 Coupling: (3.779 - 3.845 w/ .042 shim pack [SAE 00 FWH])

2) Pre-Installation Checks			
2.1 Rotor Adapter CMM Number:_____	(SAE 1): 15.0000 ± .0005 (SAE 0): 18.8735 ± .0007 (SAE 00): 24.2115 ± .0005	2.2 Flexplate Pilot Diameter:_____	(SAE1): 15.000 ± .001 (SAE 0): 18.875 + 0.005, -0.000 (SAE 00): 24.2080 - 24.2110
2.3 Radial runout of flexplate pilot bore OD:(0.003" max.): SAE 1/0 (0.004" max.): SAE 0/00		2.4 Axial runout of flexplate (0.035: max.):	
2.5 Radial runout of flywheel housing (.010" max.):		2.6 Axial runout of flywheel housing (.010" max.):	
2.7 Perpendicular alignment of generator feet (.010" max.):		Left Right	
2.8 Radial runout of stator adapter plate (.010" max.):		2.9 Axial runout of stator adapter plate (.010" max.):	
2.10 Perpendicular alignment of rear engine mounts (.005" max.):		Left Right	

3) Rotor Adapter Positioning Checks				
3.1 Radial runout of the ID on mounted rotor adapter bore (less than .001)	Position1_____	Position2_____	Position3_____	Position4_____

4) Rotor Adapter Plate Shimming			
4.1 Engine endplay (per engine manufacturer's specification):			
4.2 Distance between straight edge and flexplate face:	Position 1 _____	Position 2 _____	Average (Dimension A) _____
4.3 Shim pack: Average distance between straight edge and flexplate (Dimension A): = _____ (From 1.3) Setup adapter to stator dim. (Dimension B) = _____ Difference =			
4.4 Total number of shims and thickness of each used in the assembly:			

5) Install Generator and Shim Generator Feet			
5.1A SAE 1/0 Gap at top and bottom:	Top	Bottom	Difference
5.1B SAE 00 Need 4 locations before and after	Before	After	Differences (≤ .010)
5.2 Shim pack thickness under generator feet:	Left	Right	
5.3 Used Loctite, and torque wrench and safety wire to secure the rotor adapter.	Yes	No	
6) Final Checks			
6.1 Engine endplay			
6.2 Radial runout of generator shaft (.003" max.):			

Figure 213. Generator installation worksheet

(9) Generator Vibration Test Record Sheet

Item		Test #1	Test #2	Test #3	Test #4	Test #5
Date of Test						
Machine S/N						
Hourmeter Reading						
Generator Axial Vibration	NDE					
Generator Horiz. Vibration	NDE					
Generator Vert. Vibration	NDE					
Generator Horiz. Vibration	DE					
Generator Vert. Vibration	DE					
Engine Rear Vert.	Engine Block					
Engine Rear Horiz.	Engine Block					
Engine Rear Axial	Engine Block					
Engine Front Vert.	Engine Block					
Engine Front Horiz.	Engine Block					
Engine Front Axial	Engine Block					
Test Conducted By:		By:	By:	By:	By:	By:
Date:		Date:	Date:	Date:	Date:	Date:
NDE = Non Drive End DE = Drive End						

Figure 214. Vibration test record

NOTICE

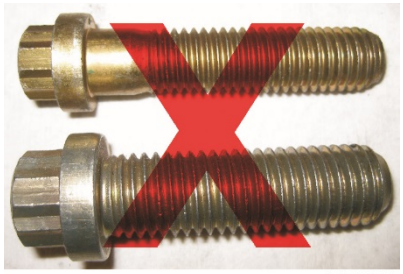
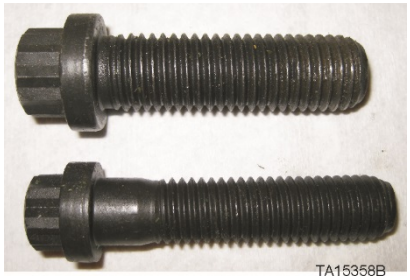
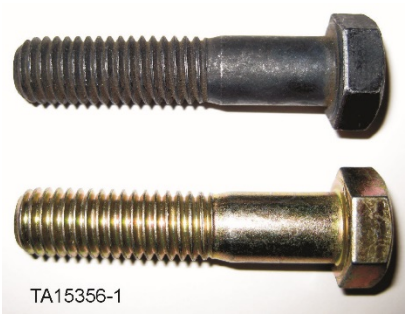
Use this sheet as a template & make copies for recording actual data.

Capscrew and Bolt-Nut Torque Specifications

There are some exceptions to the torques provided on the following pages. Reduced torques are specified in the planetary drive rebuild manual, for the capscrews holding the planetary drive covers, due to a copper sealing washer under the head of the capscrew.

The torque specifications on this chart apply only to Grade 8 bolts, black or gold colored, and 12pt black-colored alloy steel capscrews. 12pt capscrews with gold-colored zinc chromate plating are excluded from these specifications and the zinc chromate 12pt capscrews should not be used on loaders or dozers. (except for planetary drive covers)

These torque values are for normal routine operations. If doing component rebuilds or any other abnormal machine component assembly/disassembly, please contact the factory for these values for specific instances.

 TA15358A	 TA15358B	 TA15356-1
Does not apply **X**	12PT Alloy Capscrew ✓	Grade 8 Bolt ✓

NOTICE

Please note the additional tables for exceptions to the torque values for items such as Lift Arm Ballcaps, Super Nuts and steering pin bolts with drilled grease passages.

Please direct any questions to Product Support.

Capscrew and Bolt-Nut Torque Specifications Chart

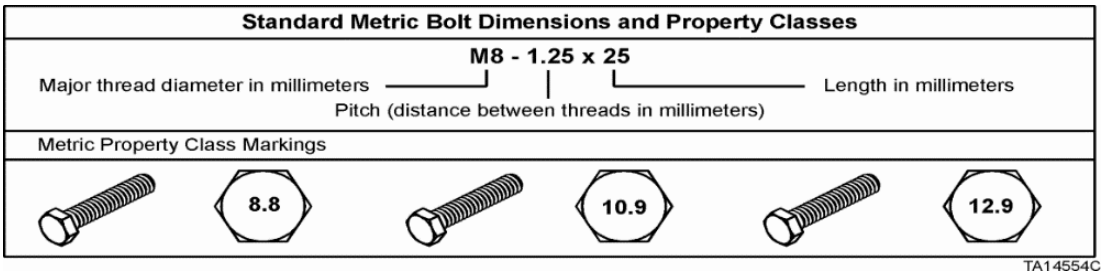
Standard SAE G8 and Alloy Steel and Hex Socket Capscrews

Size	Thread	GRADE 8 Fasteners		Alloy Steel 12PT. and Hex Socket Capscrews	
		USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m
		**Lubed	**Lubed	**Lubed	**Lubed
1/4 (0.25)	20 UNC	9	13	12	16
	28 UNF	10	14	14	19
5/16 (0.3125)	18 UNC	18	25	24	33
	24 UNF	20	27	27	37
3/8 (0.375)	16 UNC	33	45	45	61
	24 UNF	37	50	50	68
7/16 (0.4375) (* See Note below)	14 UNC	52	71	70	95
	20 UNF	58	79	79	107
1/2 (0.5) (* See Note below)	13 UNC	80	109	108	146
	20 UNF	90	122	122	165
5/8 (0.625)	11 UNC	159	216	203	275
	18 UNF	180	244	230	312
3/4 (0.75)	10 UNC	282	383	361	490
	16 UNF	315	427	403	546
1 (1.0) (*** See Note below)	8 UNC	682	925	872	1182
	14 UNS	764	1,036	977	1325
1-1/8 (1.125)	7 UNC	966	1310	1235	1674
	12 UNF	1083	1468	1385	1878
1-1/4 (1.25) (**** See Note below)	7 UNC	1,363	1,848	1744	2365
	12 UNF	1,509	2,046	1930	2617
1-1/2 (1.5)	6 UNC	2,371	3,215	3033	4113
	12 UNF	2,668	3,618	3413	4628

* See Special Torque Specifications for ROPS super nut.
** See page 4 for specifications for "LUBED" – engine oil on threads and shoulder.
*** See Special Torque Specifications for 950/1150 steering pins.
*** This bolt is UNS (with 14 threads per inch), it is NOT UNF. It is a unique thread count bolt.
**** See Special Torque Specifications for loader lift arms and 1350/1850/2350 steering pins.

Standard Metric Bolts and Grades (SAE J1701M)

Size (mm)	Pitch (mm)	Property Class 8.8		Property Class 10.9		Property Class 12.9	
		USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m
		** Lubed	** Lubed	** Lubed	** Lubed	** Lubed	** Lubed
6	1.00	6	8	8	11	10	13
7	1.00	10	13	14	19	16	22
8	1.25	14	19	20	27	24	32
10	1.50	28	38	40	54	47	63
12	1.75	49	66	70	94	81	110
14	2.00	77	105	111	150	130	176
16	2.00	121	164	173	235	202	274
18	2.50	167	226	239	324	279	378
20	2.50	244	331	337	458	394	535
24	3.00	422	572	584	791	682	925



Capscrew and Bolt-Nut Torque Specifications

Special Torque Specifications

Alloy Steel 12PT. Capscrew for Wheel Loader Lift Arm Ballcaps

Size	Type	Thread	USA Units lb-ft	Metric Units N-m	Application
			**Lubed	**Lubed	
1-1/4 (1.250)	12PT. capscrew F-C on head	7 UNC	1900	2577	LHD, L-950, L-1150, L-1350, L-1850, and L-2350 (Lift arm ball caps only)
1-1/4 (1.250)	12PT. capscrew B-7 on head	12 UNF	1320	1790	L-1000-L-1100 (Lift arm ball caps only)

Steering Pins (Hex Head Bolt)

Size	Type	Thread	USA Units lb-ft	Metric Lubed N-m	Application
			** Lubed	** Lubed	
1 (1.0)	Bolt (drilled center)	8UNC	425	576	LHD, L-950, D-950, L-1150 (Steering Pins)
1-1/4 (1.250)	Bolt (drilled center)	7UNC	850	1152	L-1350, L-1850, L-2350 (Steering Pins)

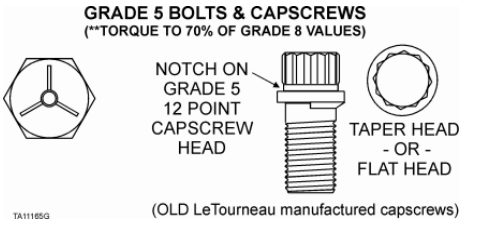
Aluminum 12pt. Capscrews used for Motor Pinion Balancing

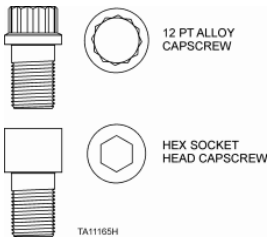
Size	Type	Thread	USA Units (lb-ft)		Metric Units (N-m)	
			Dry	**Lubed	Dry	**Lubed
¾ (0.75)	Aluminum	16 UNF	114	86	155	117
¾ (0.75)	Aluminum 2024-T4	16 UNF	150	113	203	153
15/16 (.9375)	Aluminum 6061 T6	12 NF	217	163	294	221
15/16 (.9375)	Aluminum 2024-T4	12 NF (2 START)	285	214	387	290

2-Thread (2-Start) Steel 12PT. Capscrews

Size	Type	Thread	USA Units lb-ft	Metric Units N-m
			** Lubed	** Lubed
3/8 (.3750)	12PT.	24 NF	25	34
9/16 (.5625)	12PT.	18 NF	87	119
15/16 (.9375)	12PT.	14 NF	428	584
1-5/16 (1.325)	12PT.	12 NF	1216	1660

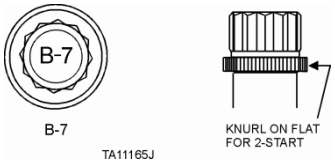
Bolt and Capscrew Markings on Head





Typical Markings on Alloy Capscrew Heads

Typical B-7, 2-Start



** See “Key Items” for specifications for “LUBED” – engine oil on threads and shoulder.

Capscrew and Bolt-Nut Torque Specifications

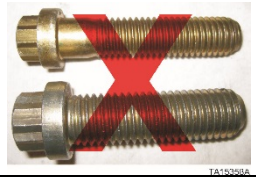
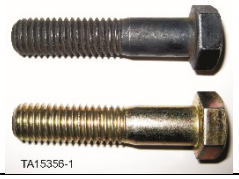
Key Items

- "LUBED" is defined as having the threads and under the head lubricated with engine oil. Engine oil is defined as SAE 30 or 40 weight oil, including multi viscosity grades 5W-30 through 15W-40. No other lubricant (such as anti seize, MolyKote, copper coat, grease, etc.) is permitted unless specifically called out in a Komatsu procedure.

****LUBED = Lubricated with engine oil on threads and under head**
(SAE 30 or 40 weight oil, including multi viscosity grades 5W-30 through 15W-40)

NOTE: No other lubricant (such as anti seize, never seize, MolyKote, copper coat, grease, etc.) is permitted unless specifically called out in a Komatsu procedure.

- All capscrews and bolts should be started by hand until a minimum of three (3) threads are engaged prior to any air impact equipment being used.
- If a procedure in a Rebuild Manual, Repair and Overhaul or Operating and Service Manual calls for the use of Loctite® threadlocker on the threads, the torque specification for "lubed" should be used. The threads on both the fastener and mating part should be thoroughly cleaned with a proper solvent prior to use of Loctite®. The Loctite® thread sealant should only be used on the threads - not the head.
- Certain applications in components such as drivers or lift arm ball caps may specify a FERRY brand of capscrew. Use only FERRY brand capscrews in these applications.
- Komatsu, recommends that any old 12PT. Komatsu-fabricated (fabrication was stopped many years ago) capscrew (refer to illustration under BOLT AND CAPSCREW MARKINGS ON HEAD) be replaced at the time of repair with alloy capscrews. If new capscrews are not available, then the Komatsu-fabricated capscrews should only be torqued to Grade 5 specifications (70% of Grade 8 value - lubed).
- The torque specifications on the charts on page 2 only apply to Grade 8 bolts, metric bolts and 12PT. black-colored alloy steel capscrews. Capscrews with gold-colored zinc chromate plating are excluded from these specifications and these capscrews should not be used on loaders or dozers except for driver covers.

		
Does not apply X	**12PT Alloy Capscrew ✓**	**Grade 8 Bolt ✓**

- CLEANING: It is mandatory to remove all paint, rust and debris from all mating surfaces, surfaces under the head of the bolt or capscrew and threads prior to installation and torquing of all bolts and capscrews.

G200 Single Bearing Generator Alignment L1850, L2350

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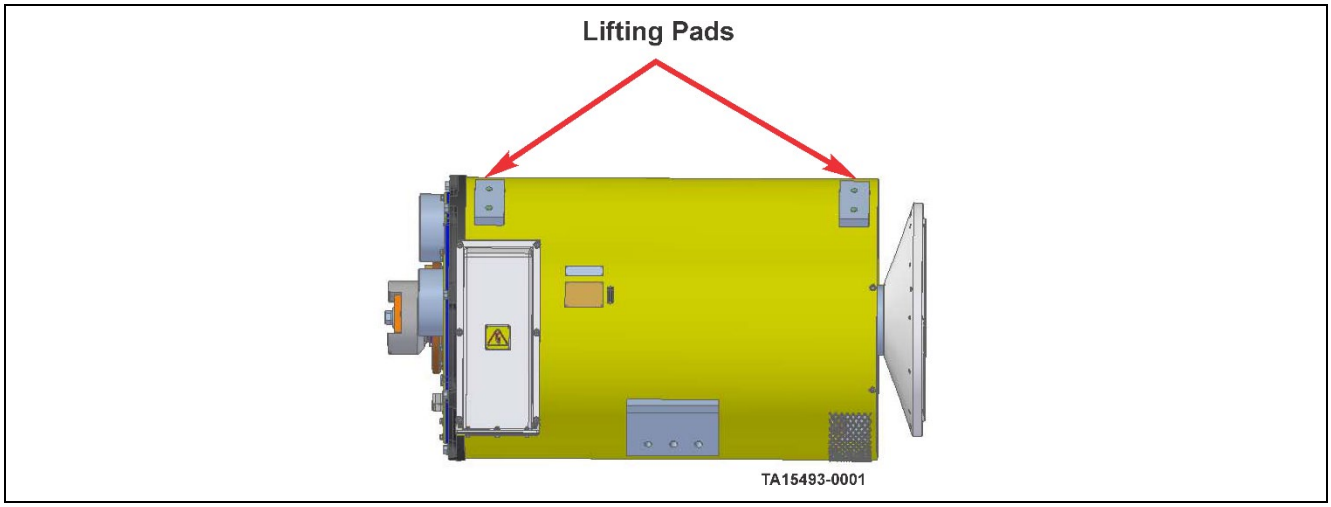


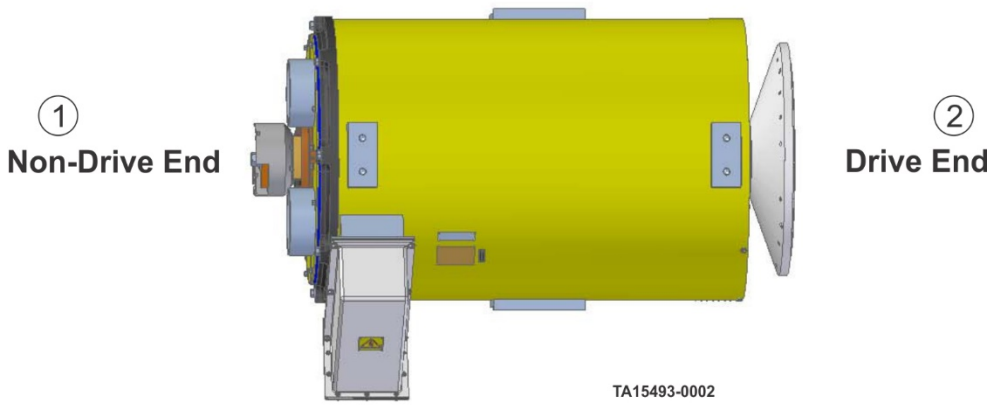
Figure 215. G200 Lifting Pad Locations

Weights (approximate)

Generator Type	Generator Assembly	Stator	Rotor
G200 (Tier I)	8471 lbs (8435 kgs)	5591 lbs (2541 kgs)	2880 lbs (1309 kgs)
G200 (Tier II)	8338 lbs (3782 kgs)	5458 lbs (2480 kgs)	2880 lbs (1309 kgs)

Item/Equipment	L-1850/L-2350	
	LBS.	KGS.
Engine, Detroit Diesel 16V4000 2300 HP - T1	16,575	7,543
Power Unit (Engine/Generator) Detroit Diesel	25,045	11,384
Engine, Detroit Diesel 16V4000 2300 HP HA - T1	16,575	7,543
Power Unit (Engine/Generator) Detroit Diesel	25,045	11,384

Item/Equipment	L-1850/L-2350	
	LBS.	KGS.
Engine, Detroit Diesel 16V4000 2000HP - T2	17,857	8150
Power Unit (Engine/Generator) Detroit Diesel	26,195	11,881
Engine, Detroit Diesel 16V4000 2300HP - T2	17,857	8,150
Power Unit (Engine/Generator) Detroit Diesel	26,195	11,881



1) Non-Drive End, **2)** Drive End

G200 Generator – Top View - Typical

Introduction

NOTICE

Refer to the parts manual for an exploded view illustration and parts list of the engine/generator installation specific to your machine.

⚠ WARNING

Crush hazards exist when lifting components. The engine/generator assembly weights shown in the tables titled "WEIGHTS" are approximate weights. Always allow a safety margin when selecting lifting equipment. Consult the engine manufacturer for exact engine weights. Failure to allow a safety margin for lifting equipment can cause crush hazards resulting in serious injury or death.

Also supplied in this document are the following:

- **Generator alignment worksheet. The worksheet should be copied and filled out to maintain a record of each installation.**
- **Tools and parts listing.**

NOTICE

Dial indicators shown in the various photos and diagrams are representations only. Many types of dial indicators are suitable. A dial indicator with a scale from .000” to 1.000” with .001” graduations is recommended. It should be noted that a dial test indicator will be required for the pilot shoulder O.D. measurements.

These instructions detail the procedures and tool requirements for installing and aligning a single bearing G200 generator. Installation of the power unit into the vehicle is not included in these instructions.

The various components are shown in the following diagram. The size and type of these components will vary depending on the generator and engine. While various configurations of rotor and stator adapters have been shown in this document - it is important to check the parts manual provided with your machine for specific components used on a given machine.

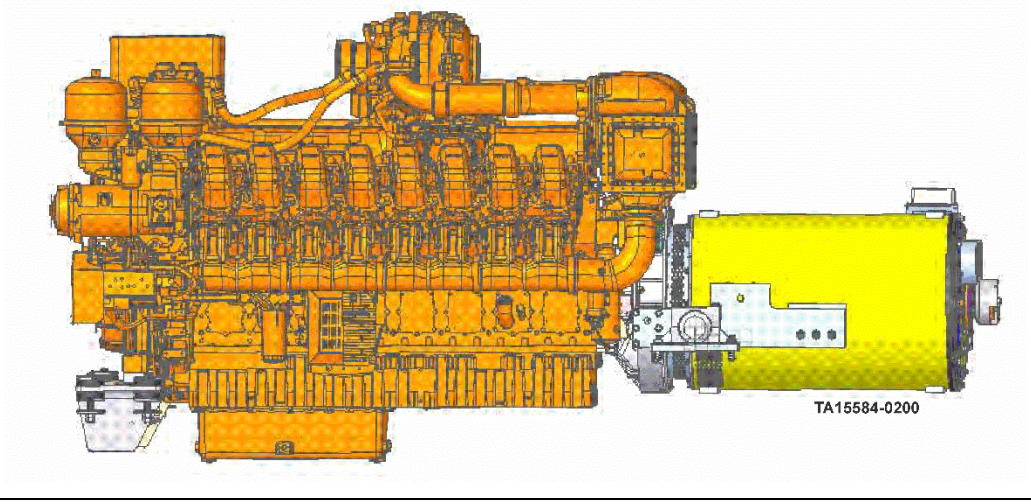


Figure 216. Detroit Diesel Engine with G200 Generator Mounted - Typical

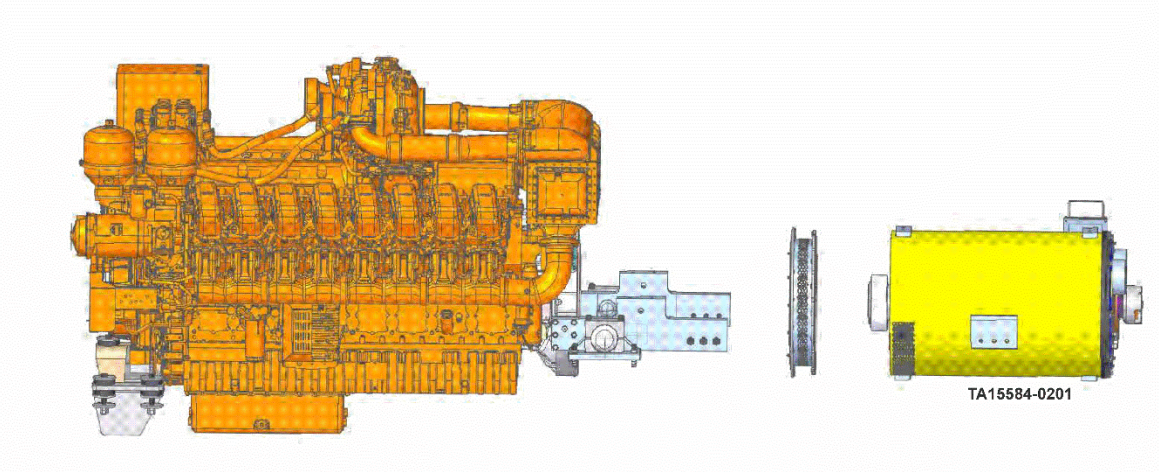
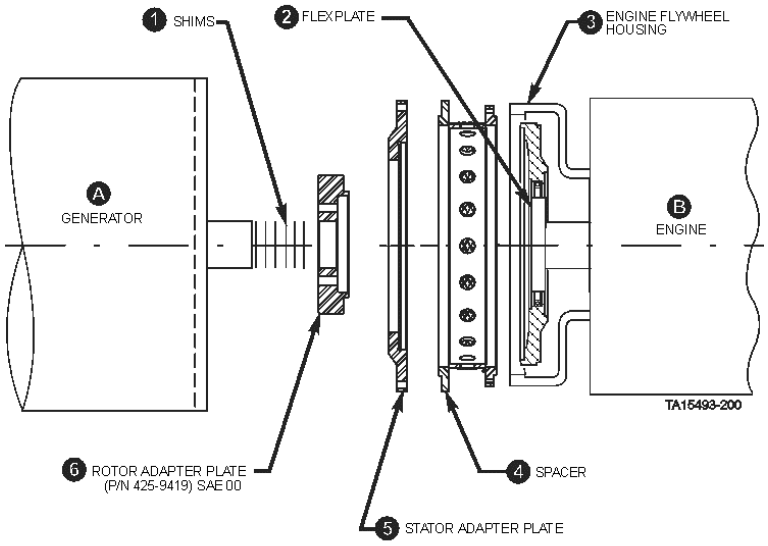


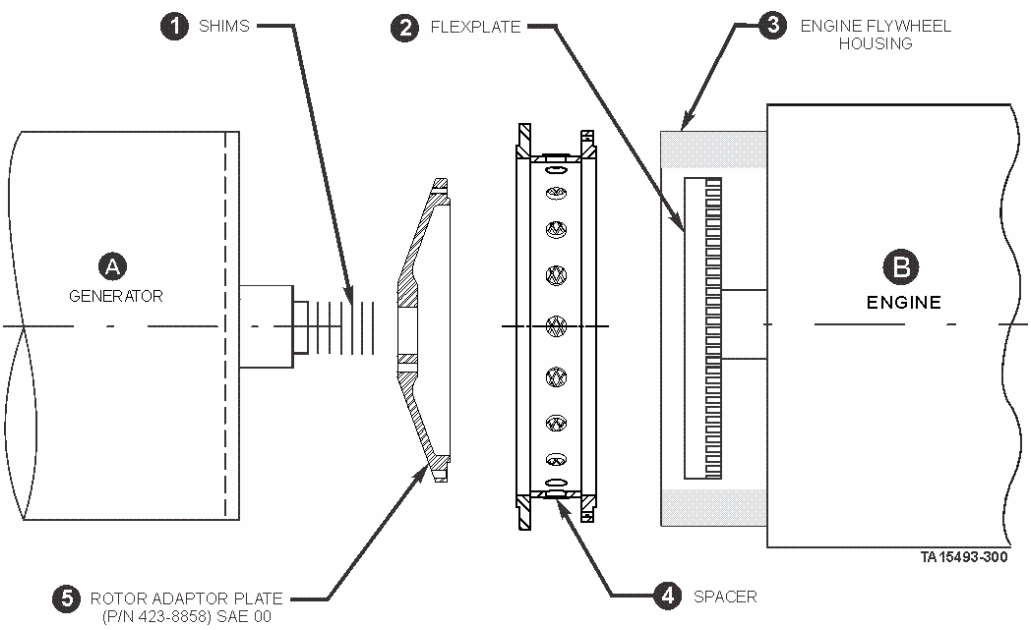
Figure 217. Detroit Diesel Engine with G200 Generator Dismounted - Typical



1) Shims, **2)** Flexplate, **3)** Engine flywheel housing, **4)** Spacer, **5)** Stator adaptor plate, **6)** Rotor adapter plate

A) Generator, **B)** Engine

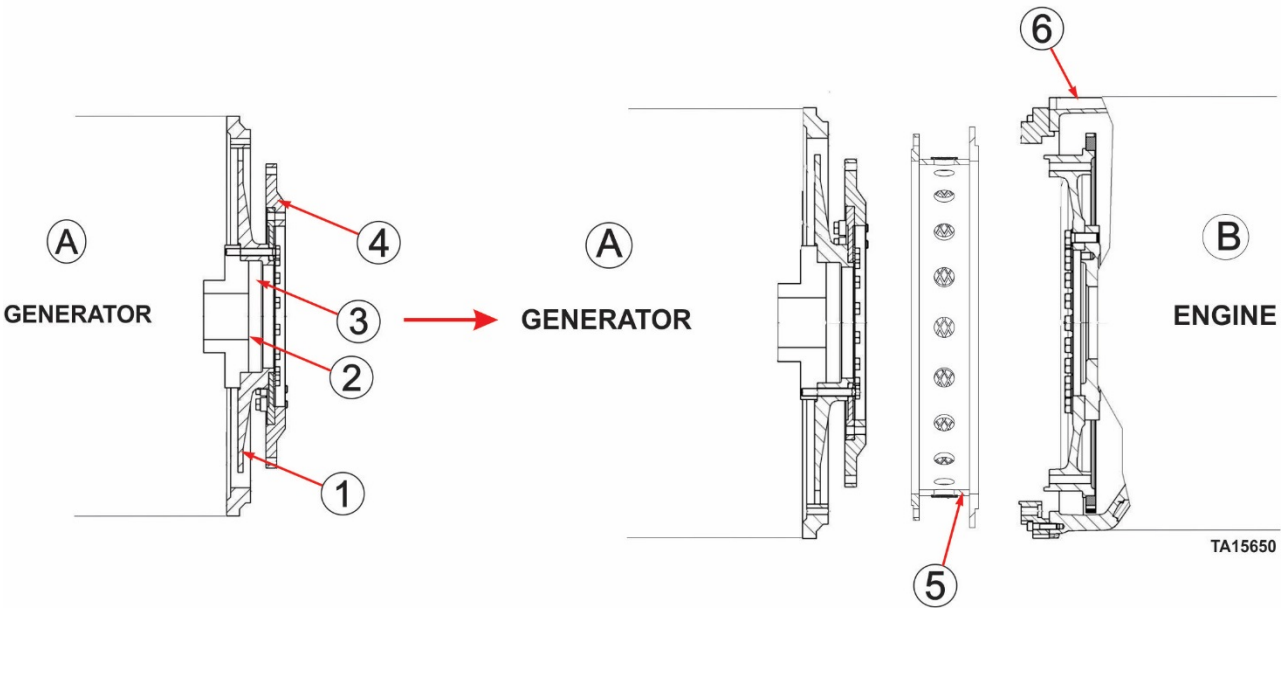
Figure 218. Exploded Arrangement of Engine to Generator G200 Generator (P/N R4264703)



1) Shims, **2)** Flexplate, **3)** Engine flywheel housing, **4)** Spacer, **5)** Rotor adaptor plate

A) Generator, **B)** Engine

Figure 219. Exploded Arrangement of Engine to Generator G200 Generator (P/N R4264707)



1) Diaphragm coupling, **2)** Shims, **3)** Rotor adapter, **4)** Flex plate, **5)** Spacer, **6)** Engine flywheel housing

A) Generator, **B)** Engine

Figure 220. Arrangement of Engine to Generator Coupling Components (G200 Generator - Tier 2)

- **Generator** - single bearing G200 (Tier I and Tier II)
- **Shims** - provide for axial adjustment.
- **Rotor adapter** - connects the generator rotor shaft to the engine flexplate. This can be flat or conical shaped and can be various diameters.
- **Spacer/Stator adapter(s)** - connects the generator stator to the engine flywheel housing. Depending on the engine and generator combination - this can be either one or two pieces of various diameters.
- **Flexplate** - supplied by engine manufacturer. Uses a pack of thin laminations to provide flexibility between the engine crankshaft and the generator rotor. This can be various diameters depending on the engine.

NOTICE

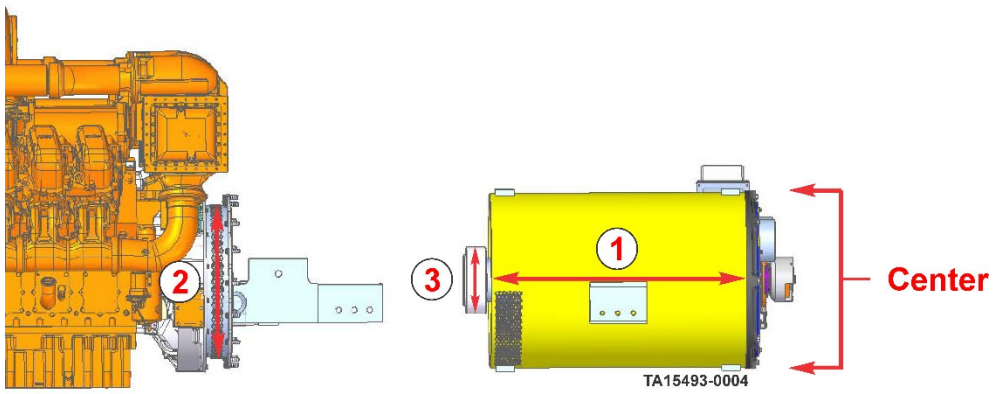
MTU Tier 2, 4000 series engines are provided with a solid plate on the engine. The lamination pack becomes part of the rotor adapter.

- **Flywheel housing** - typically a casting on rear of ending that provides a connecting point for the generator and the engine mount structures. This will vary depending on the engine.

Primary Key Steps

The installation and alignment of a G200 single bearing generator can be broken down into several basic steps.

- Center the rotor axially so that it does not apply axial load to the engine. This is done with shims.
- Square up and center the stator axially with respect to the engine so that no loads are applied to the engine bell housing.
- Center the rotor radially so that the generator rotor is lined up with the engine crankshaft so that it does not cause vibration.



Shown with left engine/generator Mount removed for clarity

Generator alignment must be done using an engine/generator stand. The engine/generator stand may be purchased from Komatsu or it may be locally fabricated. Detailed prints for the stand will be provided to use for local manufacture. Contact your local Komatsu Service Center for details

CAUTION

Do not align the generator to the engine with the engine mounted in the frame. This can cause engine and generator problems due to misalignment.

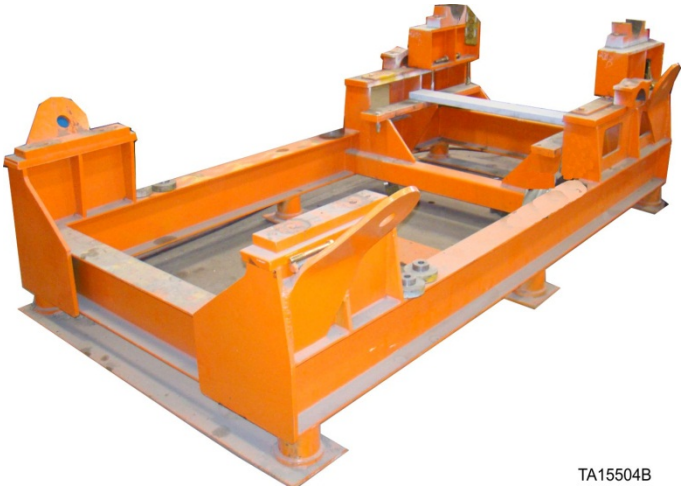


Figure 221. Typical Engine/Generator Assembly Stands L1850/L2350 - Stand (P/N R1032750)

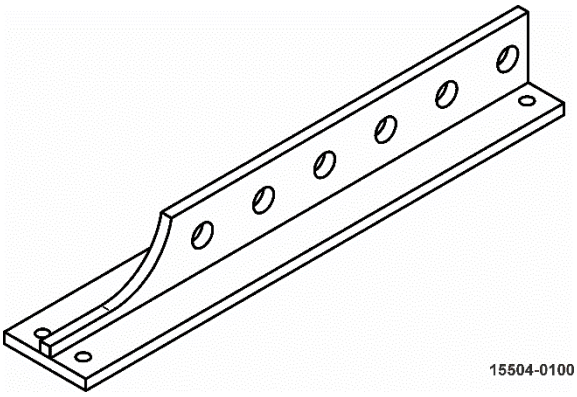


Figure 222. G200 Lifting Fixture - (P/N R1036777)

Alignment Procedure Summary Overview

General Steps that must be followed to Assure Minimal Vibration and Correct Engine and Generator Endplay.

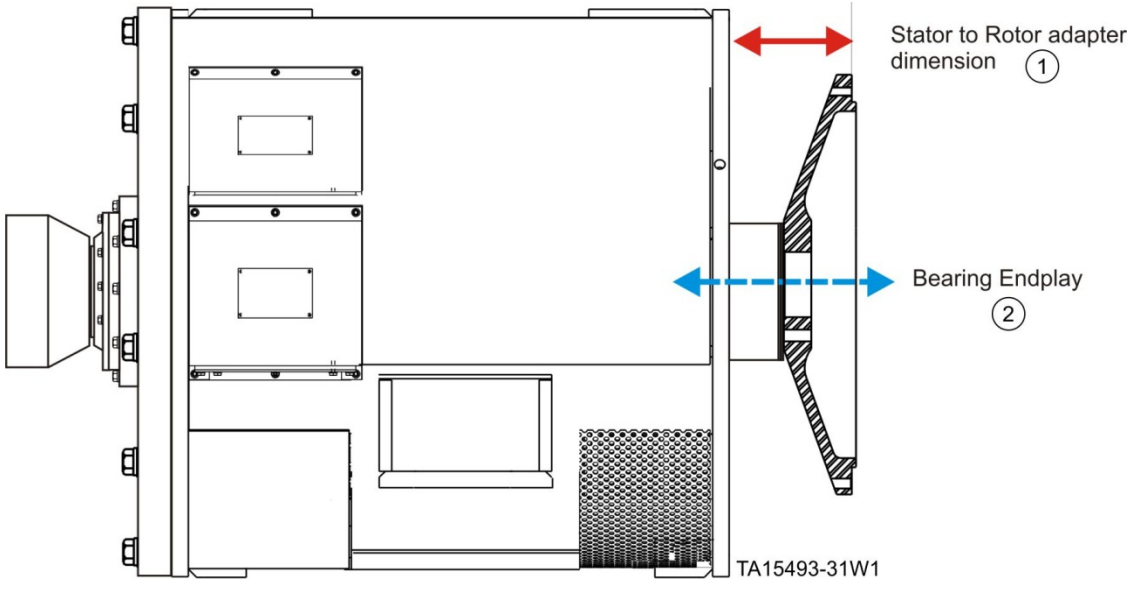
1. Rotor endplay and stator/rotor adapter measurements.

6. Pre installation engine alignment inspections and setup.
7. Alignment of rotor adapter onto flywheel.
8. Set axial endplay.
9. Install generator.
10. Rotor shaft TIR runout.

The following is a brief summary of the generator alignment steps. Details for each step are provided in the following sections/chapters.

Rotor Endplay and Stator/Rotor Adapter Measurements

- Measure generator bearing endplay.
- Measurement from stator to rotor adapter with bearing in middle of endplay.

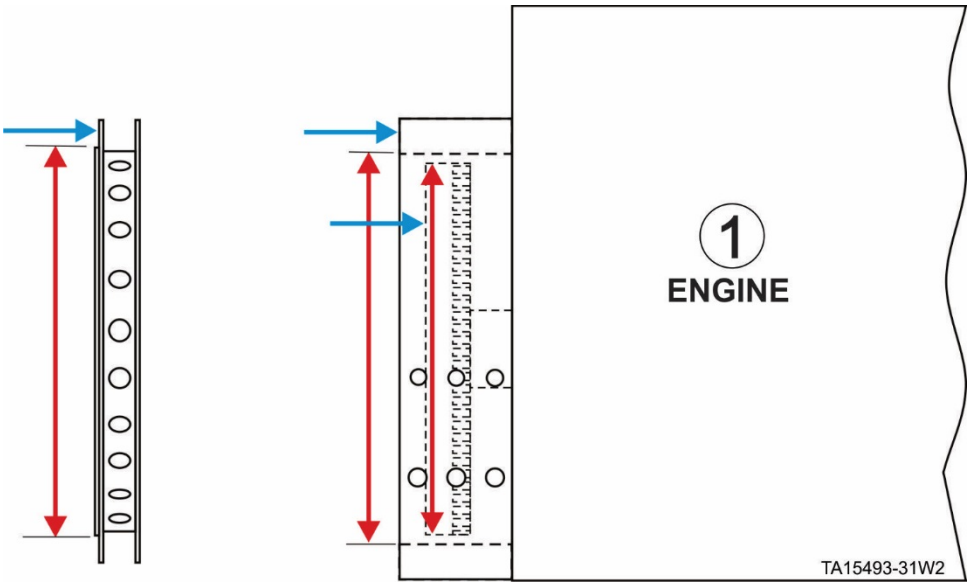


1) Stator to rotor adapter dimension, **2)** Bearing endplay

Figure 223. Generator measurements - (typical)

Pre- installation Engine Alignment Inspections and Setup

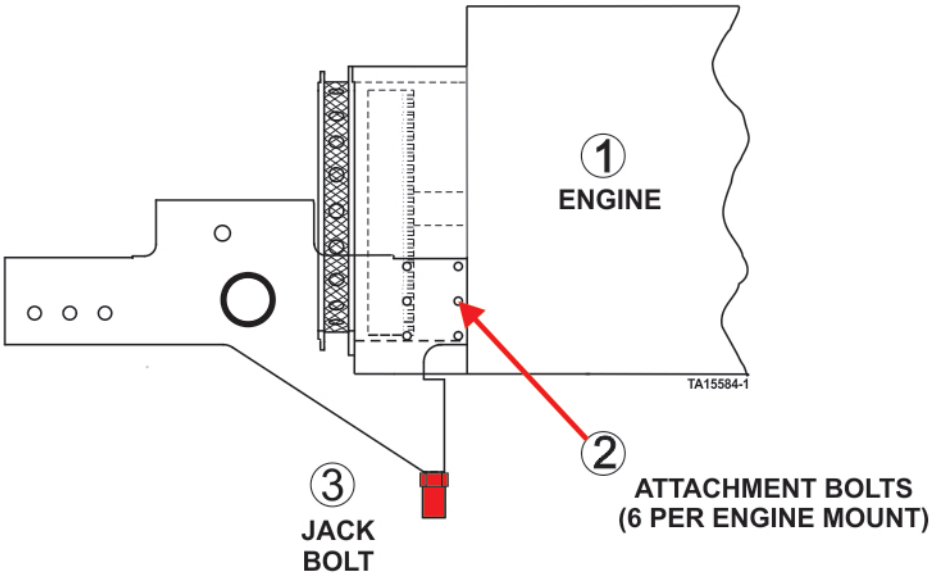
- Structural measurements of flywheel bell housing and stator adapter.



1) Engine

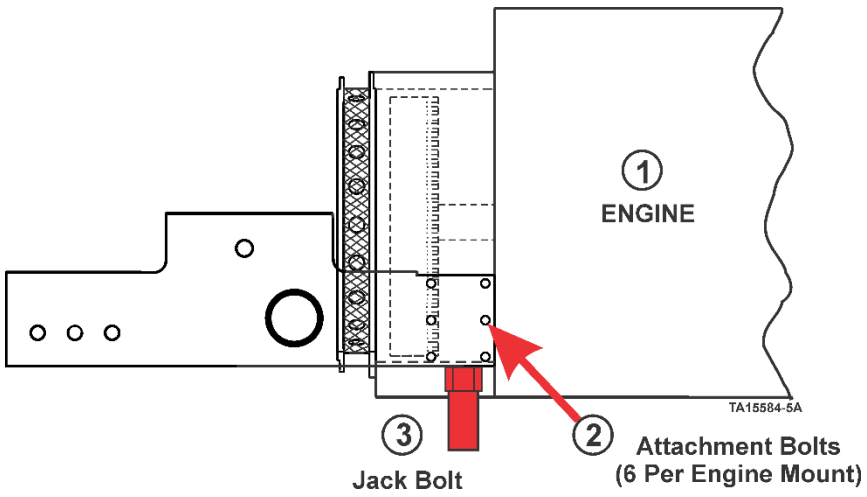
Figure 224. Pre-installation inspections

- Install the engine mounts
- Install jack bolts to prevent stress on the flywheel bell housing.



1) Engine, **2)** Attachment Bolts (6 per engine mount), **3)** Jack Bolt

Figure 225. Pre-installation inspections Gen 2 -Tier 1 - G200

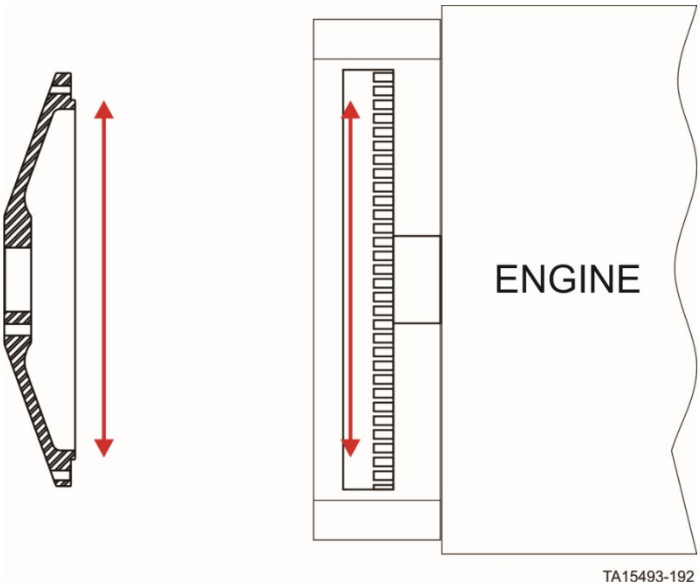


1) Engine, **2)** Attachment Bolts (6 per Engine Mount) **3)** Jack Bolt

Figure 226. Pre-installation inspection Gen 2 - Tier 2 - G200

Alignment of Rotor Adapter onto Flywheel

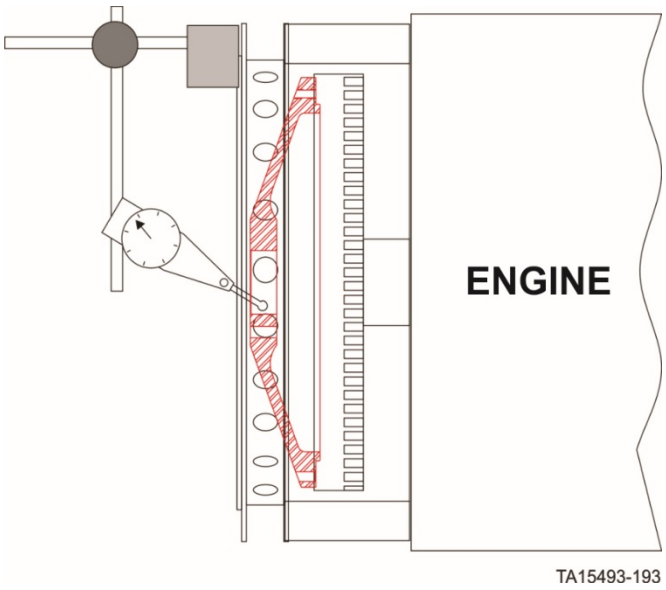
- Must be about .000 - .002. tight fit.



1) Engine

Figure 227. Alignment of rotor adapter onto the flywheel

- Position the rotor adapter for minimum runout in the inner bore where it mounts to generator shaft.

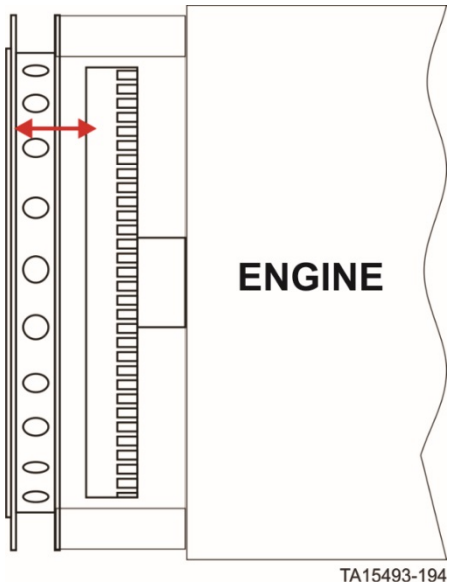


Engine

Figure 228. Alignment of rotor adapter onto the flywheel

Set Axial Endplay

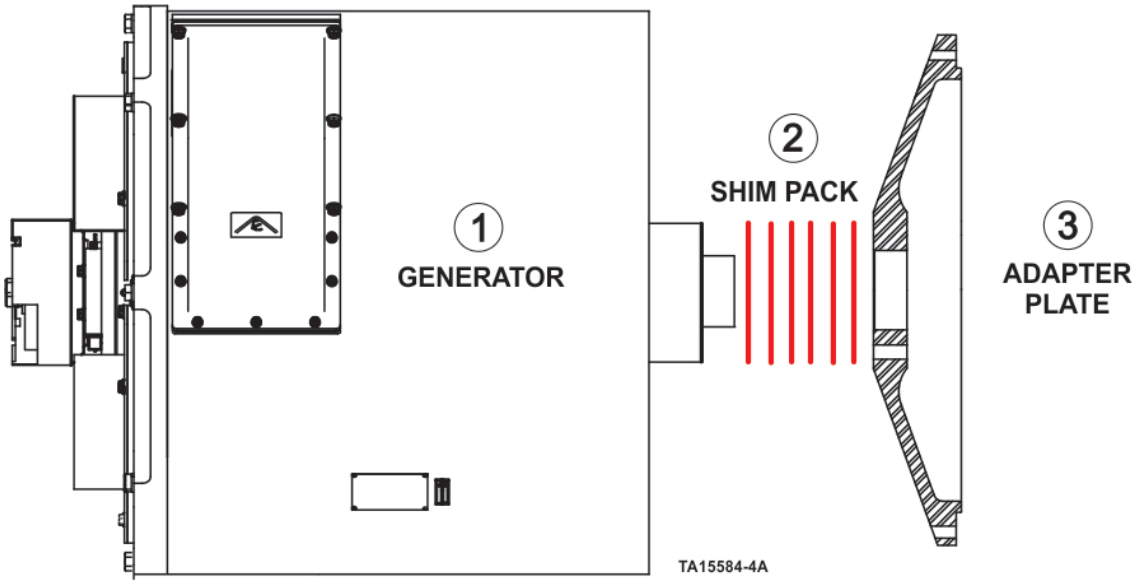
- Measure stator adapter to flexplate.



Engine

Figure 229. Measure stator adapter to flexplate

- Determine the proper shim pack so the generator bearing will be positioned in the middle of the endplay after assembly. This will assure that there is no generator loading on the engine thrust bearings. Use generator worksheet data.



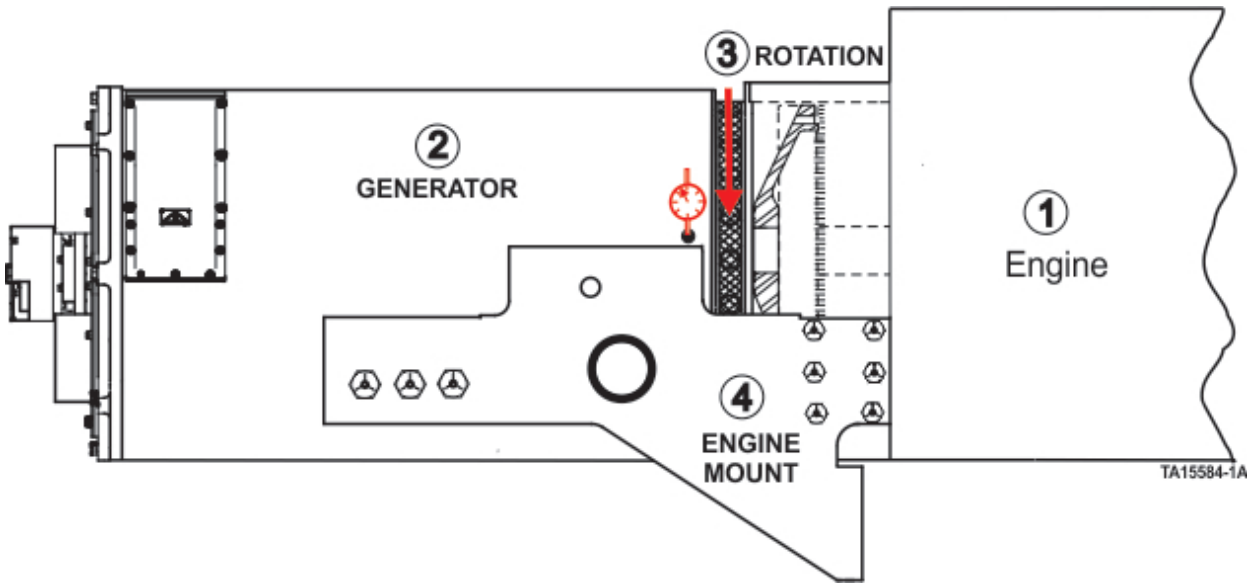
1) Generator, **2)** Shim Pack, **3)** Adapter Plate

Figure 230. Determine shim pack

Install Generator

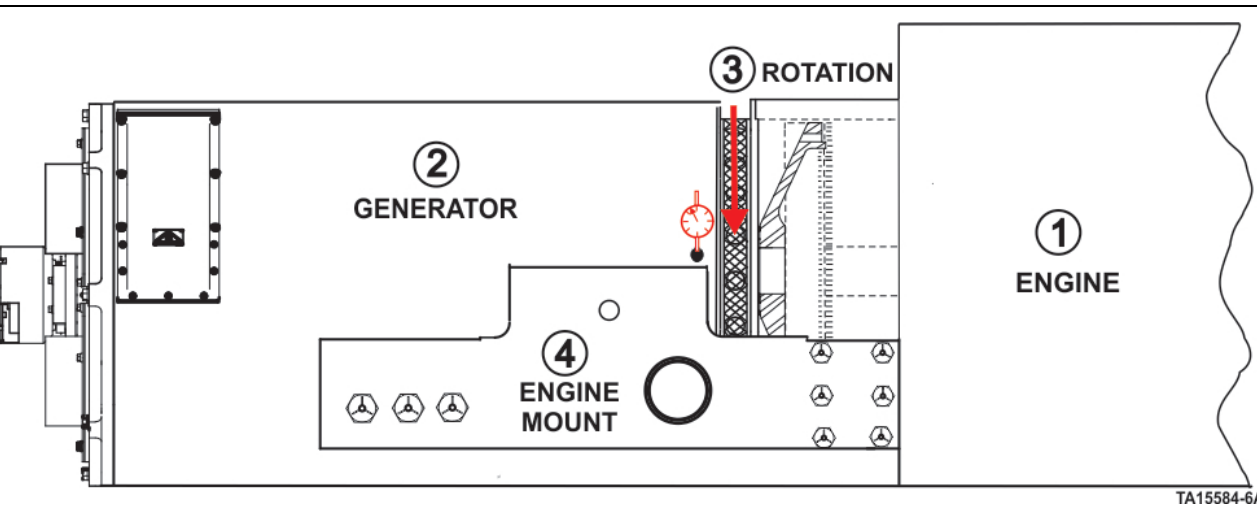
Final Rotor Shaft Runout Check

- Use a dial indicator to check rotor shaft runout.



1) Engine, **2)** Generator, **3)** Rotation, **4)** Engine Mount

Figure 231. Rotor shaft runout check (G200 Gen 2 - Tier 1)

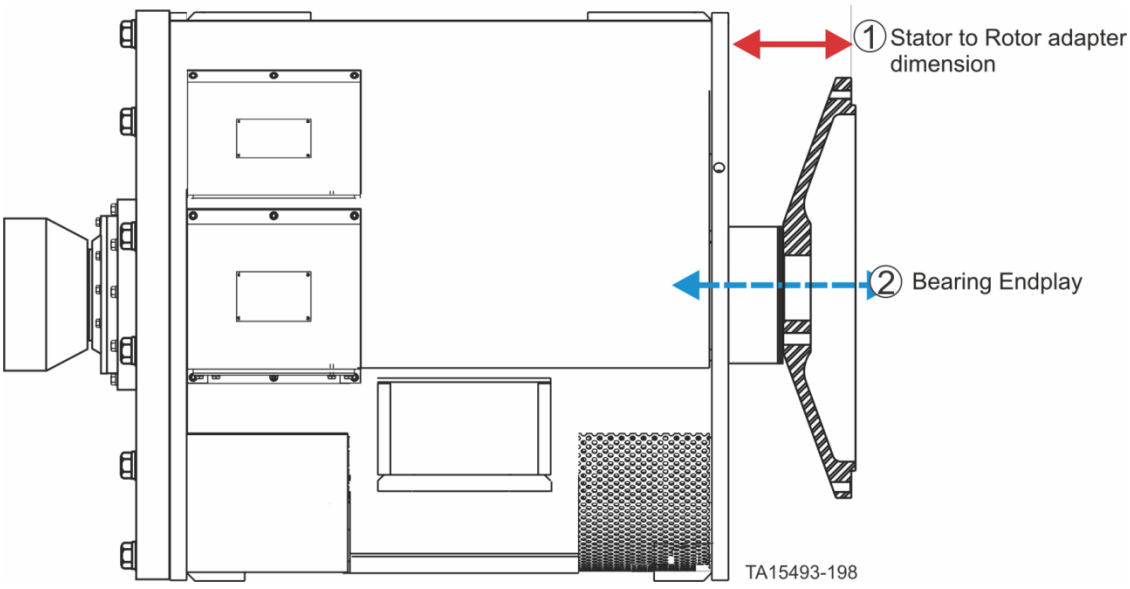


1) Engine, **2)** Generator, **3)** Rotation, **4)** Engine Mount

Figure 232. Rotor shaft runout check (G200 Gen 2 -Tier 2)

Detailed Step by Step Instructions

Rotor Endplay and Stator/Rotor Adapter Measurements



1) Stator to rotor adapter dimension, **2)** Bearing endplay

Figure 233. Generator measurements

The rotor in a single bearing generator is designed with a slip fit in the endbell so that it can move approximately .050” maximum axially. This movement will compensate for differences in thermal expansion between the stator and rotor during normal operation of the generator. The endplay is derived from two areas: 1) the internal clearance of the bearing and 2) limited axial movement of the outer bearing race in the endbell.

The goal of these measurements is to position the generator rotor in the center of its endplay when connected to the engine.

1. Check the engine end of the rotor shaft, the ID of the rotor adapter and the rotor shims to be sure that all mating surfaces are clean and free from any protective coatings or burrs.
2. Gather the standard number of rotor shims which are positioned between the rotor adapter and the shaft.

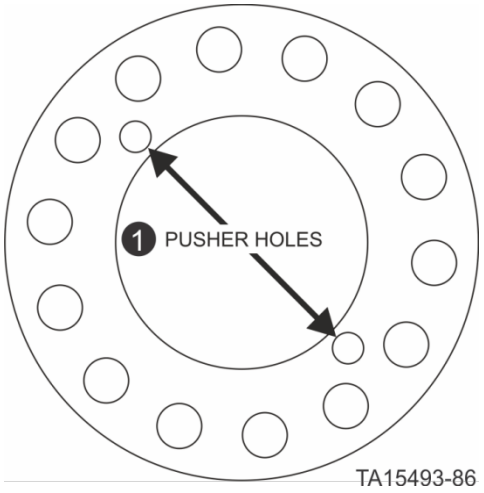
NOTICE

The number of shims in the standard shim pack is a typical average and is just a starting point for measurements and adjustments. This quantity is not critical as the specific quantity of shims required for a given alignment and generator installation will be adjusted at later step in this procedure.

Generator or Flywheel	Standard Shim Pack
G200 (SAE 0 and 00) (Tier 1 & Tier 2)	6 each – (P/N R4164561) large diameter .007” shims = .042”

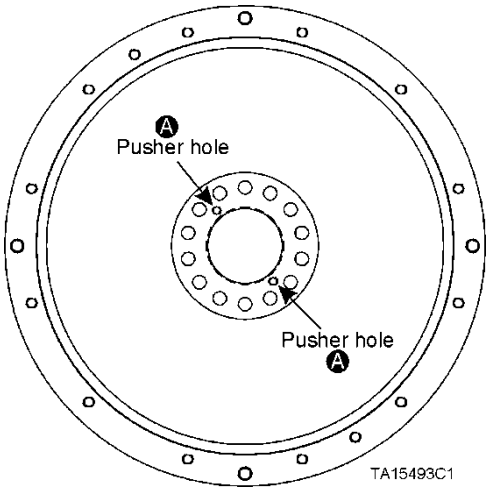
NOTICE

Assure that the two .531” diameter holes in the shim pack lineup with the pusher holes in the rotor adapter. Refer to illustration below for a diagram of the shims. If the holes are not aligned - the shims will be severely damaged when rotor adapter is removed from shaft.



1) Pusher holes - large diameter shims

Figure 234. Pusher holes - large diameter shims



A) Pusher hole locations

Figure 235. Pusher holes in rotor adaptor - (typical)

3. Mount the rotor adapter and shims with the pusher holes aligned. This will prevent damage to the shims when the rotor adapter is removed.
4. Torque the 3/4" fasteners to 50 ft-lb.
5. Obtain the rotor endplay and stator to adapter dimension using one of the following methods:

Endplay Measurements

NOTICE

The endplay is measured horizontally - the dimensions between stator and rotor adapter should always be taken horizontally.

1. Orient the generator horizontally.
2. Lift the rotor adapter/shaft slightly with a lifting strap on the drive end with a crane until the rotor is free and centered (not touching the stator bore).

Figure 236. Lifting strap located on drive end

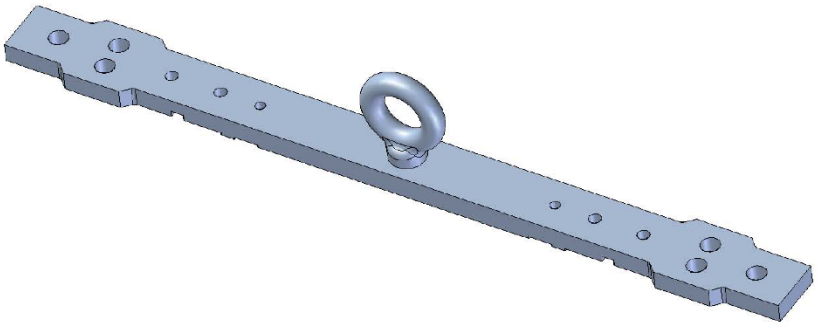
CAUTION

Do not wrap any type of lifting equipment (chain, for example) around the shaft that might cause damage to the shaft. The shaft surface in this area must be undamaged and unmarked for use in the final checkout.

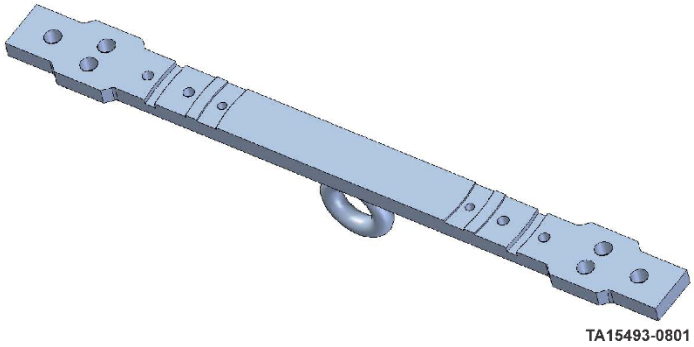
⚠ CAUTION

Crush hazard exists when supporting the rotor. If not properly supported, the rotor can fall. If a crane is not available to support the rotor - it is also permissible (but not required) - to support the rotor with the rotor endplay tools. Failure to properly support the rotor can cause crush hazards resulting in personal injury.

Figure 237. Rotor endplay tools

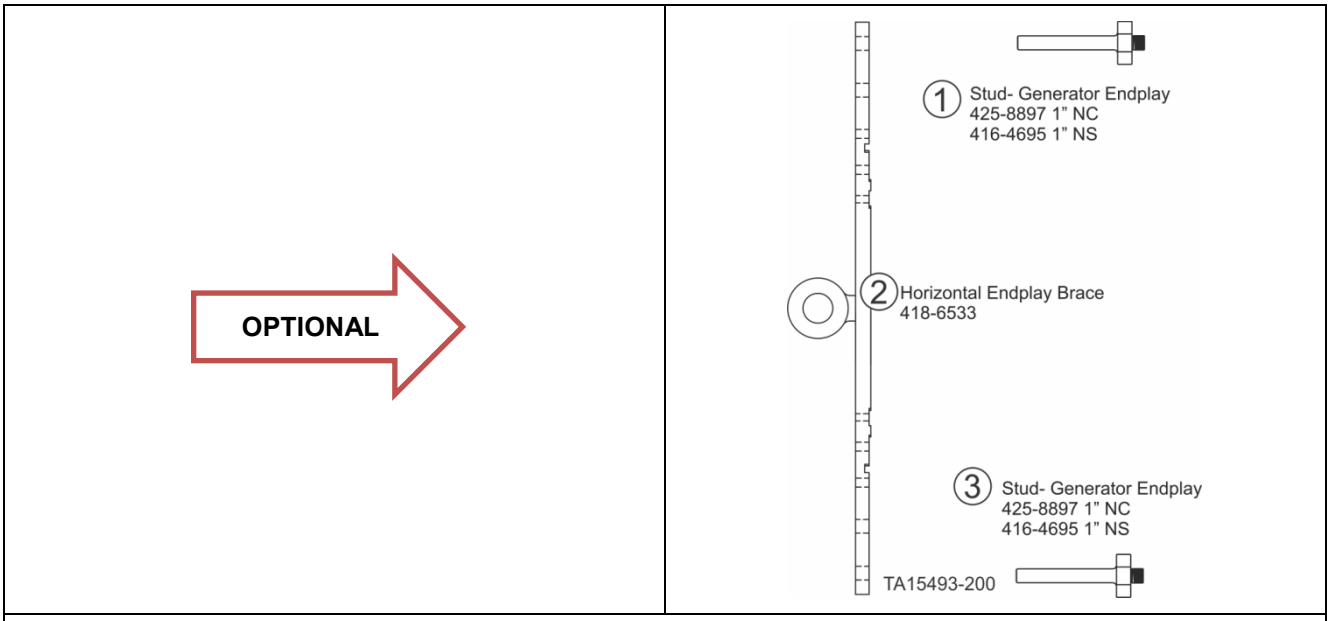


Top View



Bottom View

Figure 238. Horizontal Endplay Brace - 1 of 2



1) Stud – generator endplay, **2)** Horizontal endplay brace, **3)** Stud – generator endplay

Figure 239. Horizontal endplay brace

3. Install a large diameter lifting eye in the non-drive end of the shaft. This requires a lifting eye with 1" X 14 UNS threads.

NOTICE

For this purpose the eyes will NOT be used for lifting, so locally fabricated eyes would be acceptable – these eyes should be clearly marked that they are for rotor shifting only. DO NOT use any locally fabricated eyes for lifting.

CAUTION

DO NOT use any locally fabricated eyes for lifting.

4. Remove one endbell bolt that is approximately horizontal or a little above and Install a large diameter eye.

Endbell		
G200.	5/8-11 UNC thread	Length depends on endbell thickness
Rotor shaft		
G200	1" x 14 UNS Thread	1-1.5" thread engagement

5. Install a long bar through the eyes.

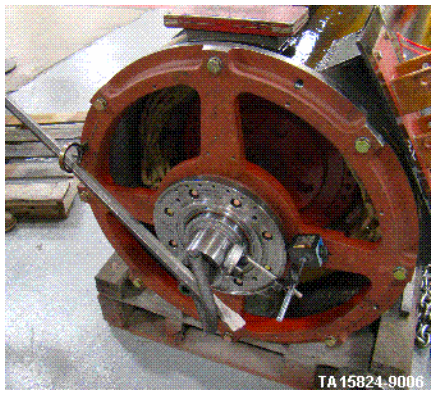


Figure 240. Pry bar

6. Mount a dial indicator on the non drive end of the generator with the tip or button of the indicator resting against the face of the outer seal race as shown in illustration. Mount the magnetic base on the endbell near the bearing retainer. Adjust so that the dial indicator is measuring movement of the inner race (pressed onto the shaft).

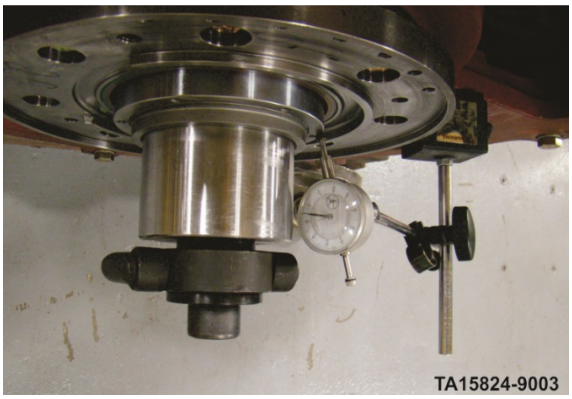
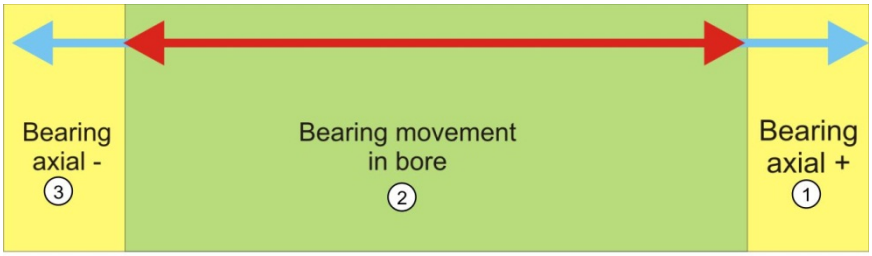


Figure 241. Dial indicator

7. Using the bar - shift the rotor all the way toward the non drive end.
8. Release the load from bar and zero the indicator.
9. Shift the rotor all the way toward the drive end of the generator.
10. Release load from bar and note the dial indicator measurement.
11. Repeat several times to verify that the number obtained is repeatable.

NOTICE

This measurement taken in this step is only looking for the bearing movement in the endbell bore. The bearing has an internal axial endplay of about .020” to .030”. It is normal to have a slight amount (.010-.015” maximum) of spring like movement due to the axial internal endplay of the bearing when the rotor has been fully shifted one way or the other. The bearing should center up when the load on the shifting bar is removed.



1) Bearing axial + , **2)** Bearing movement in bore, **3)** Bearing axial -

Figure 242. Bearing endplay - bearing movement plus bearing axial

12. Record the total endplay on line 1.1 of the Generator Installation Worksheet.

NOTICE

GEN 1 - Typical total rotor endplay in the horizontal position should be between .070” and .100”.

GEN 2 - (Tier 1 & Tier 2) Typical total rotor endplay in the horizontal position for the G200 should be between .035 and .055.

Possible reasons for variance outside this range could be:

- Incorrect bearing.
- Endbell thickness incorrect.
- Bearing retainers damaged or incorrect.
- Gaskets not in or too thick/too thin.

13. Shift the rotor all the way toward the non drive end of the generator.

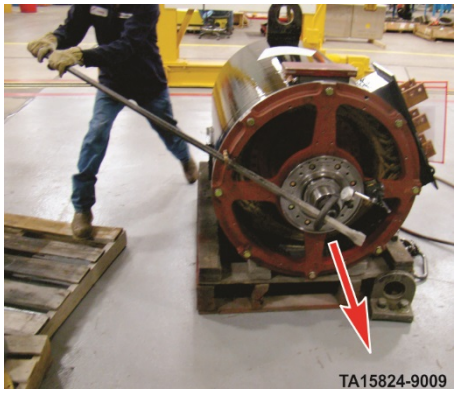


Figure 243. Shift rotor toward non drive end

14. Continue to support the rotor with the strap, or with the horizontal endplay brace, so that the rotor is centered in the stator.
15. Measure the distance between the face of the rotor adapter and the stator mount face using an inside micrometer and appropriate straight edge as shown in the illustrations.

NOTICE

The straight edge used for this inspection must have a perfectly flat surface and must not be bent or damaged.

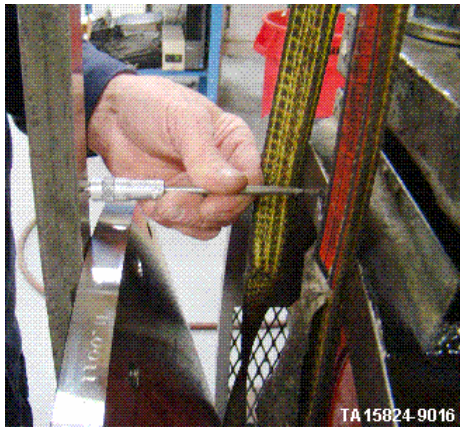
CAUTION

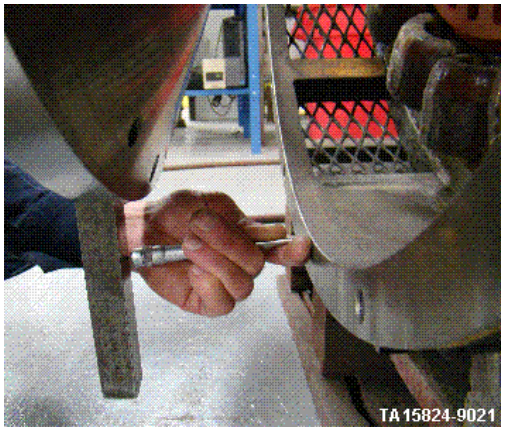
DO NOT measure to the horizontal endplay brace as it typically will not have a flat surface. The horizontal endplay brace is not a straight edge.

Figure 244. Do not measure between endplay brace as it is most likely not a straight edge

Figure 245. Measurement between a straight edge and generator stator

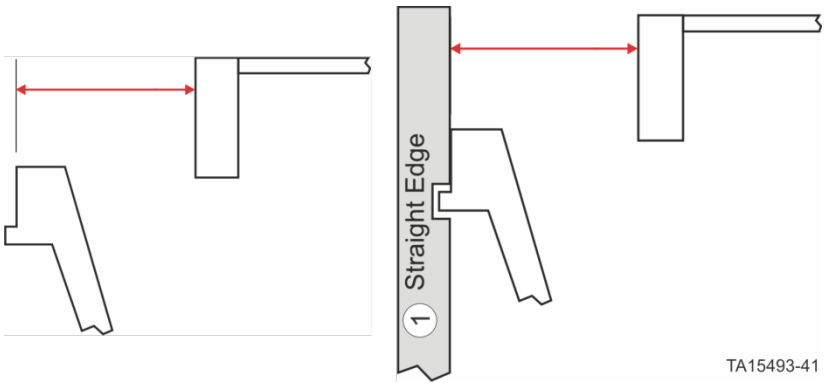
16. Measure the gap at the top and bottom
17. Calculate the average.
    - (Top measurement + bottom measurement)/2
18. Record the average number on line 1.2 of the Generator Installation Worksheet labeled “Adapter to Stator Dimension”.





NOTICE

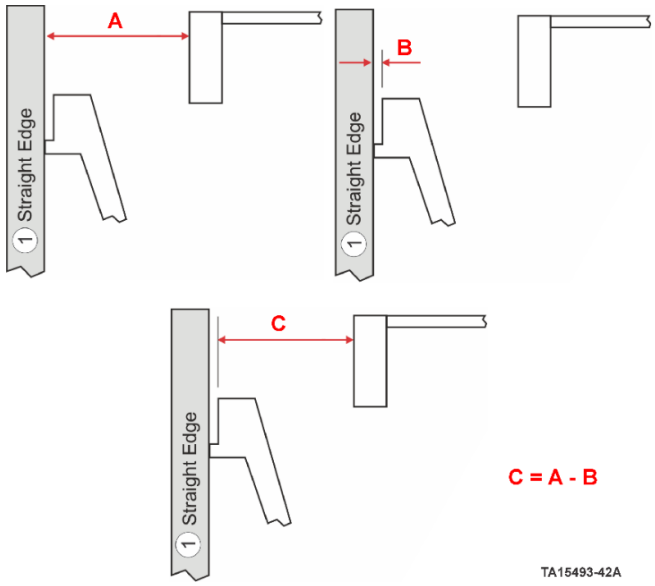
This dimension is from the mounting face surface to the flange on the stator. Some rotor adapters will have a mounting face as shown that can be checked with a standard flat edge. Others will have a face that is recessed behind a shoulder and will require either a special straight edge or extra math calculations.



1) Straight edge

Figure 246. Measuring "adaptor to stator dimension" between face of rotor adapter and face of generator pole ring - cone type rotor adapter with special straight edge tool

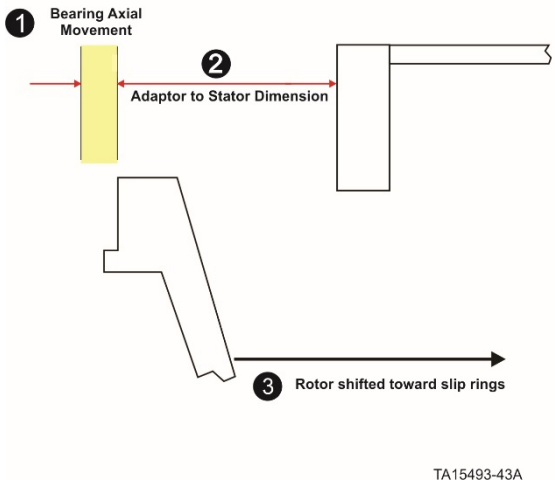
19. If the special straight edge tool is not available, the same measurement can be taken with a common straight edge - it just takes several steps. See the next figure.
    - Measure from the generator flange to the straight edge.
    - Measure the gap between the straight edge and the mounting face of the rotor adapter.
    - Subtract step b from step a.
    - This is the desired measurement from the face of rotor adapter to face of generator flange.



1) Straight edge

Figure 247. Measuring "adapter to stator dimension' between face of rotor adapter and face of generator pole ring - cone type rotor adapter with common straight edge - 3 steps required

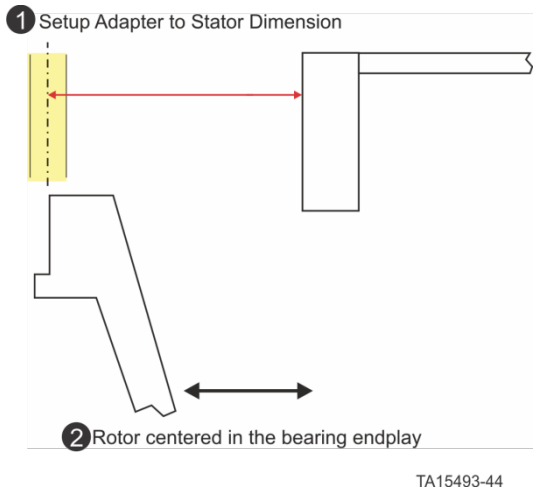
20. Add one-half of the total rotor endplay to the “Adapter to Stator Dimension” dimension.



1) Bearing axial movement, **2)** Adapter to stator dimension, **3)** Rotor shifted toward slip rings

Figure 248. Adapter to stator dimension" and bearing endplay

21. Record this “new” dimension on line 1.3 of the Generator Installation Worksheet labeled “SETUP ADAPTER TO STATOR DIMENSION”. This dimension is the distance between face on generator stator and rotor adapter – when the generator rotor is centered in middle of bearing movement.



1) Setup adapter to stator dimension, **2)** Rotor centered in the bearing endplay

Figure 249. Setup adapter to stator dimension = “adapter to stator dimension" + = 1/2 bearing endplay

Pre-installation Engine Checks and Setup

a. Remove the rotor adapter plate from the generator. The pilot diameter shown on the generator worksheet is for reference. Record the CMM (coordinate measuring machine) number on line 2.1 of the Generator Installation Worksheet.

b. Check the pilot diameter on the flexplate. Refer to the generator worksheet for the proper dimensions. Record the measurement obtained on line 2.2 of the Generator Installation Worksheet.

c. It is important that the rotor adapter plate bore and flexplate pilot shoulder be within tolerance. A slight interference fit is needed between these two parts to ensure proper alignment between rotor and crank. If the fit is within specifications, pulling the adapter plate onto the pilot shoulder with the bolts will typically be necessary (and push it off with the pusher holes). The pilot shoulder on the flexplate is designed to carry the weight of the rotor. The two dowel pins in the face of the flexplate are a loose fit in the rotor adapter for guidance purposes only. If these pieces do not have the correct tight fit - replace the defective component - or correct the fit.

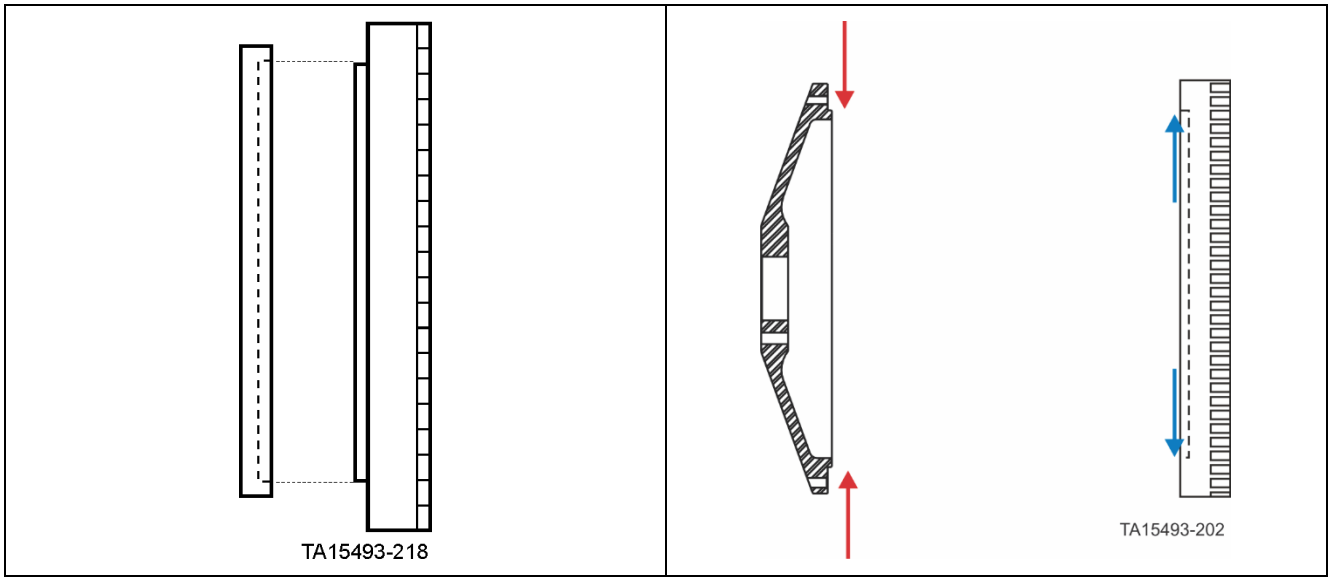


Figure 250. Measure Diameter on Rotor Adapter and Flexplate

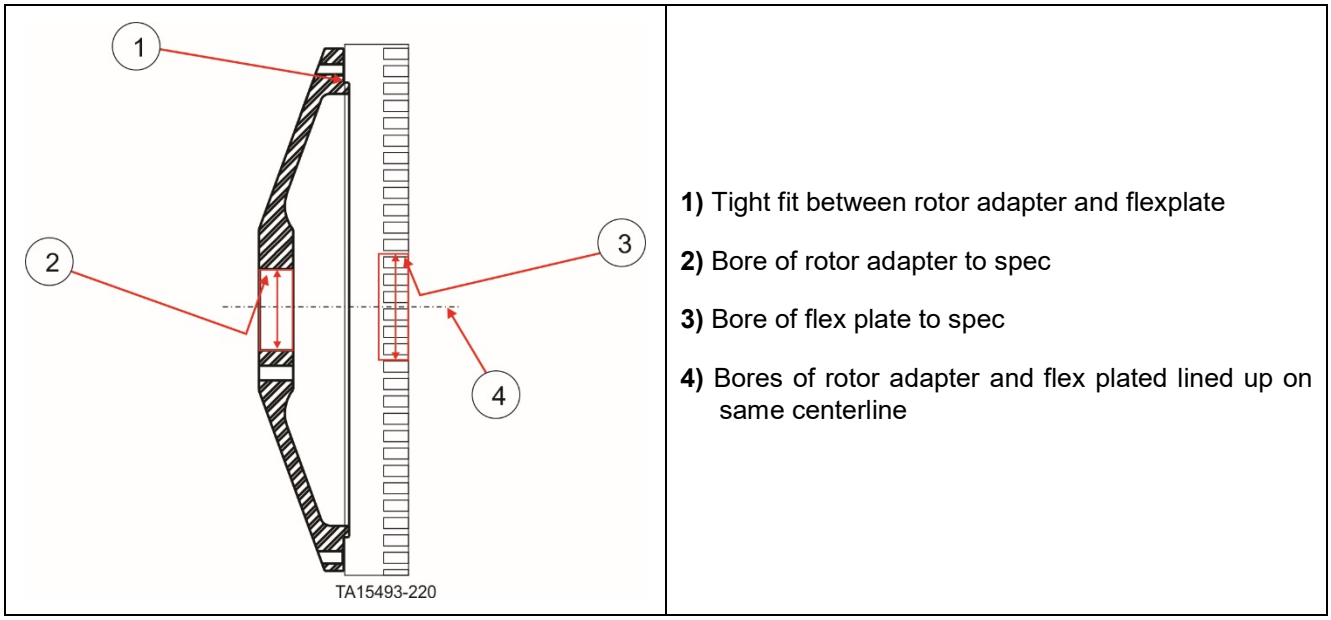
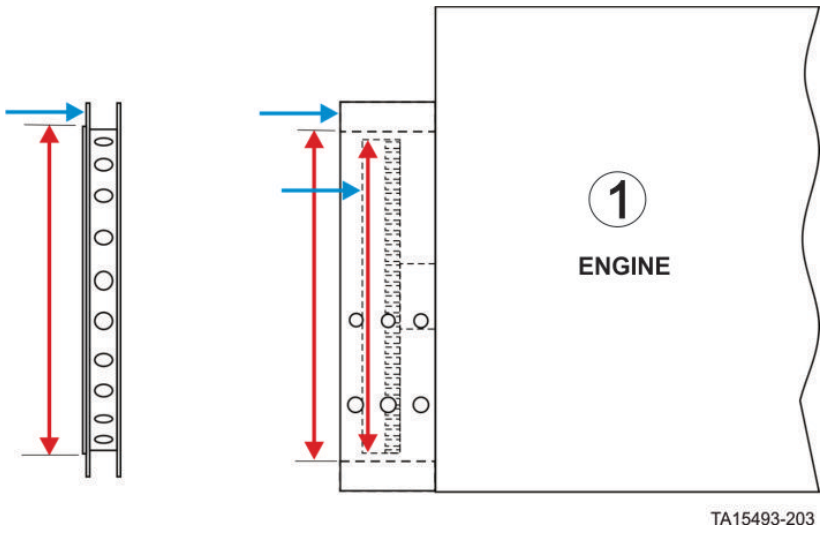
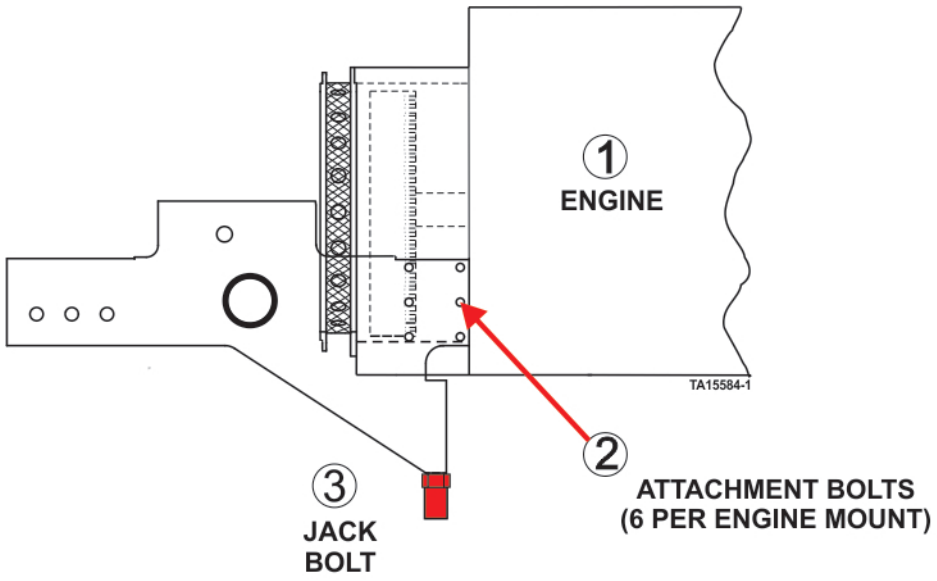


Figure 251. Measure Diameter on Rotor Adapter and Flexplate



1) Engine

Figure 252. Pre - installation Inspections - 1 of 2



1) Engine, **2)** Attachment Bolts (6 per engine mount, **3)** Jack Bolts

Figure 253. Pre - installation Inspections - 2 of 2

NOTICE

It is recommended that all steps be followed each time a generator is installed to assure that job is done properly.

d. Ensure that the engine flexplate, flywheel housing, stator adapter plate, stator frame mounting face and rotor adapter face are clean and free from any dirt or protective coating. Pay particular attention to the various pilot diameters to ensure that they are free from nicks and burrs.

Figure 254. Clean All Mounting Faces and Shoulders

e. Ensure that the mating faces on the engine mounts and the flywheel housing are clean and free from paint and oil. *Clean out all tapped holes on the flywheel housing.

f. Ensure that the face on the engine mounts arm and flywheel housing are flat and free from machine marks.

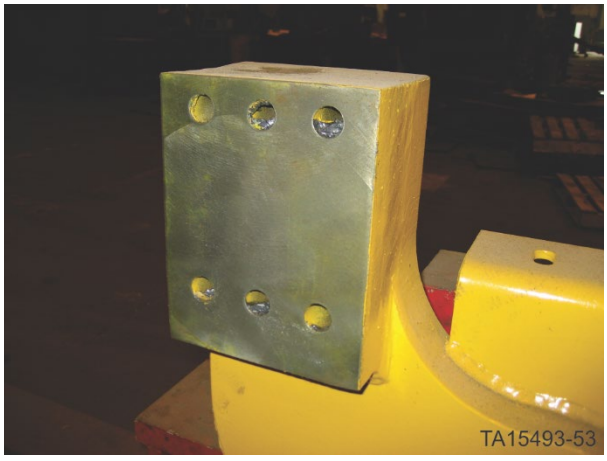


Figure 255. Clean Mounting Faces on the Engine Mounts and the Flywheel Housing

g. If you have the engine support stand - the engine mounts and the front engine support can be mounted to the stand.
h. Support the engine at the front near the front mount and at the rear near the mounts at the flywheel housing.
i. Install both rear engine mounts. The engines are a flat clamp surface. There are no precision shoulders that the mounts sit against
j. Ensure that the mounts are pushed tight against the shoulders provided on the flywheel housing and the bolts are properly torqued. This only applies to engines that have a shoulder as shown.

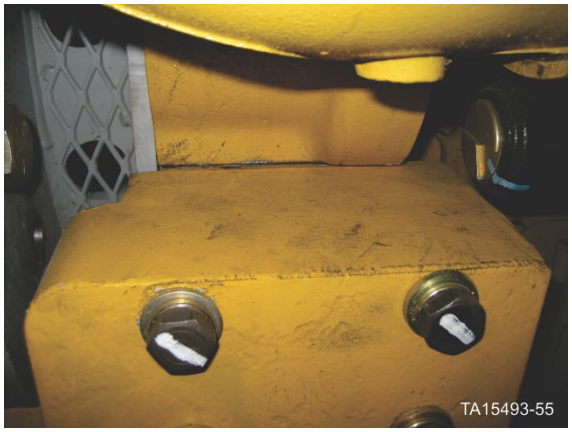


Figure 256. Mounts Pressed Tight Against the Shoulders on Flywheel Housing

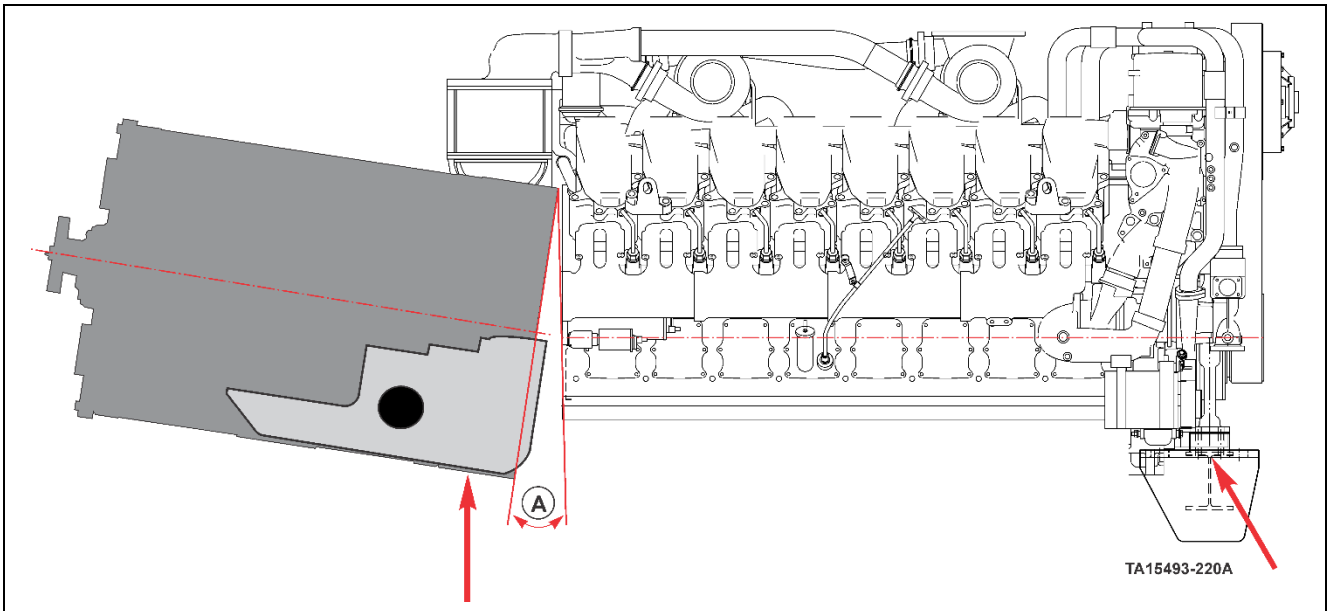
k. Tighten bolts.

		Torque Dry		Torque Lubricated	
MTU 2000/4000	M16-16 mm x 10.9	230 lb.-ft.	313 N ● m	173 lb.-ft.	235 N ● m
Cummins QST30, QSK45, QSK 60 MTU 16V 4000 Stiffener	M20-20 mm x 10.9	450 lb.-ft.	610 N ● m	338 lb.-ft.	456 N ● m
Cummins QSK38	3/4-10 G8	376 lb.-ft.	510 N ● m	282 lb.-ft.	383 N ● m

Figure 257. Jack Bolt Directly Under Engine Mount

NOTICE

Failure to support the mounts/engine with jack bolts will cause problem with alignment and can cause flywheel housing oil leaks particularly on MTU/Detroit series 4000 engines.



Red arrows indicate where supports should be located

A) Distance greatly exaggerated in illustration

Figure 258. Misalignment Problem caused by Failure to Properly Support the Engine and Generator

l. Check the runout of the pilot diameter on the flexplate. Use a dial indicator mounted on the flywheel housing. Rotate the flexplate from the front of the engine. Refer to the Generator Installation Worksheet for the maximum allowable T.I.R. Record the measurement obtained on line 2.3 of the Generator Installation Worksheet.

m. If the flexible T.I.R. is higher than the limit, the problem should be corrected before proceeding with the alignment procedure. Contact your local engine distributor to obtain another flexplate. Most engines will be rotated from the starter end. This is done with a rotation tool.

Installation of the Engine Rotation Tool

Rotating Engine Crankshaft from the Front of the Engine

NOTICE

Early version of the Tier 1 engines allowed for the rotation of the engine crankshaft from the front of the engine. With the newer model engines this is no longer an acceptable practice because of the factory installed cover.

NOTICE

Rotating from the front of the engine is the preferred method for the earlier version of the Tier 1 engine. The engine must be rotated in the direction that will tighten the bolt. Forward engine rotation will require a torque multiplier, and this method will reduce the flexplate distortion that occurs when the engine is rotated via the manual drive gear typically provided (refer to illustration "Rotate engine crankshaft with manual drive gear").

a. Remove the crankshaft grounding strap from the front of the engine.

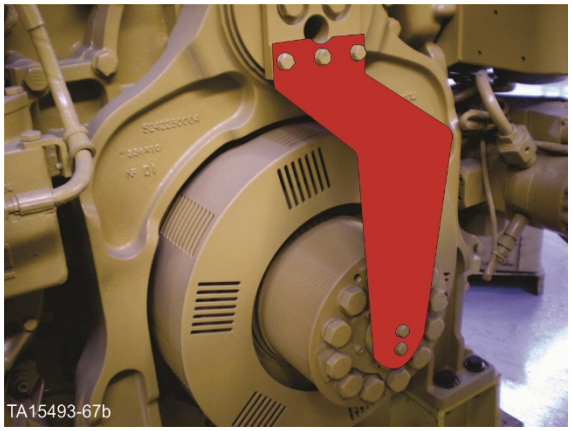
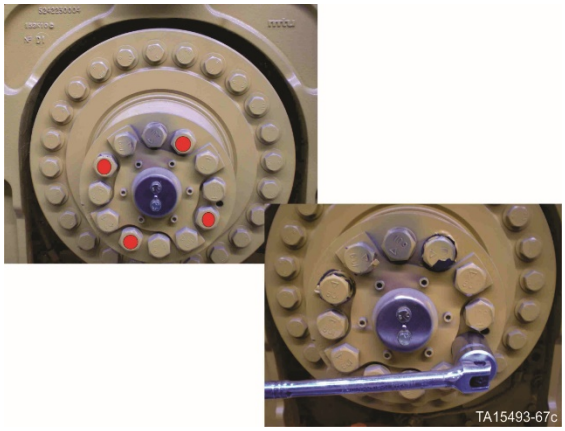
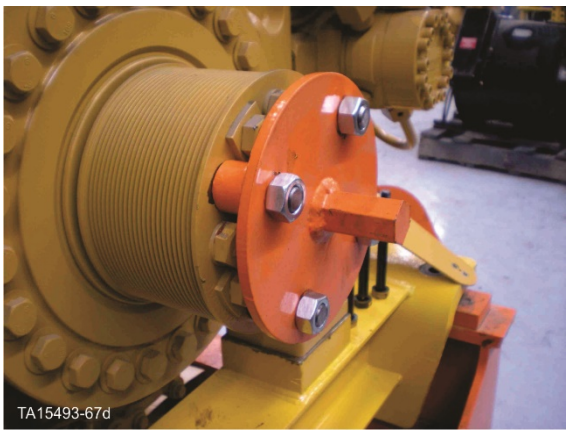


Figure 259. Crankshaft Grounding Strap - Typical

b. Remove four of the 10.9 M20-2.5 bolts from the engine's crankshaft pulley, one every 90°.
   - Leave the engine grounding strap adapter on the engine's crankshaft pulley.



c. Install the indexing tool (P/N R1037405); using four 250mm long M20-2.5 bolts or M20-2.5 all thread studs and nuts, as illustrated in the graphic below.



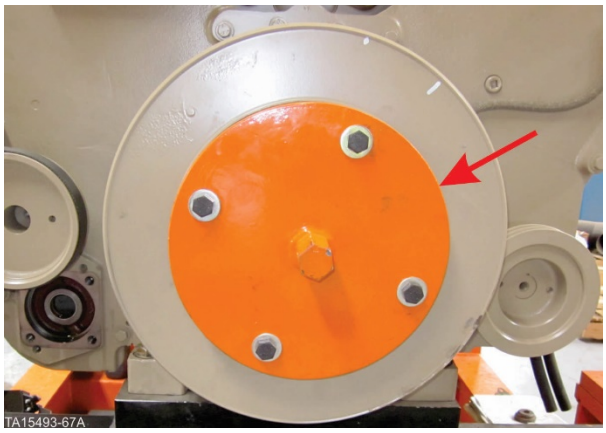
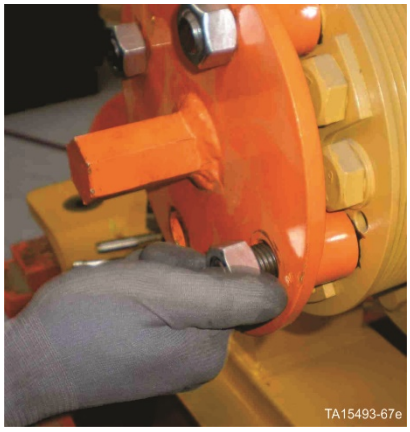


Figure 260. Rotating Engine Crankshaft from Front

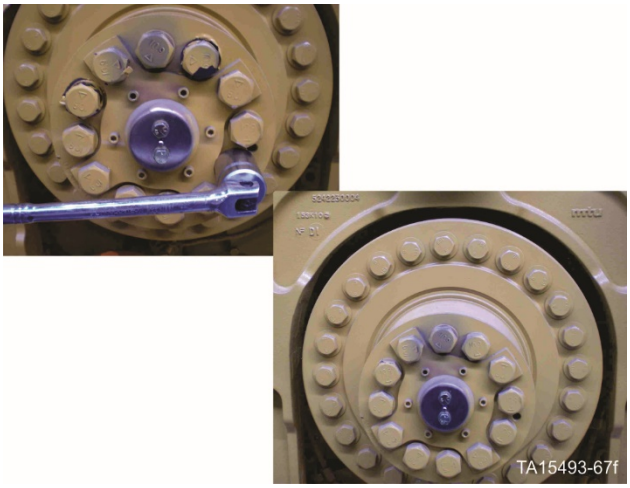
NOTICE

Remove tool after engine rotation process.

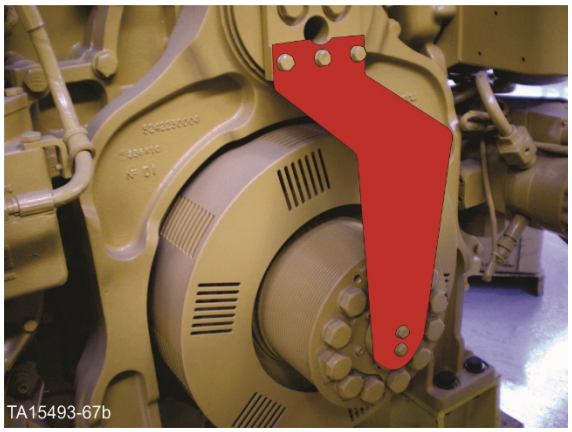
d. Remove the four 250mm long M20-2.5 bolts or M20-2.5 all thread and nuts and remove the tool.



e. Reinstall the original 10.9 M20-2.5 bolts and torque to the specified torque called for from the Detroit Diesel service manual. (500-550 N•m none lubed).



f. Reinstall the crankshaft grounding strap on the front of the engine.



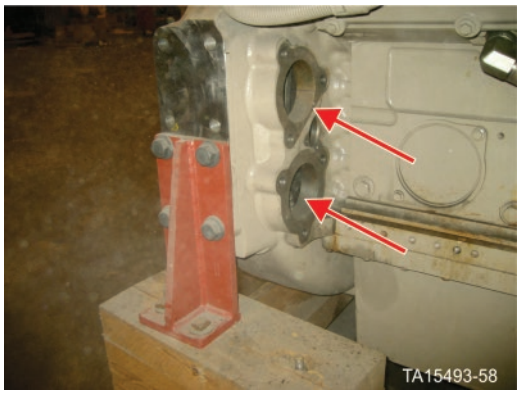
Rotating the Engine Crankshaft with Manual Drive Gear

Current engines should be rotated from the starter end. This is done with an engine rotation tool that engages the teeth of the flywheel.

NOTICE

Rotating from starter end can cause the flexplate to “flex” and affect the axial and radial readings.

a. Remove the cover from the rear of the engine that allows access to the clearance holes in the flexplate. Where necessary, also remove the starter.



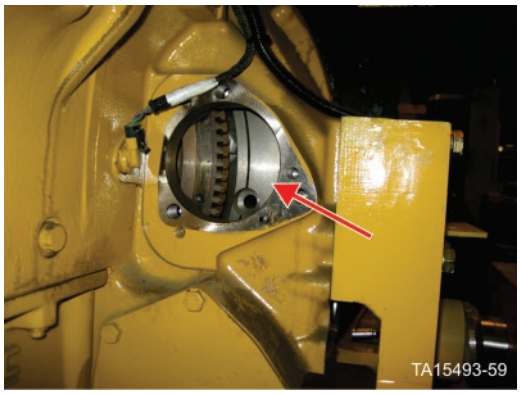


Figure 261. Remove Cover/Starter to Access Back Side of Flexplate

b. Cummins engines are normally provided with a rotation tool.

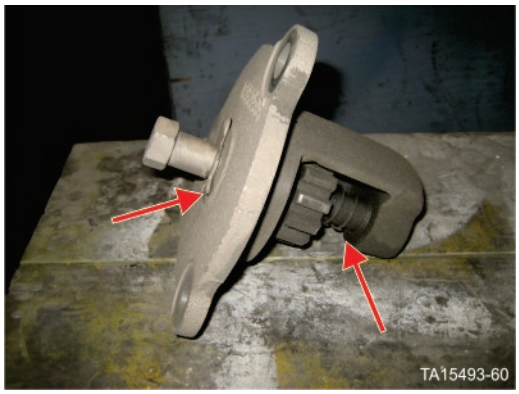


Figure 262. Cummins Engine Rotation Tool - Retainer and Spring

c. The tool is normally held in the out position with a retainer ring so it does not contact the flexplate gear. It is also spring loaded to keep it away from the flexplate gear.

CAUTION

Put the retainer ring on the engine rotation tool back in place after using.

d. The bolt has to be pushed in and held in place when rotating. This will typically require a small spacer inside the socket to assure it is fully pressed in.

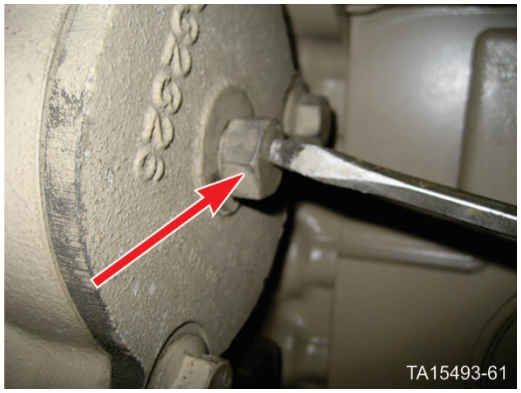


Figure 263. Cummins Engine Rotation Tool

e. Commercial tool is available from Detroit dealers that will turn both Cummins and Detroit engines. Contact your Detroit dealer for more information.

CAUTION

The engine rotation tool must be removed from the engine after each use.

Figure 264. The engine rotation tool must be removed from the engine after each use.

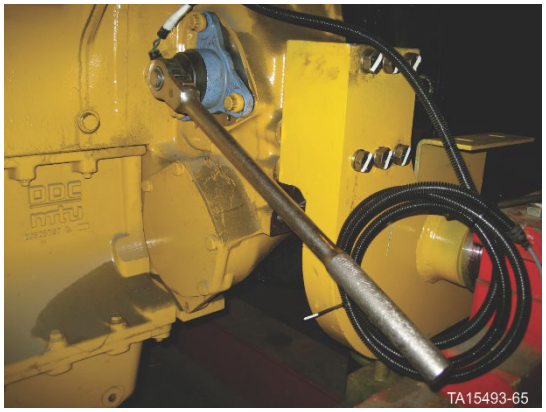


Figure 265. Rotating Engine Crankshaft with Manual Drive Gear

f. Check the radial runout of the flexplate shoulder.

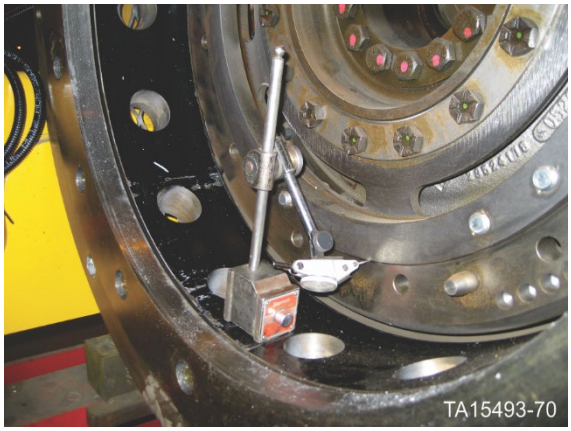
NOTICE

This could be either an external or internal shoulder depending on type of flexplate.

Internal Shoulder

External Shoulder

Figure 266. Flexplate with Either an External or Internal Shoulder



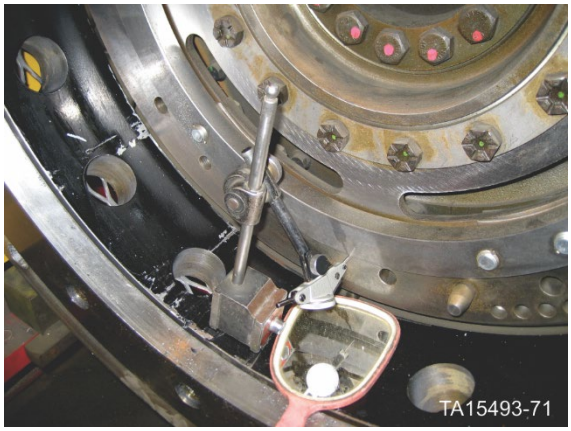


Figure 267. Measurement of Radial Runout of Engine Flexplate

NOTICE

The Tier 2 DD/MTU engine has a different flywheel setup from previous engines. The flywheel is a solid piece of steel with no flex package. The steps for alignment are the same as you must check the ID diameter and runout of the shoulder. You must also check the axial runout.

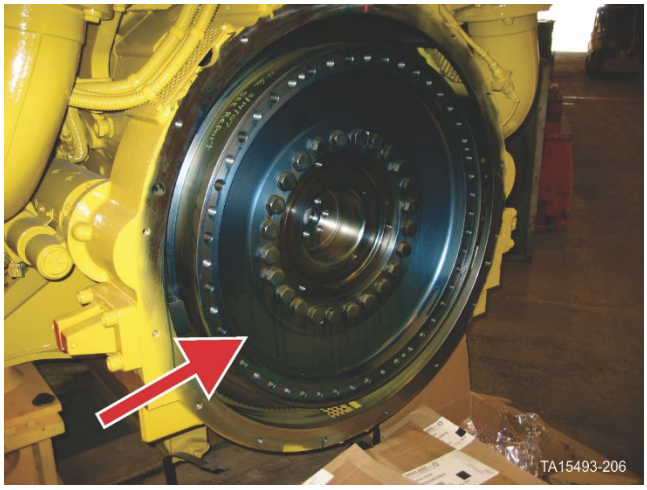


Figure 268. Measurement of Radial Runout of Engine Flywheel - Tier 2 DD/MTU

g. A mirror may be required in order to read the dial indicator depending on the type of dial indicator that is used.

h. Check the axial runout of the mating face (the surface that mates with the rotor adapter) of the flexplate. Simultaneously monitor the axial endplay of the crankshaft to ensure a true axial runout is being taken. This is done by placing a second indicator on the front of the engine block and measuring to the front of the crankshaft.

Internal Shoulder

External Shoulder

Figure 269. Measurement of Axial Runout of Engine Flexplate Mating Surface

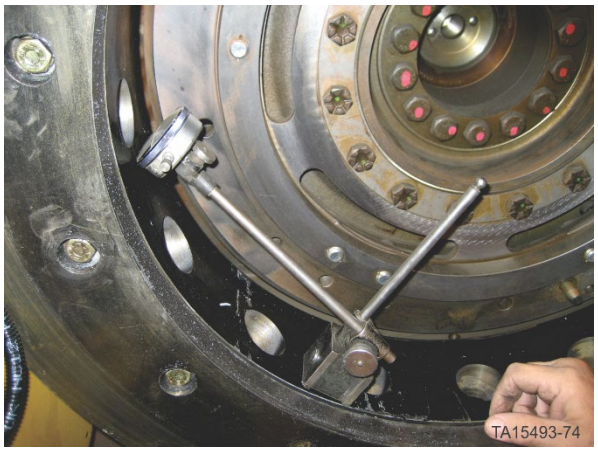
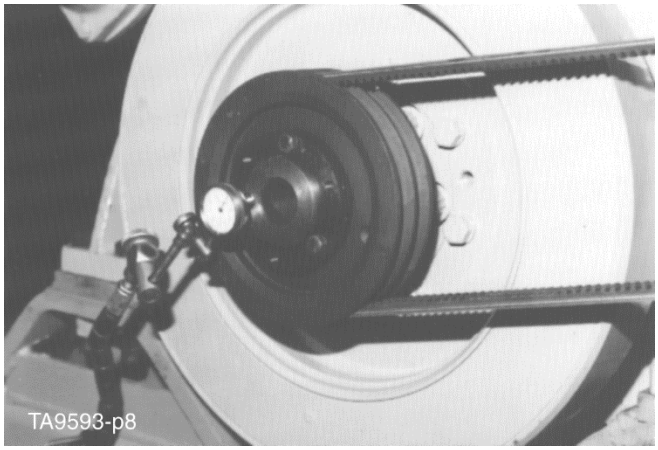


Figure 270. Measurement of Axial Runout of Engine Flexplate Mating Surface

i. Add the two dial indicator readings as the maximum and minimum readings are taken. Refer to the generator installation worksheet for the maximum allowable axial runout. Record the measurement obtained on line 2.4 of the Generator Installation Worksheet.

NOTICE

This number can be high for various reasons: Flex package permanently flexes or movement of flexplate from using flywheel turn tool. Data must be analized to know if flexplate is bad or simply sprung.



Example: Both dial indicators were set to zero at the starting position and the crankshaft was rotated. Illustration "USING TWO DIAL INDICATORS FOR AXIAL CHECKS" summarizes the readings of both dial indicators.

Crankshaft Rotation	Crankshaft Indicator Reading	Flexplate Indicator Reading	Actual Flexplate Axial Runout
start	.000	.000”	.000”
1/8 revolution	.001”	-.002”	-.001“
1/4 revolution	.000”	-.002”	-.002”
3/8 revolution	-.001”	-.003”	-.004” (min)
1/2 revolution	-.002”	-.001”	-.003”
5/8 revolution	-.003”	-.001”	-.002”
3/4 revolution	-.003”	.003”	.000”
7/8 revolution	-.004”	.005”	.001” (max)
1 revolution	-.004”	.004”	.000”

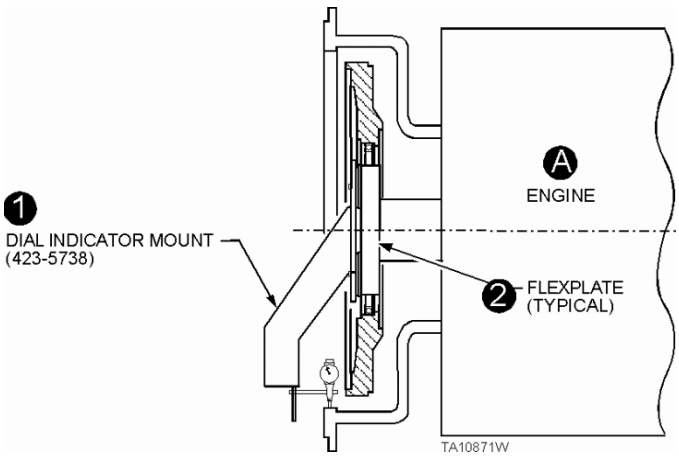
In this example, the minimum reading was -.004” at 3/8 revolution, and the maximum reading was .001” at 7/8 revolution. The total axial runout is .005”.

NOTICE

If the sum of the dial indicators after one full revolution of the crankshaft does not add to zero, one of the indicators has moved and the axial runout must be checked again.

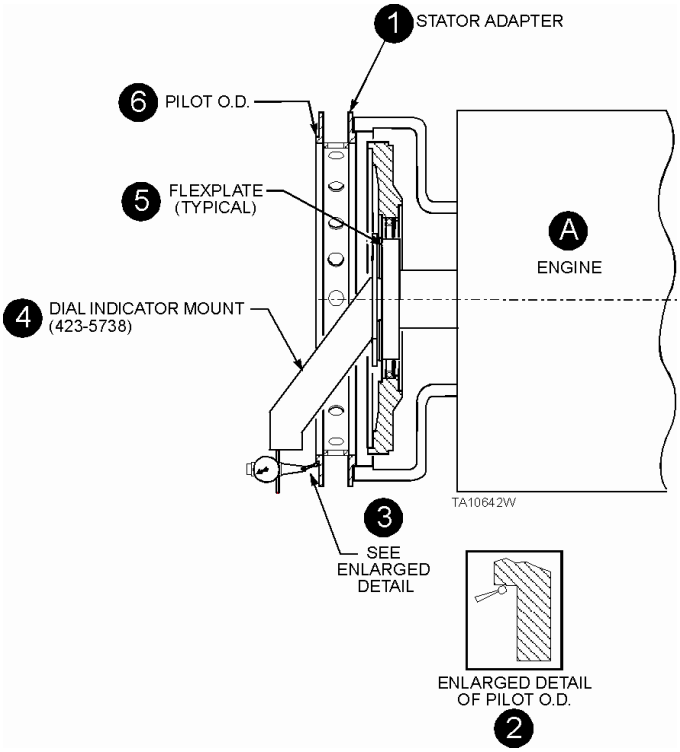
Figure 271. Using Two Dial Indicators for Axial Checks

j. Fasten the dial indicator-mounting fixture to the face of the crankshaft. Position the dial indicator button so that it rests against the bore I.D. on the flywheel housing, and manually rotate the engine crankshaft from damper end of engine. The maximum radial runout should not exceed the value listed on the Generator Installation Worksheet. Record the radial measurement obtained in this step on line 2.5 of the Generator Installation Worksheet.



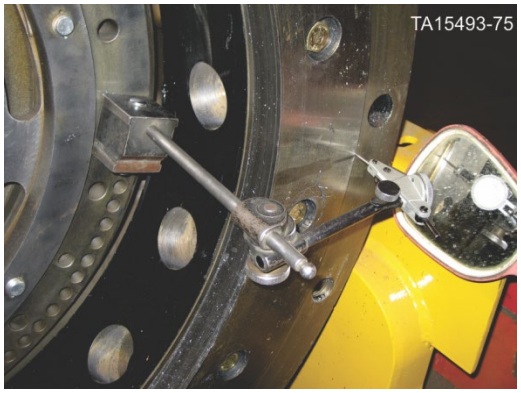
1) Dial indicator mount, **2)** Flexplate – typical, **A)** engine

Figure 272. Radial runout of adapter - (1 of 3)



1) Stator adapter, **2)** Enlarged detail of pilot outside diameter, **3)** See enlarged detail, **4)** Dial indicator mount, **5)** Flexplate – typical, **6)** Pilot outside diameter, **A)** Engine

Figure 273. Radial runout of adapter - (2 of 3)



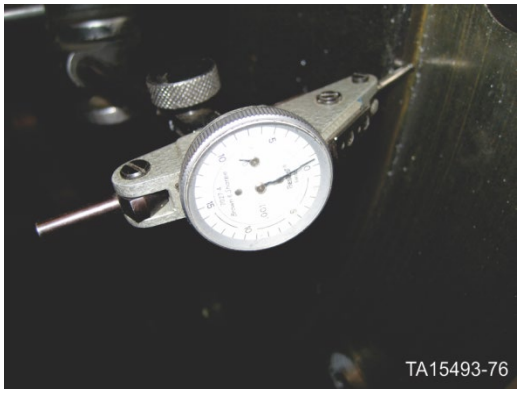
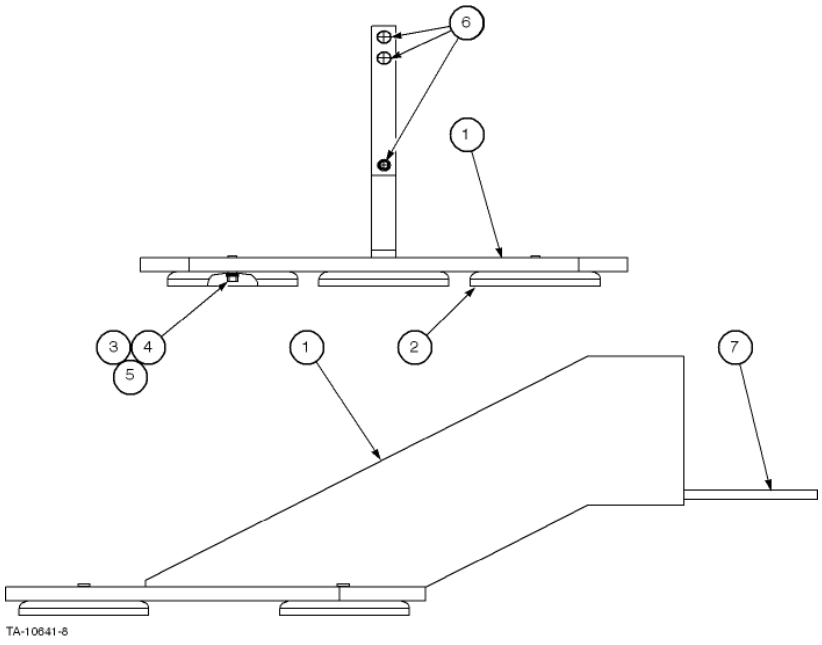


Figure 274. Radial runout of adapter - (3 of 3)



1) Structure

2) Magnet typical three (3) places

3) Bolt

4) Flatwasher

5) Lockwasher

6) E-Z LOK insert

7) Mounting post

Figure 275. Tool for holding dial indicator

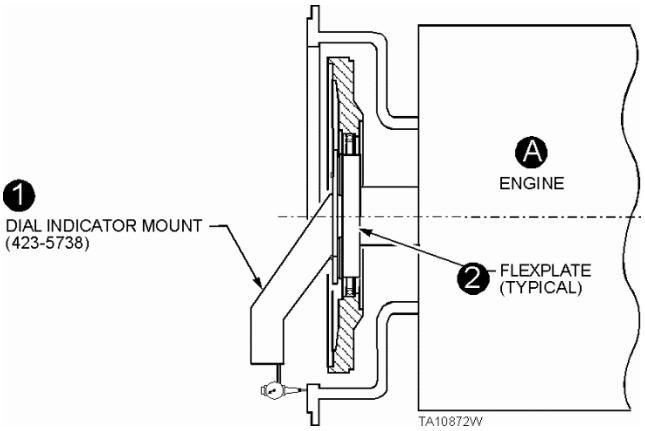
k. Reposition the button so that it rests axially against the mounting face of the flywheel housing. Locate another dial indicator at the front of the engine positioned with the button as close to the center of the crankshaft as possible. Rotate the engine in the same manner as discussed in paragraph “j”. Verify that the maximum axial runout is less than the value listed on the Generator Installation Worksheet, line 2.6. Monitor both indicators to detect how much the crankshaft is moving axially (“walking”) and how much of the reading is true runout. Record the axial measurement obtained in this step on line 2.6 of the Generator Installation Worksheet.

l. Mount the stator adapter and properly torque the bolts. Visually verify that there is no interference between the adapter and the rear engine mounts.

m. Repeat Steps “k” and “l” for the stator adapter plate and record the readings on lines 2.7 and 2.8 on the Generator Installation Worksheet. Rotate the adapter as required to obtain readings that are within tolerance.

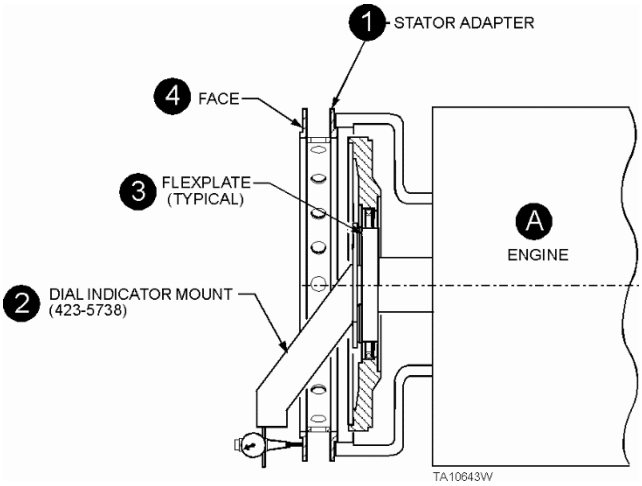
NOTICE

This number can be high for various reasons: Flex package permanently flexes or movement of flexplate from using flywheel turn tool. Data must be analized to know if flexplate is bad or simply sprung.



1) Dial indicator mount, **2)** Flexplate – typical, **A)** Engine

Figure 276. Axial runout of adapter



1) Stator adapter, **2)** Dial indicator mount, **3)** Flexplate, **4)** Face, **A)** Engine

Figure 277. Axial runout of stator adapter

Alignment of Rotor Adapter onto Flywheel

NOTICE

A tight fit (approximately .001” interference) is required between the engine flexplate and the rotor adapter to ensure proper alignment between rotor and crank. If the fit is within specifications, pulling the adapter plate onto the pilot shoulder with the bolts will typically be necessary (push it off with the pusher holes). If it fits together easily - it is probably too loose. The pilot shoulder on the flexplate is designed to carry the weight of the rotor.

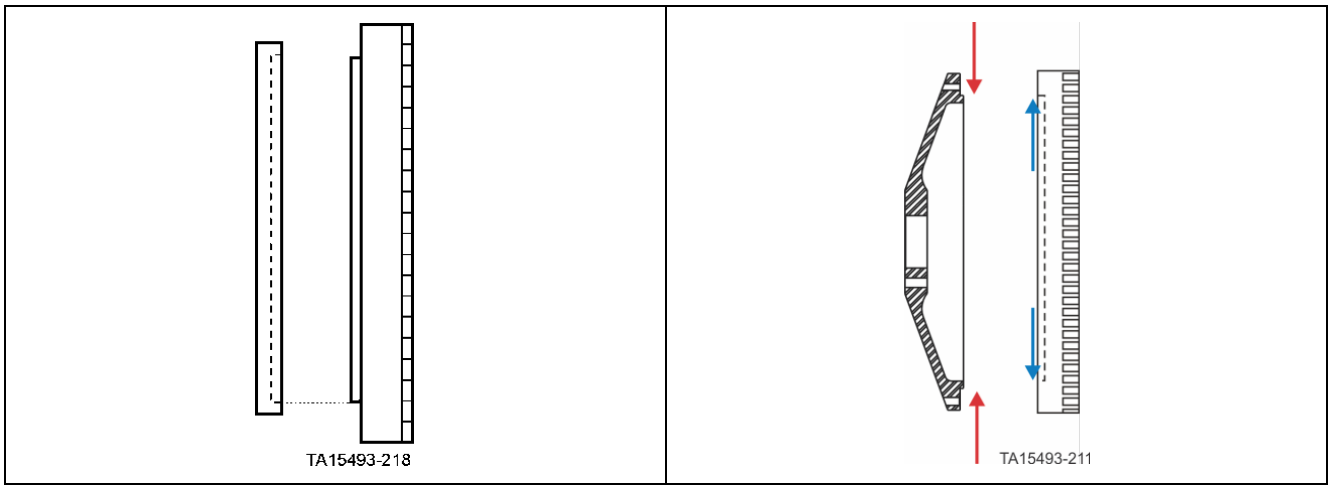


Figure 278. Tight fit

a. Install the rotor adapter to the flexplate using four evenly spaced fasteners. Carefully apply a small amount of SAE 30W motor oil to the pilot bores of stator adapter plate and the rotor adapter plate. Be sure that the face of the rotor adapter is free from protective coatings, nicks and dirt and will fit tightly against the face of the flexplate. Note that there are four possible orientations of the rotor adapter relative to the flexplate because there are four holes in the adapter to accept the two dowel pins in the flexplate. Distinctively mark the orientations on the rotor adapter with a grease pencil (“1”, “2”, “3”, and “4”) with reference to one of the flexplate dowel pins.

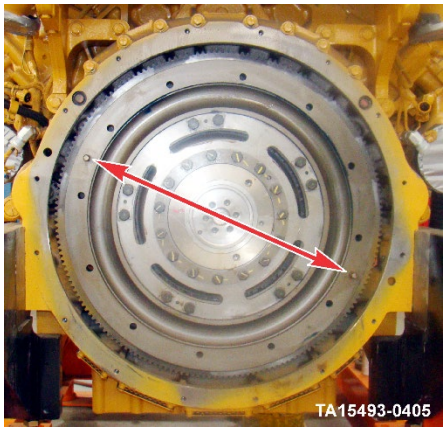


Figure 279. Dowel Pin Location in Flexplate - Typical

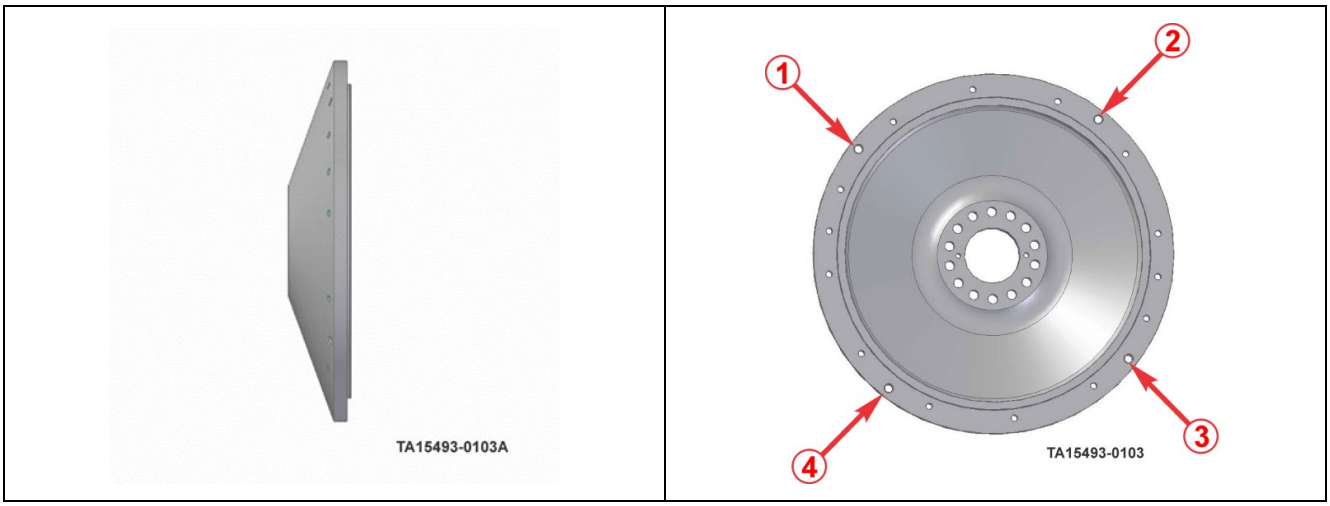


Figure 280. Dowel Pin Locators in Rotor Adapters

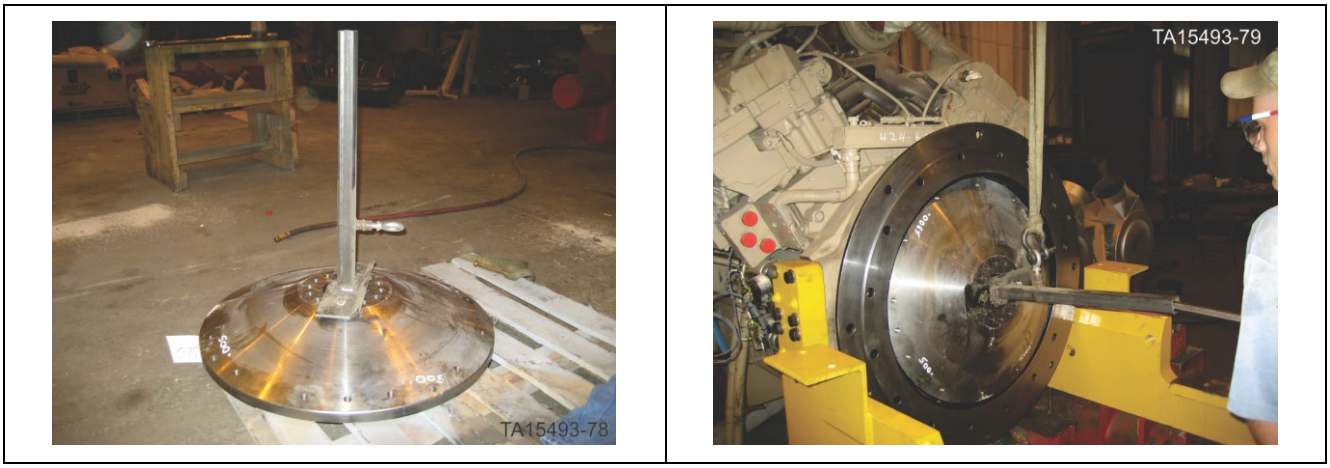


Figure 281. Lift and install rotor adapter

b. Check the runout of the I.D. of the rotor adapter. Mount a dial indicator on an extension bar bolted to the stator adapter plate. When possible, rotate the flexplate from the front of the engine. Record the measured T.I.R. on the rotor adapter by No. 1 and also on the worksheet. Record the measurement obtained in this step on line 3.1 of the Generator Installation Worksheet.

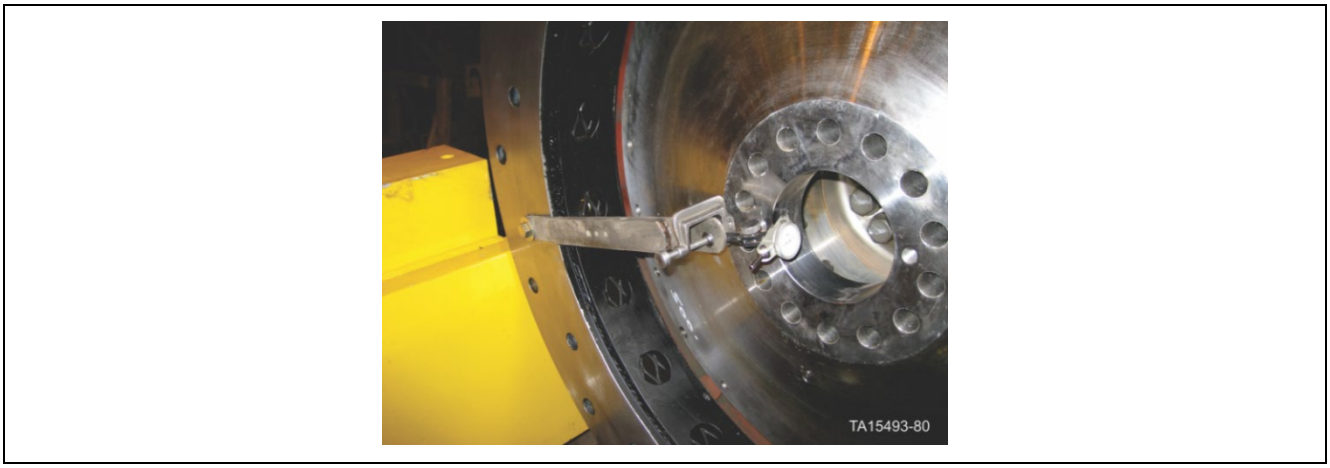
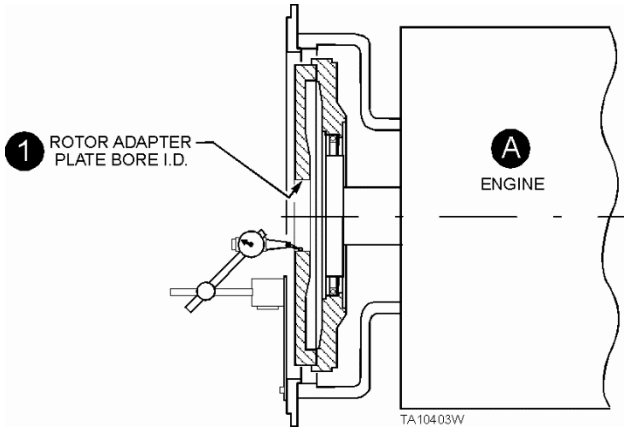
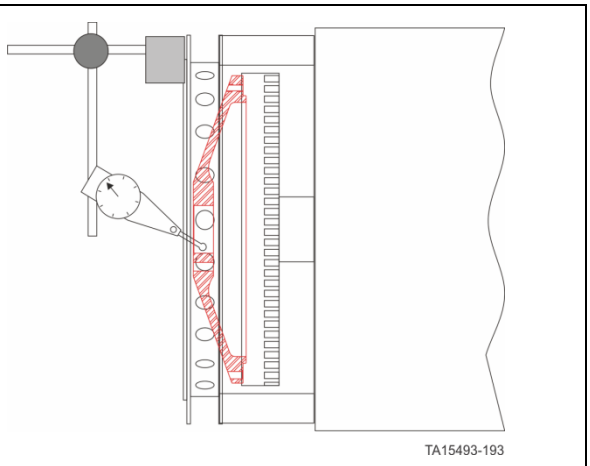


Figure 282. Checking I.D. runout of rotor adapter plate - (1 of 2)





1) Rotor adapter plate bore internal diameter, **A)** Engine

Figure 283. Checking I.D. runout of rotor adapter plate - (2 of 2)

c. If the runout is greater than .001 inches, rotate the rotor adapter 90º relative to the reference dowel pin on the flexplate to the No. 2 position. Repeat the previous step. Be sure to record this new T.I.R. by No. 2 and on line 3.1 of the Generator Installation Worksheet.

d. Repeat above step for the next two orientations (position “3” and position “4”), as required. Record the measurements obtained in these steps on line 3.1 of the Generator Installation Worksheet.

e. If none of the four orientations produce a radial runout of less than .001 inches, then choose the orientation that produced the least amount of runout lower than .003 inches. If none of the orientations produced a runout of less than .003 inches, then either a different rotor adapter plate must be used or the flexplate and rotor adapter must be modified. If another plate is available, then repeat the above steps (“a” to “d”) with the new rotor adapter. The goal is to minimize runout and Checking I.D. Runout of Rotor Adapter.

CAUTION

If a new rotor adapter plate is not available, then the flexplate and rotor adapter plate must be checked to determine the source of the problem. The problem must be corrected before continuing with installation.

f. Once the orientation is selected, manually rotate the engine so that the high side of the bore is at the 12 o’clock position. (This will cause the weight of the rotor to relieve any clearance between rotor adapter and flexplate in a direction which will minimize the final radial runout.) Punch mark the rotor adapter and the flexplate at the 12 o’clock position. This will provide a permanent record and will aid in future alignments. Remove the rotor adapter from the flexplate.

NOTICE

The rotor adapter on an DD/MTU Tier 2 engine is different. The flex package is part of the rotor adapter. The procedures for inspection and alignment are the same. The rotor adapter must be checked for proper diameter and runout prior to use.

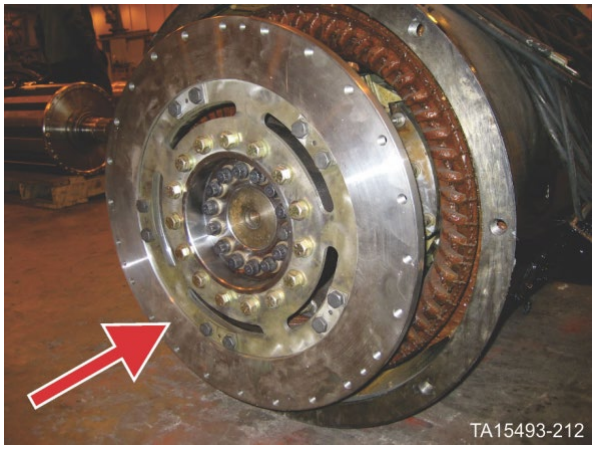
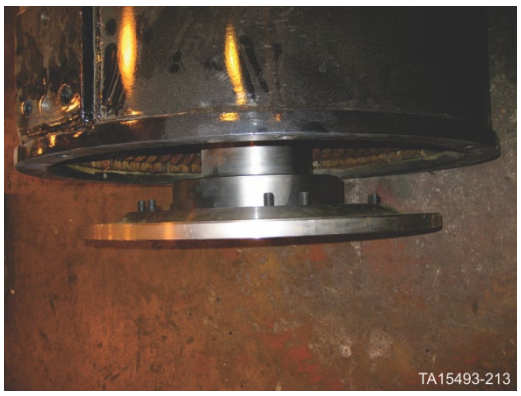
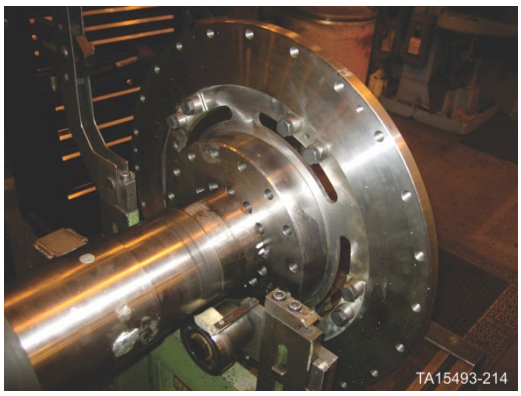


Figure 284. Tier 2 DD/MTU rotor adapter





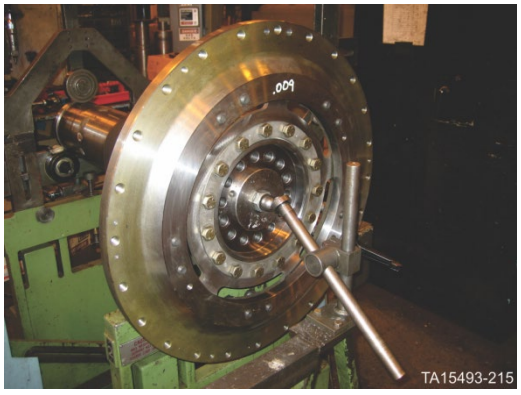


Figure 285. Tier 2 DD/MTU rotor adapter

Some of the older flat rotor adapters were designed with deliberate runout and has an “H” stamped on the high side of the adapter. This was done to compensate for engine flexplates that did not meet spec. Current rotor adapters are built and inspected to have minimum runout.

Rotor Adapter Shimming

The rotor adapter is shimmed so that the generator bearing will be in the middle of its axial movement when bolted to the engine (also in middle of its axial movement.).

Figure 286. Stator adapter straight edge tools

a. Bolt the stator adapter plate straight edge in place on the stator adapter plate.

b. Mount a dial indicator as shown in illustration "MEASURING ENGINE ENDPLAY" so that the button rests on the center part of the flexplate.

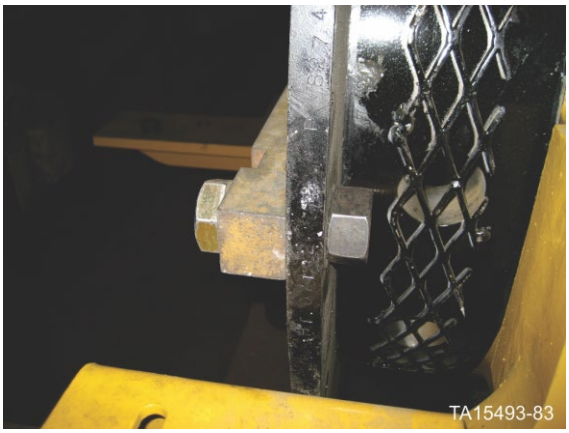
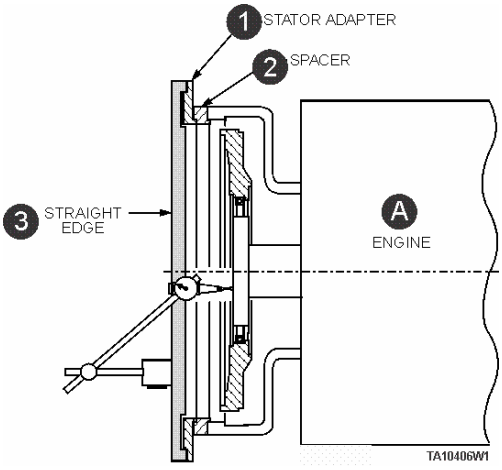


Figure 287. Install straight edge



1) Stator adapter, **2)** Spacer – not on 12B/C generators, **3)** Straight edge, **A)** engine

Figure 288. Measure engine endplay

c. Remove the crankshaft inspection cover from the side of the engine. Measure the engine endplay by prying the crankshaft “IN” (toward the front of the engine) as far as possible; then zero the indicator and pry the crankshaft “OUT” as far as possible, using a steady even push on the pry bar (pry on counterweight only). Record the measurement obtained on line 4.1 of the Generator Installation Worksheet.

d. Center the crankshaft in the middle of the engine endplay.

e. Using an inside micrometer, measure the distance between the stator adapter straight edge and the face of the flexplate as shown. Measure the distance at the other end of the straight edge. Add these two dimensions and divide by two for an average dimension. Record all measurements on line 4.2 of the Generator Installation Worksheet.

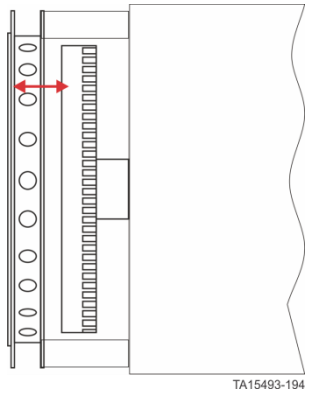


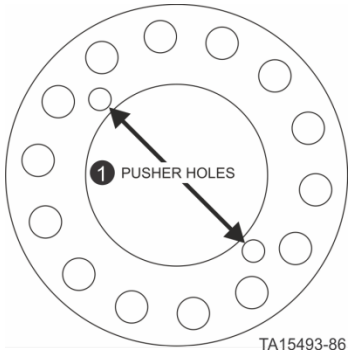
Figure 289. Measure distance between stator adapter and flexplate

f. Record the average number as dimension “A” on line 4.3 of the Generator Installation Worksheet.

g. Record the dimension from Generator Installation Worksheet line 1.3 labeled “Set-Up Adapter to Stator Dimension” as dimension “B” on line 4.3 of the Worksheet.

h. Subtract dimension “B” from dimension “A”. If the difference is less than 0.007” (0.1778 mm), then proceed to Step 9.

i. If the difference is negative, then remove the appropriate amount of shims from between the rotor adapter and the rotor shaft (remove an amount approximately equal to the difference). If the difference is positive, then add the appropriate number of shims in the same manner.



1) Pusher holes - large diameter shims

(G200 - Tier 1 & Tier 2)

Figure 290. Pusher holes - large diameter shims

j. Ensure that the ground portion of the generator shaft (where the long stem dial indicator rides for the final checkout) is free from burrs and epoxy.

k. Properly torque all fasteners. Hex bolts should be torqued to Grade 8 values (use SAE engine oil on treads and under bolt heads). Twelve (12) point capscrews should be torqued as follows:

- 100 ft-lbs. using a crossover pattern.
- 200 ft-lbs. using a crossover pattern.
- 300 ft-lbs. using a crossover pattern.
- 375 ft-lbs. using a crossover pattern.

l. Twelve-point capscrews must be used with a hardened flatwasher.

Figure 291. Fasteners

Install Generator

a. Carefully apply light coat of SAE engine oil to the pilot bores of stator adapter, rotor adapter, and flat adapter plate. **DO NOT APPLY SAE 30W OIL** to the mounting faces of these adapters.

b. Install the two alignment studs opposite one another, in the horizontal plane, in the rotor adapter. Be sure to thread them in as far as possible.

NOTICE

Alignment Studs are not needed on SAE 00 engine/generator installation)

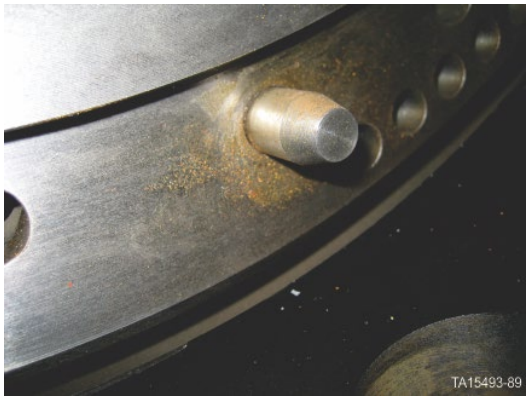
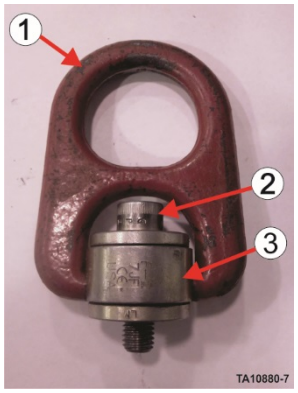


Figure 292. Alignment studs are built into the flex plate

c. Install the proper lifting fixture and rigging to the top of the generator to support the weight of the G200 generator.



1) Swivel mount, **2)** Lifting clevis, **3)** Capscrew (allen head 1”-14 NS – 2B GR8)

Figure 293. Generator lifting fixture

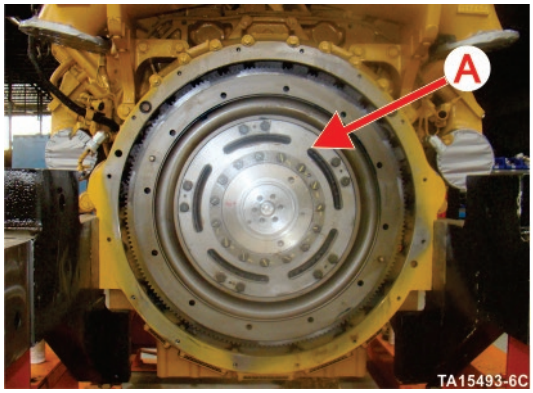
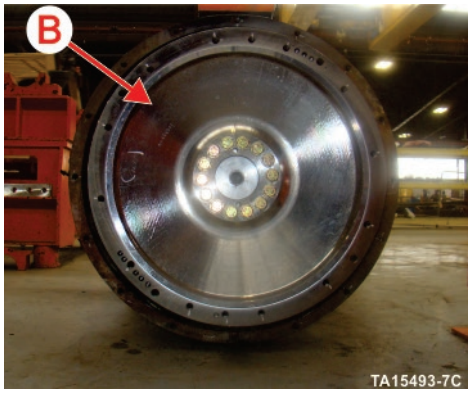
d. Utilizing a hoist, advance the generator to the engine with its horizontal centerline in line with the centerline of the engine. Note the position of the alignment stud. Make sure that the permanent mark on the rotor adapter is oriented correctly with respect to the mark on the flexplate at the 12 o’clock position. If a slight adjustment is required, rotate the flexplate.

e. Advance the generator toward the engine. **Current Engines:** Have alignment studs as part of the flex plate. **Older engines:** The alignment studs in the rotor adapter should enter their respective holes in the

flexplate. When the stator frame is touching the stator adapter plate, adjust the frame so that the pilot boss is inside the pilot bore.

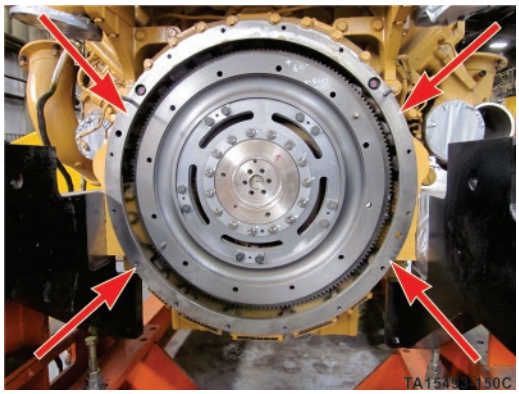
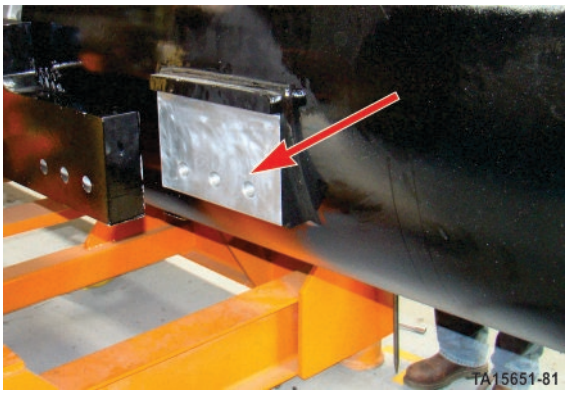
f. Insert the top and bottom mounting bolts into the stator frame through the corresponding stator adapter holes. (**SAE 00 flywheel with "U" shaped housing adapter**, install all bolts). Tighten these bolts a sufficient amount so that the boss cannot disengage from the bore.

G200 - Tier 1 Generator Installation

	
A) Flex plate is part of engine	**B)** Rotor adapter is attached to generator

NOTICE

Ensure that the mating surface on the engine mounts and generator assembly side mounts are clean and free from paint and oil.

a. Mount stator adaptor plate to engine.

Stator adapter plate is bolted to engine

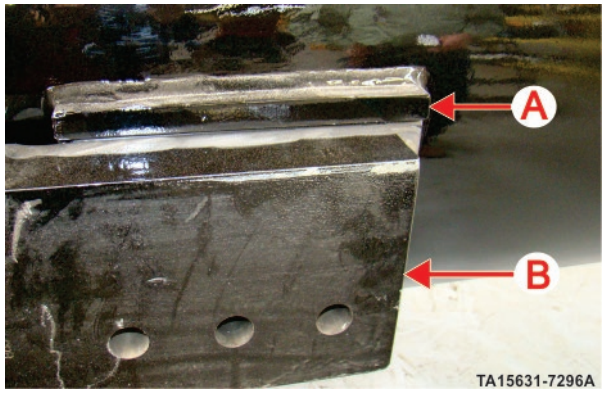
NOTICE

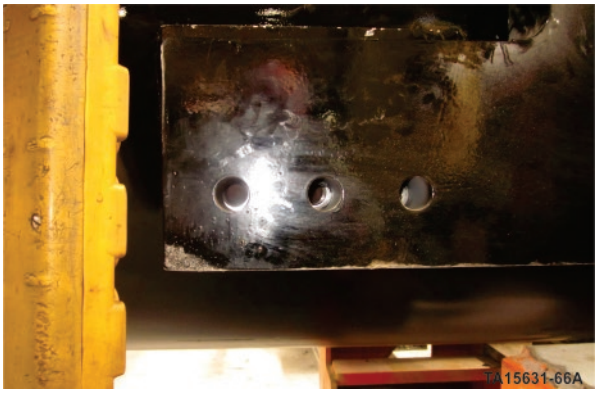
Ensure that the mating surfaces on the generator and the stator adaptor plate are clean and free from paint and oil.

b. Use overhead crane to slowly guide the generator assembly toward the engine.

Figure 294. Join motor and generator together

c. The lip of each generator side mount will rest on the top of each engine mount. The engine mount holes line up with the tapped holes on the generator side mounts.





A) Side mount lip, **B)** Engine mount

Figure 295. Generator side mount alignment

d. Starting on one side of the generator assembly, install two sets of bolts with flatwashers where the generator assembly mates to the stator adaptor plate. Then install two sets of bolts with flatwashers on the opposite side. Install bolts and washers on the top and bottom sides.

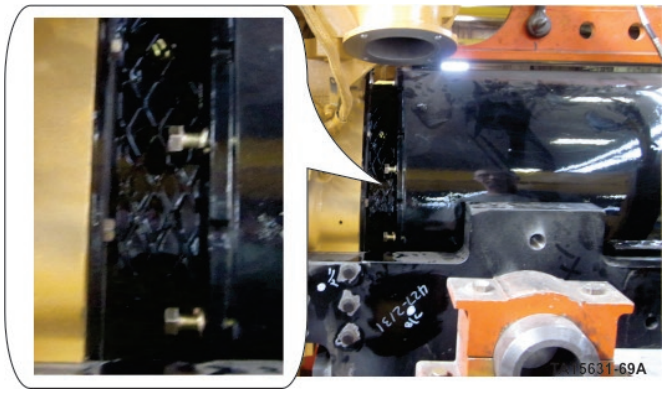


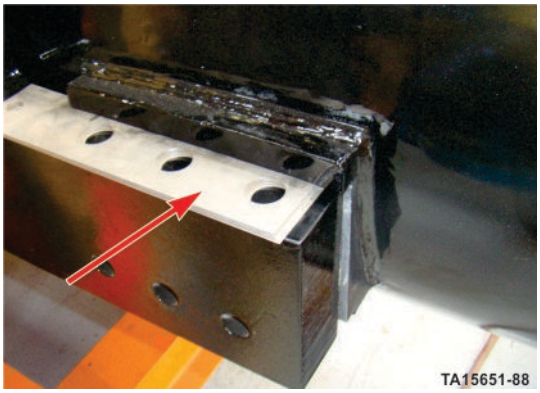
Figure 296. Hardware installation

NOTICE

If the mounting holes on one side of the stator adapter plate does not line up with the mounting holes on the generator, the generator may have to be repositioned to correct the problem.

Temporary Shimming

- Use overhead crane to slightly reposition the generator. Install enough temporary shims between the generator slide mount lip and the engine mount, on one side of the generator assembly, to allow the stator adaptor plate mounting holes to align with the generator mounting holes.



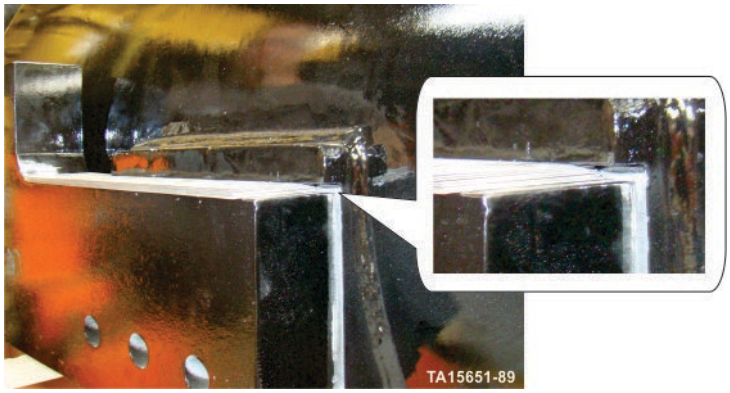


Figure 297. Temporary shimming

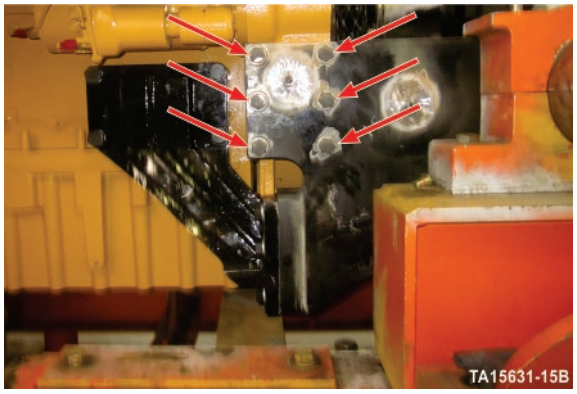
- Once the mounting holes are aligned between the stator adaptor plate, continue to install the rest of the hardware. (DO NOT FULLY TIGHTEN HARDWARE AT THIS TIME).
- Remove shims between generator slide mount lip and engine mount.

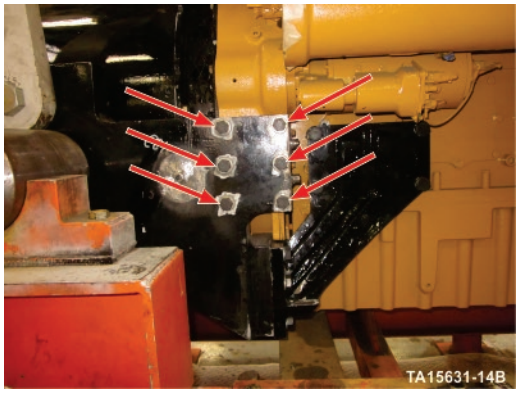
Closing the Gap

NOTICE

If there is a gap where the bottom of the generator assembly meets the bottom of the engine assembly, the gap must be closed.

a. To close the gap, slightly loosen the six bolts on each engine mount, on both sides of the engine, where the engine mounts are bolted to the engine.

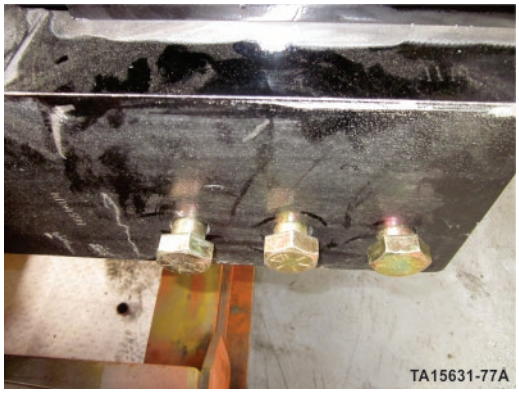




b. Slightly lift the engine with the overhead crane to close the gap between the engine and generator.

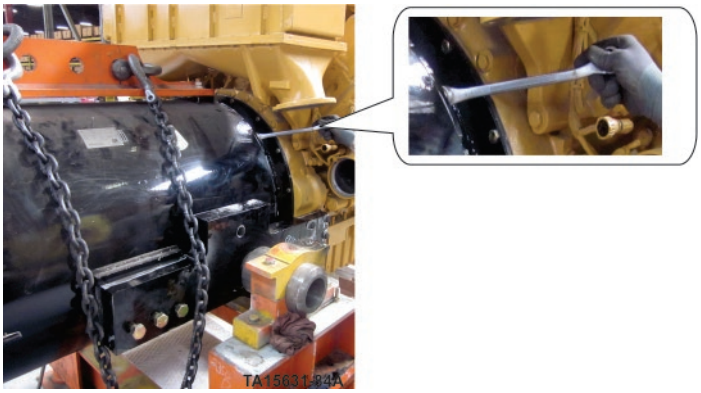
c. Retighten the six bolts, on both engine mounts, and torque the hardware to specifications found in the capscrew torque chart

d. Install mounting bolts on both sides of generator assembly.



Final Torque of Hardware

a. Initially, use a box wrench to tighten the bolts used to mate the stator adaptor plate to the generator bolts. Then use torque wrench to properly torque all bolts to the specifications listed on the capscrew torque chart. Torque bolts in a crossover pattern until all bolts have been torqued.



Box wrench used to tighten hardware - initially

Figure 298. Final torque - stator adapter plate to generator bolts

b. Properly torque the engine mount hardware to the specifications listed on the capscrew torque chart.

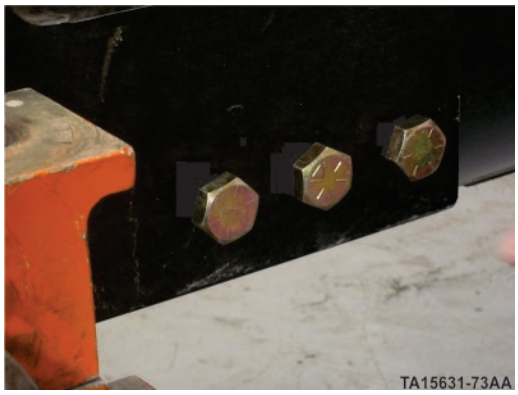
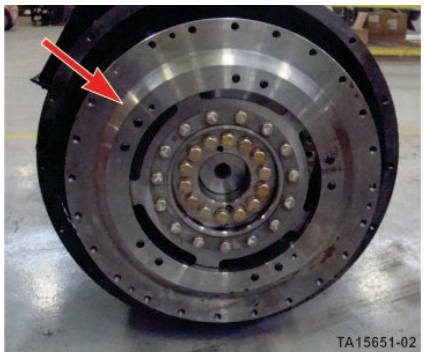


Figure 299. Final torque - engine mount bolts

G200 - Tier 2 Generator Installation

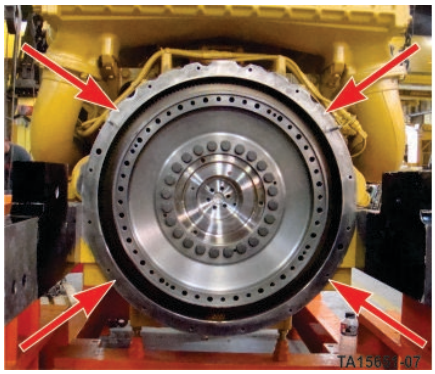
- Flex plate is part of rotor adapter.

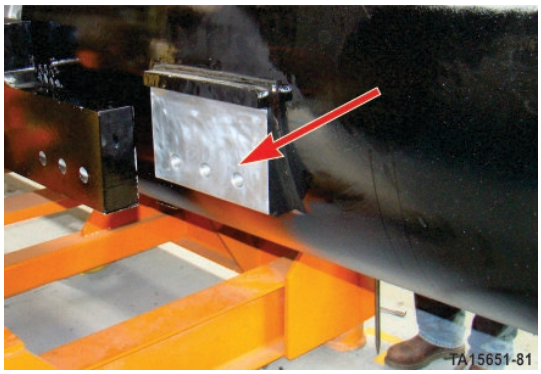


Flex Plate is Part of Rotor Adapter

NOTICE

Ensure that the mating surface on the engine mounts and generator assembly side mounts are clean and free from paint and oil.





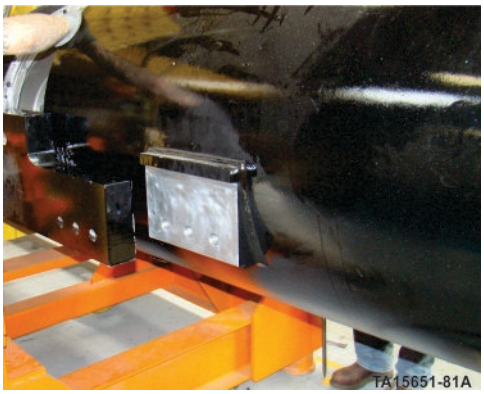
- Mount stator adaptor plate to engine.

Side view - stator adapter plate bolted to engine

NOTICE

Ensure that the mating surfaces on the generator and the stator adaptor are clean and free from paint and oil.

- Use overhead crane to slowly guide the generator assembly toward the engine.



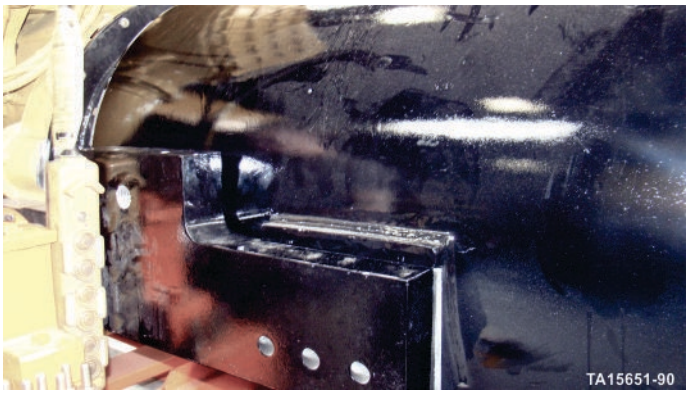
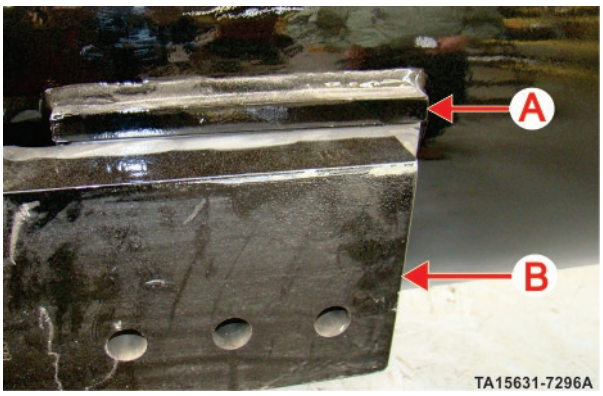
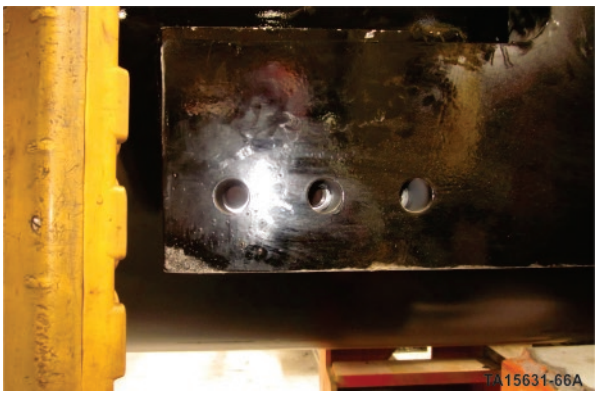


Figure 300. Joining motor and generator together

- The lip of each generator side mount will rest on the top of each engine mount. The engine mount holes line up with the tapped holes on the generator side mounts.





A) Side mount lip, **B)** Engine mount

Figure 301. Generator - side mount alignment

- Start on one side of the generator assembly and install two sets of bolts with flatwashers where the generator assembly mates to the stator adaptor plate. Then install two sets of bolts and flatwashers on the opposite side, then proceed to do the same on the top and the bottom positions.

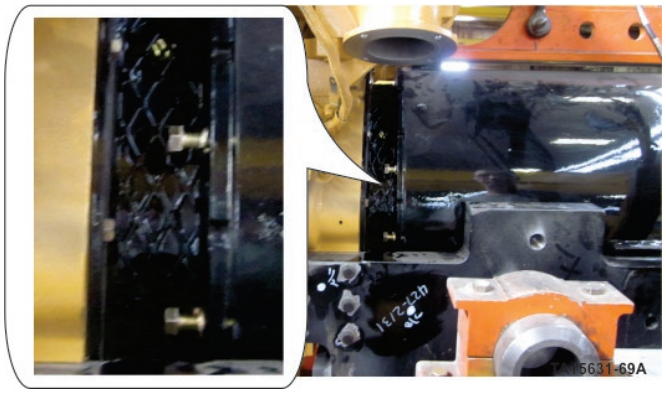


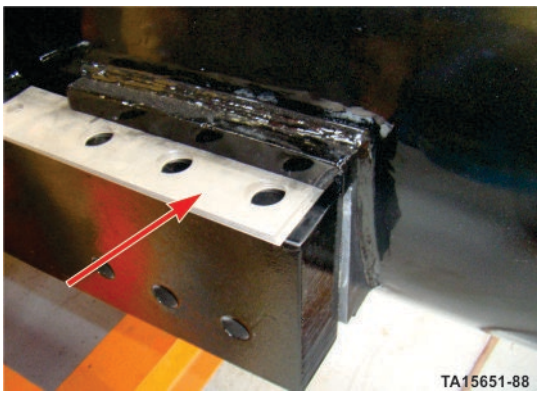
Figure 302. Hardware installation

Temporary Shimming

NOTICE

If the mounting holes on one side of the stator adaptor plate do not line up with the mounting holes on the generator, the generator may have to be repositioned to correct the problem.

a. Use overhead crane to slightly reposition the generator. Install enough temporary shims between the generator slide mount lip and the engine mount, on one side of the generator assembly, to allow the stator adaptor plate mounting holes to align with the generator mounting holes.



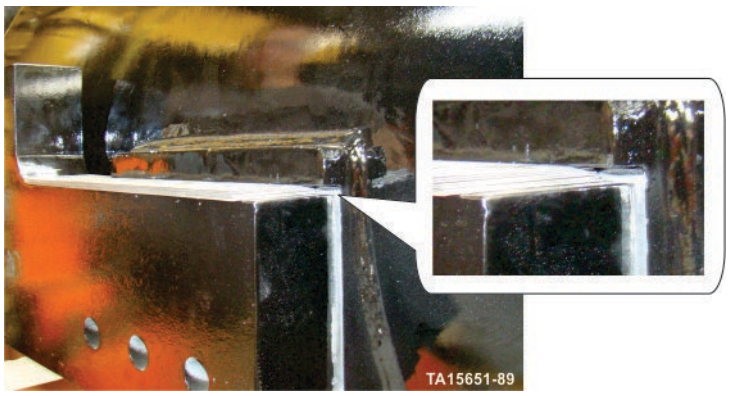


Figure 303. Temporary shimming

b. Once the mounting holes are aligned between the stator adaptor plate, continue to install the rest of the hardware. (DO NOT FULLY TIGHTEN HARDWARE AT THIS TIME).

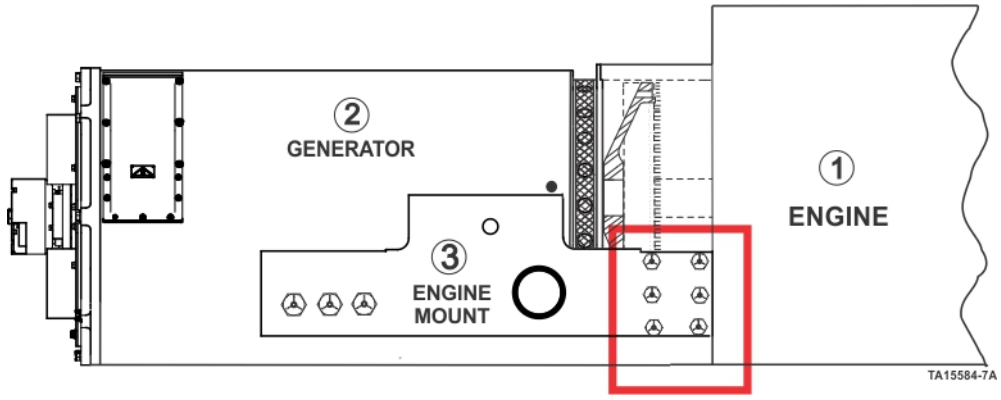
c. Remove shims between generator slide mount lip and engine mount.

Closing the Gap

NOTICE

If there is a gap where the bottom of the generator assembly meets the bottom of the engine assembly; the gap must be closed.

a. To close the gap, slightly loosen the six bolts on both sides of the engine where the engine mounts are bolted to the engine.

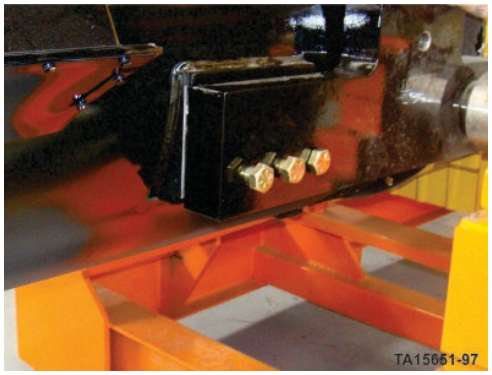


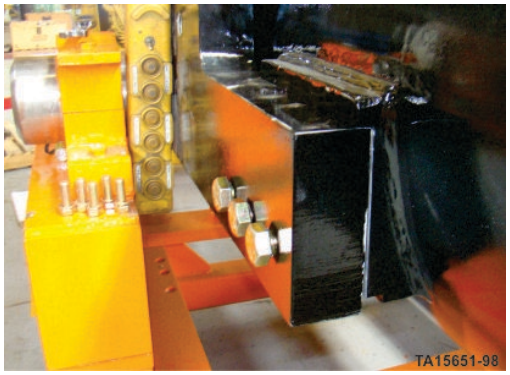
1) Engine, **2)** Generator, **3)** Engine Mount

a. Use overhead crane to slightly lift the engine to close the gap between engine and generator.

b. Retighten the six bolts on each engine mount and properly torque the hardware to the specifications found in the capscrew torque chart

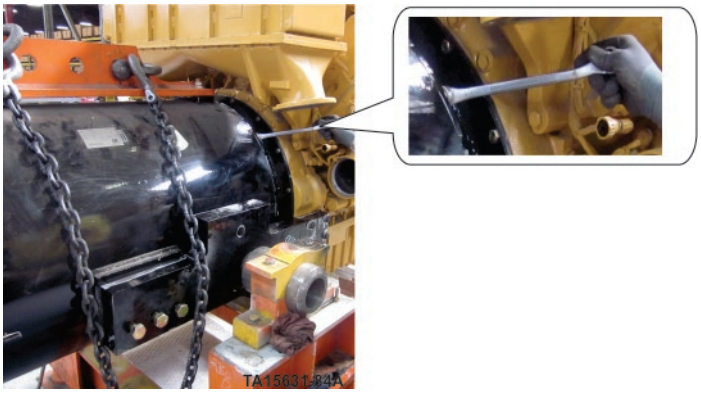
c. Install mounting bolts on both sides of generator assembly.





Final Torque

a. Initially, use a box wrench to tighten the bolts used to mate the stator adaptor plate to the generator bolts. Then use torque wrench to properly torque all bolts to the specifications listed in the capscrew torque chart. Torque bolts in a crossover pattern until all bolts have been torque to specifications.



Box wrench used to tighten hardware - initially

Figure 304. Final torque stator adapter plate to generator bolts

b. Properly torque the engine mount hardware to the specifications listed on the capscrew torque chart.

Figure 305. Final torque - engine mount bolts

Install Flexplate Fasteners

1. Using the hole created by the absence of the cover or the starter, install and torque the flexplate coupling bolts as described in 3-8 below. Torque to specs on the capscrew torque chart, located in the appendix of this manual.

2. For the following steps, the directions given will be from the front of engine to the rear of engine. Adherence to this procedure is required to ensure that the rotor adapter mates evenly (is not “misaligned”) with the flexplate.

3. Using the hole created by absence of cover on bell housing on the left side of engine, lube and insert first flexplate coupling bolt and torque to 25% of rated torque.

4. Rotate engine counter-clockwise so that flexplate rotates 180º, lube and insert second bolt and torque to 50% of rated torque.

5. Rotate engine counter-clockwise so that flexplate rotates 90º, lube and insert third bolt and torque to 50% of rated torque.

6. Rotate engine counter-clockwise so that flexplate rotates 180º, lube and insert fourth bolt and torque to 50% of rated torque.

7. Rotate engine clockwise so flexplate rotates 90 degrees, torque first bolt to 50% of rated torque.

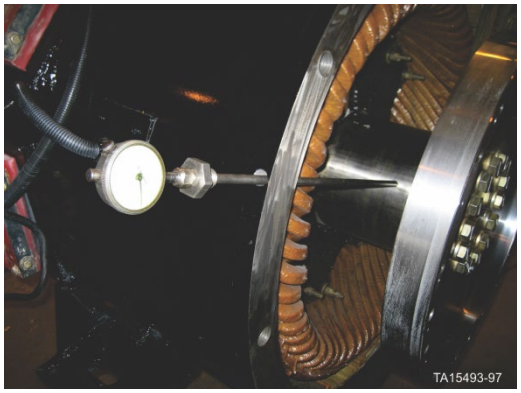
8. Remove alignment studs and insert remaining bolts, torque all bolts to 100% of full rated torque.

9. Remove the alignment studs while installing the bolts (not necessary on SAE 00 engine/generator installation).

Final Checkout

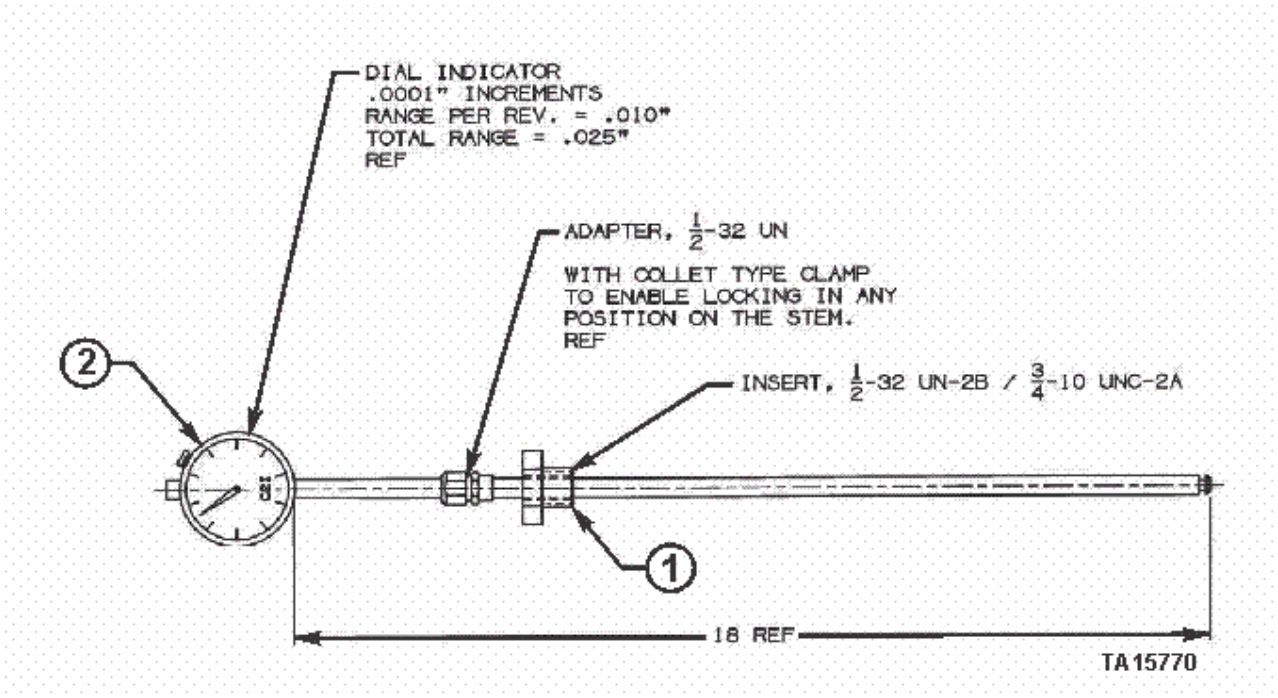
a. Recheck engine endplay as described in “Rotor Endplay and Stator/Rotor Adapter Measurements” (previously explained in this document), and recorded on line 6.1 (check to ensure that this matches the endplay recorded on line 4.1 of the Generator Installation Worksheet).

b. Using a long-stem dial indicator, measure the radial runout of the rotor shaft as shown in illustrations.



NOTICE

The picture on the left is an open view of the generator showing where the dial indicator makes contact with the shaft while measuring for radial runout.



1) Insert, **2)** Dial Indicator

Figure 306. Long stem dial indicator

NOTICE

Some generators have fine threads, current generators have coarse threads and require a thread adapter. Refer to FIGUE: TOOLS AND SUPPLIES part number of dial indicator and thread adapter.

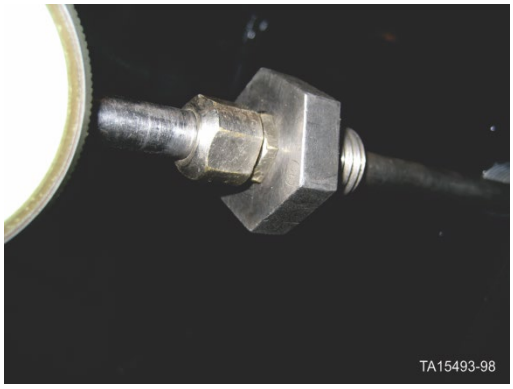
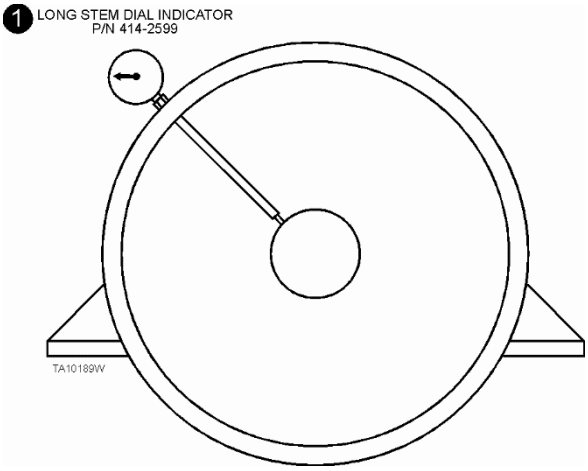


Figure 307. Thread adapter

c. Mount the indicator, in the threaded hole in the stator bolt flange, and manually rotate the engine (from the front). The maximum runout should not exceed the value shown in the Generator Installation Worksheet. Record the measurement obtained on line 6.2 of the Generator Installation Worksheet.

d. Remove the dial indicator and reinsert the threaded plug.

e. Place the worksheet in the proper machine or component file for future reference.



1) Long stem dial indicator

Figure 308. Final radial runout check

Pre-start and Operational Checks

Prestart Check-out Procedures

The following inspection, checks and tests should be conducted after the initial installation of a new or rebuilt generator. While some of these may have been checked during the fabrication or rework of the generator – they should be checked again prior to starting the engine.

NOTICE

It is assumed that the installation has been properly conducted and that the alignment to the engine has been thoroughly checked. The generator alignment worksheet should be completely filled in and all values should be within the specifications listed.

a. Inspect cable connections

- Check that all connections externally to the generator are correct.
- Check that the bolts are tight on external connections.

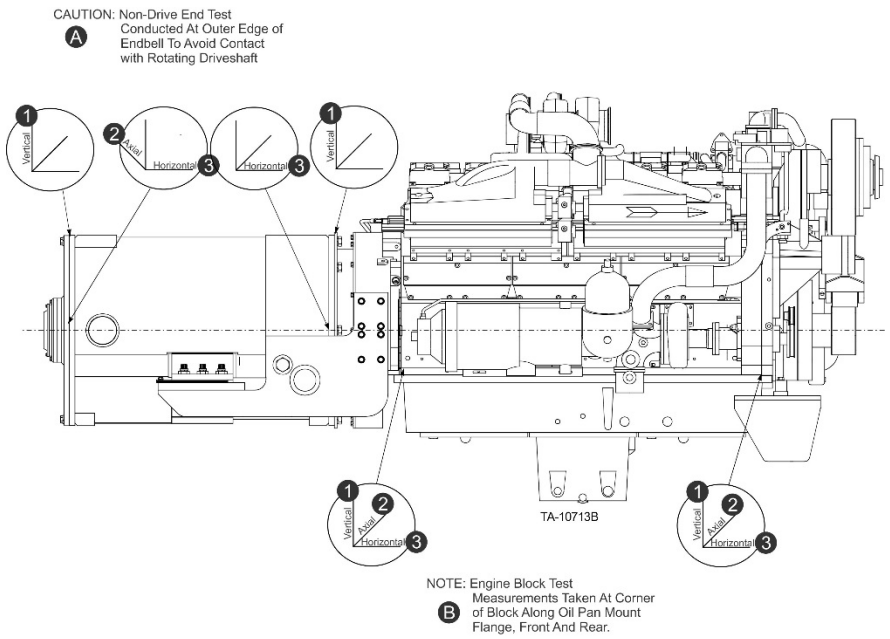
Any problems found during the previous inspections should be corrected prior to starting the engine.

All Machines - Operational checks following initial start up

a. Inspect bearing temperature

- Bearing check will involve the main generator bearing.
- After operating the generator for several hours continuously – check the temperature of the ball bearing assembly on the non drive end of the generator.
- Use a contact type temperature probe and place it on the outer bearing retainer. The maximum bearing temperature should not exceed 70°F (39°C) above ambient.

b. Inspect vibration levels



1) Vertical, **2)** Axial, **3)** Horizontal, **A)** CAUTION Non drive end test conducted at outer edge of endbell to avoid contact with rotating driveshaft, **B)** NOTE: Engine block test measurements taken at corner of block along oil pan mount flange, front and rear.

Figure 309. Typical loader power unit vibration test locations

⚠ WARNING

Entanglement hazard exists if attempting to work on rotating equipment. Use extreme caution when conducting vibration tests on operating power unit. KEEP CLEAR OF ROTATING SHAFTS. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities may cause an entanglement hazard that results in serious injury or death.

c. The vibration levels at the following measurement points should be measured and recorded as a baseline measurement. An example record sheet is located at the end of this section and can be used to record all measurements. All measurements should be taken as close to the rotational centerline as possible with the engine at high throttle and no load, with the machine on tires, and bucket (loaders) one to three feet off of the ground. Refer to illustration “TYPICAL LOADER POWER UNIT VIBRATION TEST LOCATIONS” for vibration testing locations.

1. Generator non drive end vertical on the endbell.
2. Generator non drive end horizontal on the endbell.
3. Generator non drive end axial on the endbell.
4. Generator drive end vertical on the endbell.
5. Generator drive end horizontal on the endbell.
6. Rear engine vertical on engine block.
7. Rear engine horizontal on engine block.
8. Rear engine axial on engine block.
9. Front engine vertical on engine block.

10. Front engine horizontal on engine block.
11. Front engine axial on engine block.

NOTICE

- **The readings should be within 5 mil displacement at all locations.**
- **Any high readings indicate a problem which should be corrected.**
- **Excessive vibration on the non drive end could be indicating a bearing problem or incorrectly balanced rotor.**
- **Vibration on the engine end may be due to misalignment between engine and generator or engine problem.**

d. Inspect performance - load bank test

- When provided on the machine - the generator can be load banked and checked for proper horsepower output.
- Generator voltage.
- Short circuit current.
- Lamination temperature.
- Field current vs generator output.

Generator Vibration Test Record Sheet						
Item		**Test #1**	**Test #2**	**Test #3**	**Test #4**	**Test #5**
Date of Test						
Machine S/N						
Hourmeter Reading						
Generator Axial Vibration	Nde					
Generator Horiz. Vibration	Nde					
Generator Vert. Vibration	Nde					
Generator Horiz. Vibration	De					
Generator Vert. Vibration	De					
Engine Rear Vert.	Engine Block					
Engine Rear Horiz.	Engine Block					
Engine Rear Axial	Engine Block					
Engine Front Vert.	Engine Block					
Engine Front Horiz.	Engine Block					
Engine Front Axial	Engine Block					
Test Conducted By:		By:	By:	By:	By:	By:
Date:		Date:	Date:	Date:	Date:	Date:
NDE = Non Drive End DE = Drive End						

Bearing Temperature Testing

Checking the temperature of the outer bearing retainer of the SR generator is one method for determining the condition of the bearing and grease. By taking bearing temperature measurements, on a consistent periodic basis, under consistent conditions, a temperature history can be generated, which is advantageous in developing a bearing temperature baseline. As a result, future readings will be conclusively indicative of bearing condition. The recommended test interval is every 500 hours as part of the 500 hour electrical Preventative Maintenance.

Temperature monitoring can be done during normal material handling operations, and should not require the machine to be out of service for more than a few minutes. A standard contact pyrometer is required to conduct bearing temperature monitoring.

⚠ WARNING

Entanglement hazard exists if attempting to work on rotating equipment. Never conduct bearing temperature on an operating machine. The shaft between the Hydraulic Pump Drive (HPD) and the generator rotates any time the engine is rotating, even while the engine is being cranked. Wrapping, entanglement, or contact of clothing or extremities can cause an entanglement hazard that results in serious injury or death.

NOTICE

The maximum allowable temperature rise over ambient of the outer bearing carrier should never exceed 100° F (56° C), under any operating condition. Contact your distributor, if bearing shows sustained temperatures outside this range.

Following bearing replacement, it is essential to perform the above bearing temperature check, after one hour of operation.

To conduct temperature monitoring of the generator's bearing, perform the following procedure:

a. Operate the machine for 2 to 3 hours.

a. Record ambient temperature.

b. Shut down the machine and lock out starting capability.

c. As quickly as possible following shutdown, place the pyrometer probe against bearing retainer (inside and outside-see picture below). Allow reading to stabilize and record temperature on Generator Bearing Temperature Record Sheet.

Figure 310. Typical temperature bearing testing

Generator Bearing Temperature					
Item	**Test #1**	**Test #2**	**Test #3**	**Test #4**	**Test #5**
Date Of Test					
Machine S/N					
Hourmeter Reading					
Ambient Temperature°F					
Bearing Retainer Temperature °F					
Comments:					
Test Conducted By:					
NOTE! Maximum allowable temperature rise over ambient is 100°F (37.7°C). To convert °F to °C, (°F - 32) x 5/9 e.g., 100° F would calculate as: (100 - 32) X 5/9 = 37.78°C.					

Figure 311. Bearing temperature test data record

Appendix

(1) Shaft Size Dimensions
(2) Shims
(3) Rotor Adapter Dimensions
(4) Rotor Adapter Part Number Cross Reference
(5) Rotor Adapter Fastener
(6) Tools and Supplies
(7) Insulated Bearing Components
(8) Generator Installation Worksheet
(9) Generator Vibration Test Record Sheet

(1) Shaft Size Dimensions

The G200 has a large diameter shaft and a large bolt circle for 14 pt capscrews and a long shoulder. Check the parts manual for the correct part number for your machine.

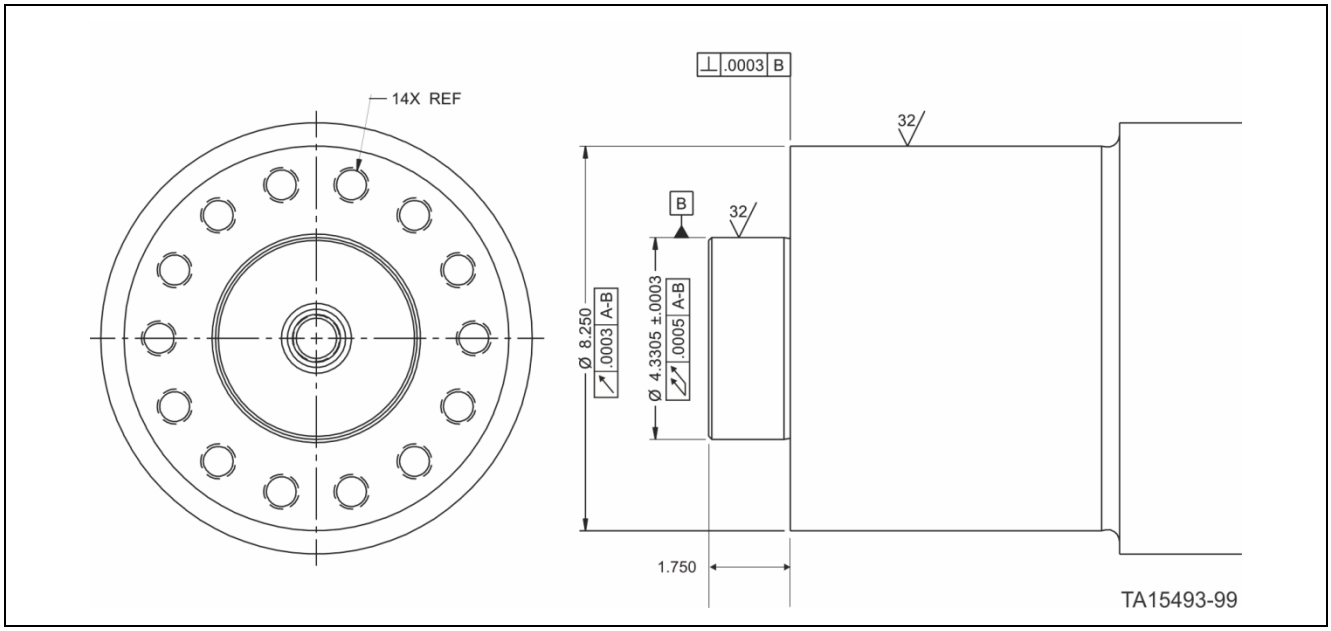


Figure 312. G200 generator shaft with 14 bolt

(2) Shims

Use the shim with the 14 bolt circle on the G200 Shaft.

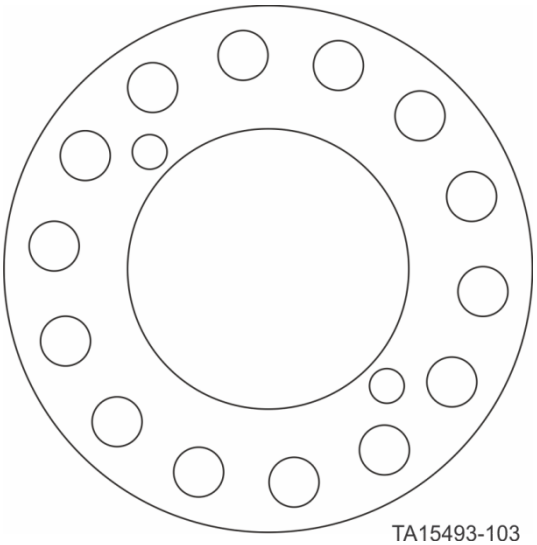
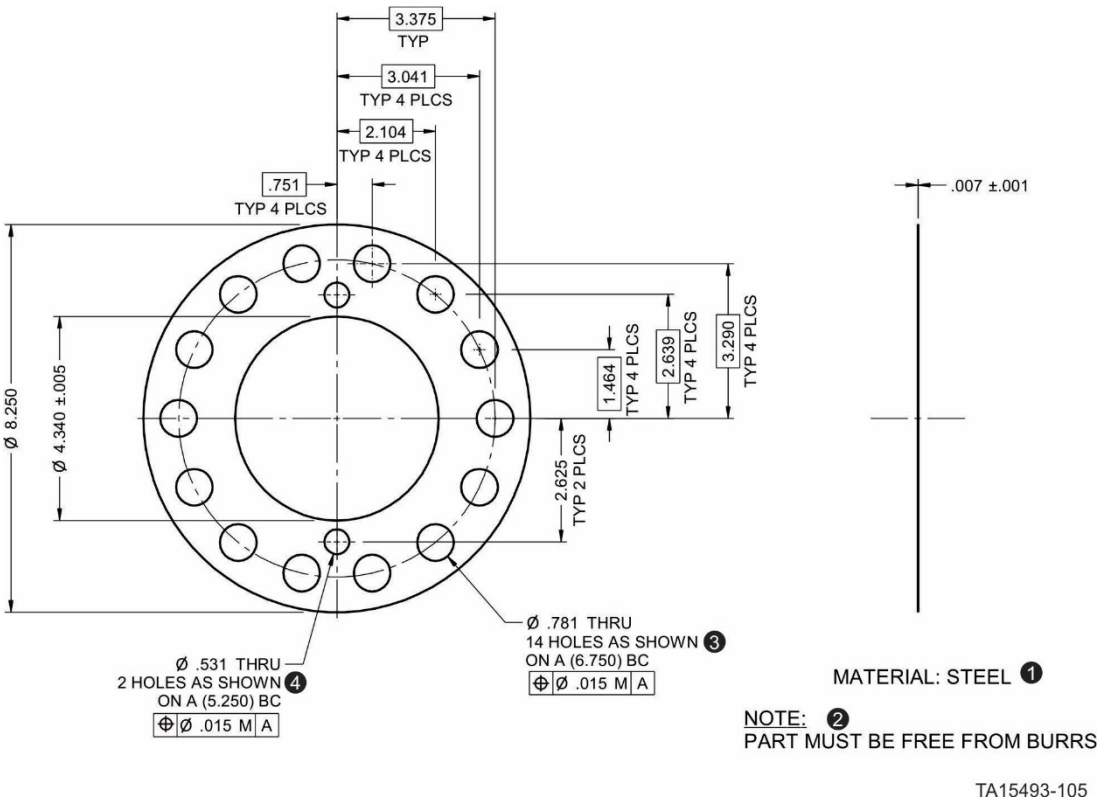


Figure 313. P/N R4164561 with 14 bolt circle (.007 thick)

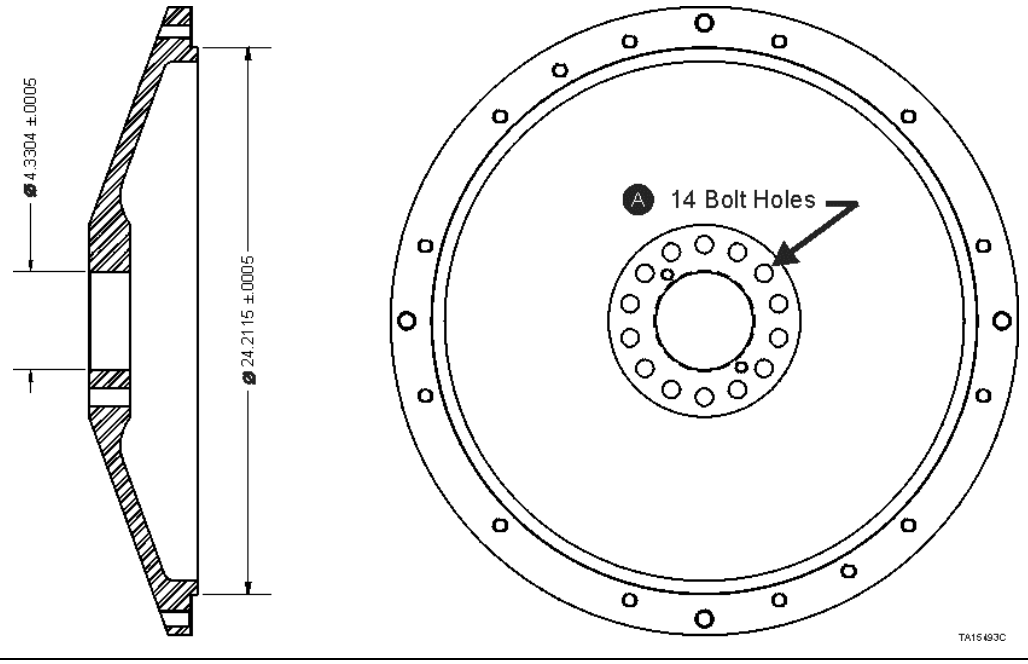


1) Steel, **2)** Part must be free from burrs, **3)** .781” diameter thru-14 holes as shown on a 6.750” bolt circle, **4)** .531” diameter thru 2 holes as shown on a 5.250” bolt circle

Figure 314. Shim (P/N R4164561) dimensions

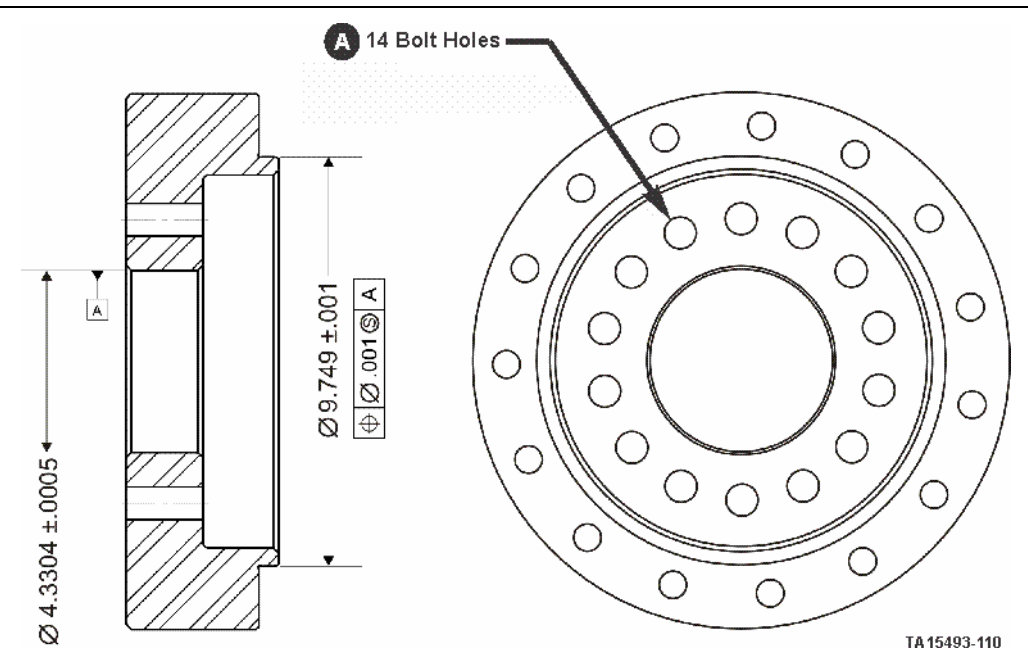
(3) Rotor Adapter Dimensions

There are several types of rotor adapters. Conical adapters are for the SAE 00 Flywheel.



A) 14 Bolt holes

Figure 315. SAE 00 rotor adapter - conical



A) 14 Bolt holes

Figure 316. SAE T2 rotor adapter

(4) Rotor Adapter Part Number Cross Reference

Type	14 Bolt Circle
SAE 00 (conical)	423-8858
SAE T2	427-5138

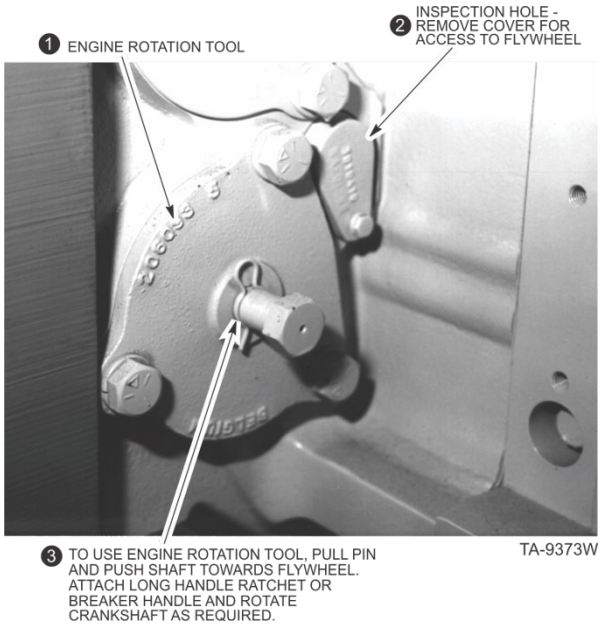
(5) Rotor Adapter Fasteners

- Flat rotor adapters typically use 6 point Grade 8 bolts due to clearance between the flexplate bolts and the rotor adapter bolts.
- Conical rotor adapters have more clearance in this area and use 12 pt capscrews.

(6) Tools and Supplies

Tools and Supplies for Generator Installation and Alignment			
Tool or Supply		**Part Number**	**Quantity**
Hoist - Power Unit/Generator Removal/Installation. Refer to chart "ENGINE AND POWER UNIT COMBINATION WEIGHTS" for weight.		N/A	1
Lifting Slings/Chains/Hooks, as required to handle weights.		N/A	1
Generator Lifting Fixture 4B/7B/9B (Eye Bolt 1”-14 UNS)		N/A	2
Generator Lifting Fixture G100. Required if moving generator only		R1036782	1
Generator Lifting Fixture G200. Required if moving generator only		R1036777	1
Engine Lifting Structure		R4188747	1
Engine rotation tool (Cummins Engine - MFG. Supplied)	Rear Engine	R4213898 (Detroit)	1
	Front Engine Rotation Adapter	R4242617	1
Engine rotation tool Locally Fabricated	Front Engine	R1037426 (Cummins)	1
	Front Engine Rotation Adapter	R1037405 (Detroit Diesel)	1
Miscellaneous Alignment Tools	Large Square	R4097099	1
	Straight Edge-(SAE 0/SAE 00) - 12B-E (refer to illustration "STRAIGHT EDGE").	R4097097	1
	Straight Edge (SAE 0/SAE 1) 4B, 7B, & 9B.	R4180730	1
	SAE 0/00 Alignment Stud (refer to illustration "ALIGNMENT STUD - SAE 0/SAE 00").	R4142674	1
	SAE 1 Alignment Stud (refer to illustration "ALIGNMENT STUD - SAE 1	R4214472	1
	Long-stem Dial Indicator	R4142599 (*includes thread adapter below)	1
	*Thread Adapter for Long Stem Dial Indicator - Fine to course threads.	R4238797	1
	Lever-actuated Dial Indicator	N/A	1
	Dial Indicator Mount Assembly	R4235738	1
	Offset Adapter Wrench Structure (for foot mount bolt installation)	R4080984	1
	Shim, rotor .007” G200	R4164561	A/R
	High Temp. Thread Lock	R4099390	A/R

Figure 317. Tools and supplies



1) Engine rotation tool, **2)** Inspection Hole - Remove cover for access to flywheel,

3) To use engine rotation tool, pull pin and push shaft toward flywheel. Attach long handle ratchet or breaker handle and rotate crankshaft as required.

NOTICE

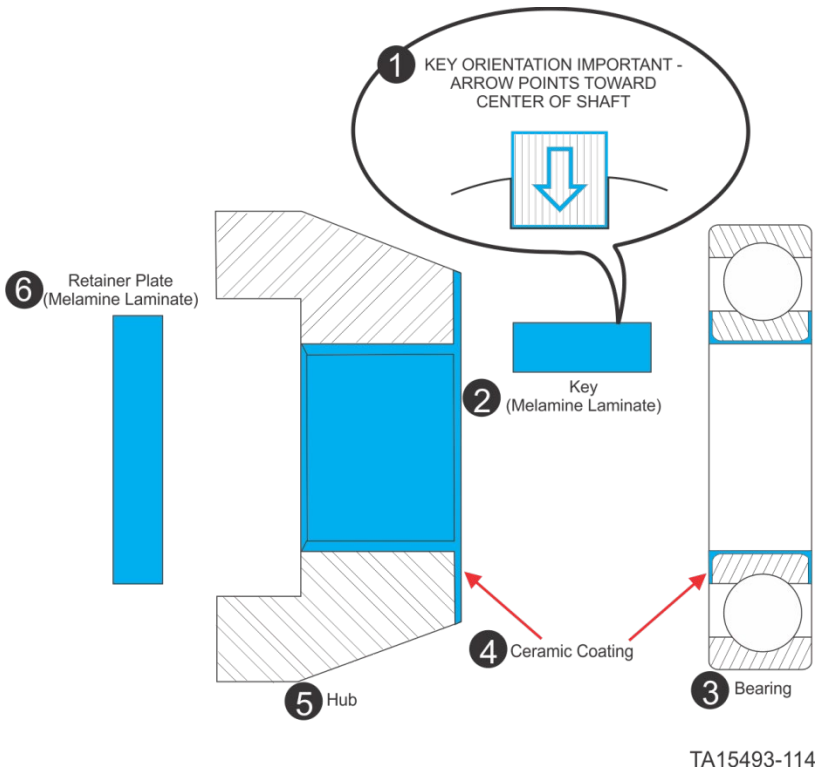
Cummins engine rotation tool shown. Engine rotation tool for Detroit works in a similar manner. For Detroit, remove starter and install the tool (P/N R4213898) in its place.

(7) Insulated Bearing Components

NOTICE

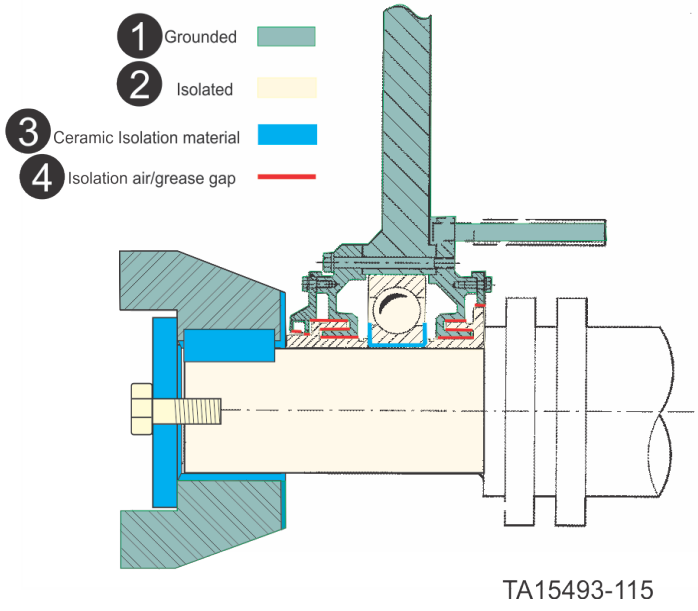
Generators utilize insulated components at the non drive end of the generator to break the circuit and prevent any current path. At the time of power unit installation into the machine, it is CRITICALLY IMPORTANT that these components be installed in the correct orientation. Refer to illustrations "GENERATOR INSULATED COMPONENTS" and "INSTALLED COMPONENTS CROSS SECTION".

When connecting generator field and tap connections on Generator Models 12B-C, torque 3/8 UNC bolts to 25 ft-lbs. Apply LOCTITE RC271 thread locking compound to the threads of the bolt.



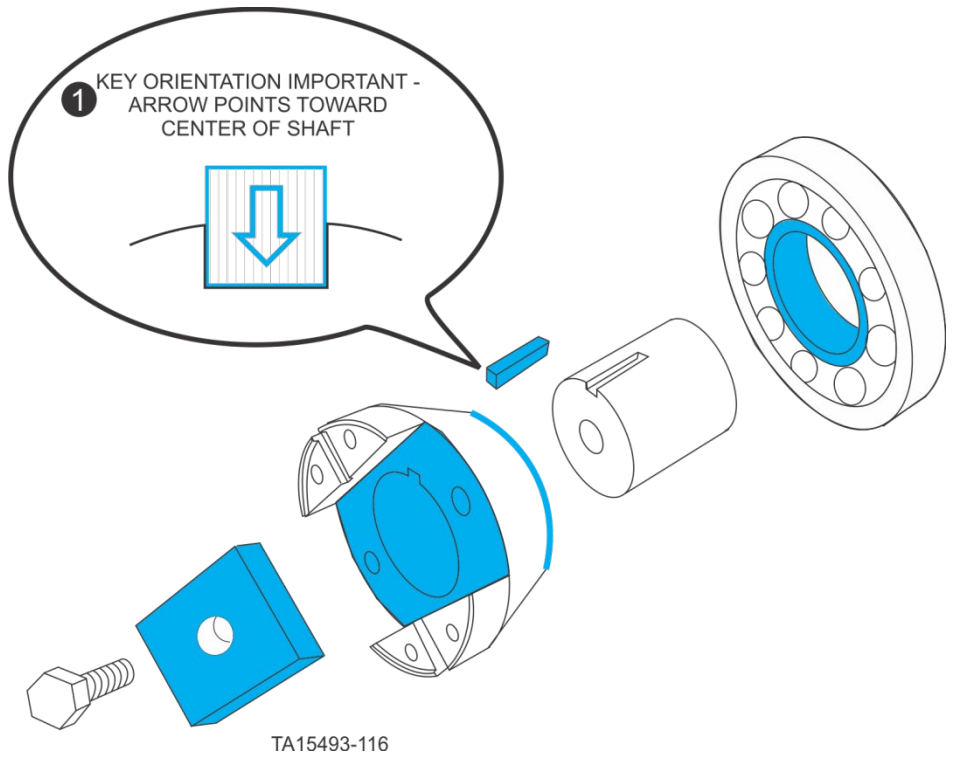
1) Key orientation important – Arrow points toward center of shaft, **2)** Key - melamine laminate, **3)** Bearing, **4)** Ceramic coating, **5)** Hub, **6)** Retainer Plate - melamine laminate

Figure 318. Generator insulated components



1) Grounded, **2)** Isolated, **3)** Ceramic isolation material, **4)** Isolation Air/Grease gap

Figure 319. Installed components cross section



1) Key orientation important - Arrow points toward center of shaft.

Figure 320. Key orientation

(8) Generator Installation Worksheet

Engine Model & S/N	Supervisor Approval:	Date:
Engine Model & S/N:	Generator Model & S/N	Machine Model & S/N:

1) Generator Rotor Endplay Checks	
1.1 Total rotor endplay:	
1.2 Adapter to stator dimension Position 1:_____ Position 2:_____ Average:	1.3 Setup adapter-to-stator dimensions (distance between stator mount face and rotor mount face with rotor in middle of endplay). [Typical dimensions listed below]. 4B/7B: (5.433 - 5.499 w/.070 shim pack [SAE 0 FWH] 5.932 - 5.988 w/ .195 shim pack [SAE 1 FWH]) 9B: (5.433 - 5.499 w/.070 shim pack [SAE 0 FWH] 5.308 - 5.374 w/ .070 shimpack [SAE 00 FWH]) 12B: (2.971 - 3.037 w/ .042 shim pack [SAE 0 FWH] 5.314 - 5.377 w/ .042 shimpack [SAE 00 FWH]) 12C: (5.314 - 5.377 w/ .042 shim pack [SAE 00 FWH]) G100: (7.69 - 7.760 w/ .042 shim pack [SAE 00 FWH]) G200: (5.314 - 5.377 w/ .042 shim pack [SAE 00 FWH]) * MTU T2 Coupling: (3.779 - 3.845 w/ .042 shim pack [SAE 00 FWH])

2) Pre-Installation Check

2.1Rotor adapter CMM number:_____	(SAE 1): 15.0000 ± .0005 (SAE 0): 18.8735 ± .0007 (SAE 00): 24.2115 ± .0005	2.2 Flexplate pilot diameter:_____	(SAE1): 15.000 ± .001 (SAE 0): 18.875 + 0.005, -0.000 (SAE 00): 24.2080 – 24.2110

2.3 Radial runout of flexplate pilot bore OD:(0.003” max.): SAE 1/0 (0.004” max.): SAE 0/00	2.4 Axial runout of flexplate (0.035: max.):
2.5 Radial runout of flywheel housing (.010” max.):	2.6 Axial runout of flywheel housing (.010” max.):
2.7 Perpendicular alignment of generator feet (.010” max.):	Left Right
2.8 Radial runout of stator adapter plate (.010” max.):	2.9 Axial runout of stator adapter plate (.010” max.):
2.10 Perpendicular alignment of rear engine mounts (.005” max.):	Left Right

3) Rotor Adapter Positioning Checks				
3.1 Radial runout of the ID on mounted rotor adapter bore (less than .001)	Position1_____	Position2_____	Position3_____	Position4_____

4) Rotor Adapter Plate Shimming			
4.1 Engine endplay (per engine manufacturer’s specification):			
4.2 Distance between straight edge and flexplate face:	Position 1 _____	Position 2 _____	Average (Dimension A) _____

4.3 Shim pack: Average distance between straight edge and flexplate (Dimension A): = _____ (From 1.3) Setup adapter to stator dim. (Dimension B) = _____ Difference =
4.4 Total number of shims and thickness of each used in the assembly:
5) Install Generator And Shim Generator Feet
5.1A SAE 1/0 Gap at top and bottom: Top Bottom Difference
5.1B SAE 00 Need 4 locations before and after Before After Differences (≤ .010)
5.2 Shim pack thickness under generator feet: Left Right
5.3 Used Loctite, and torque wrench and safety wire to secure the rotor adapter. Yes No
6) Final Checks
6.1 Engine endplay
6.2 Radial runout of generator shaft (.003” max.):

Figure 321. Generator installation worksheet

(9) Generator Vibration Test Record Sheet

Item		Test #1	Test #2	Test #3	Test #4	Test #5
Date Of Test						
Machine S/N						
Hourmeter Reading						
Generator Axial Vibration	NDE					
Generator Horiz. Vibration	NDE					
Generator Vert. Vibration	NDE					
Generator Horiz. Vibration	DE					
Generator Vert. Vibration	DE					
Engine Rear Vert.	Engine Block					
Engine Rear Horiz.	Engine Block					
Engine Rear Axial	Engine Block					
Engine Front Vert.	Engine Block					
Engine Front Horiz.	Engine Block					
Engine Front Axial	Engine Block					
Test Conducted By:		By:	By:	By:	By:	By:
Date:		Date:	Date:	Date:	Date:	Date:
NDE = Non Drive End DE = Drive End						

Figure 322. Vibration test record

NOTICE

Use this sheet as a template & make copies for recording actual data

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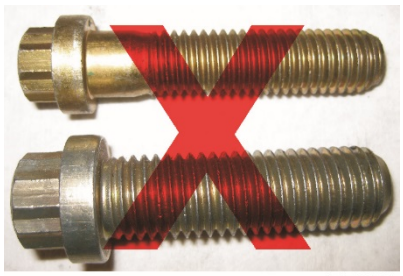
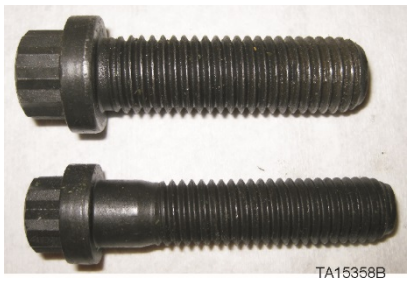
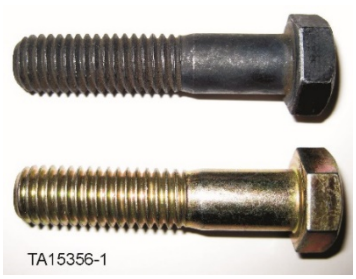
Capscrew and Bolt-Nut Torque Specifications

There are some exceptions to the torques provided on the following pages. Reduced torques are specified in the planetary drive rebuild manual, for the capscrews holding the planetary drive covers, due to a copper sealing washer under the head of the capscrew.

The torque specifications on this chart apply only to Grade 8 bolts, black or gold colored, and 12pt black-colored alloy steel capscrews. 12pt capscrews with gold-colored zinc chromate plating are excluded from these specifications and the zinc chromate 12pt capscrews should not be used on loaders or dozers. (except for planetary drive covers)

These torque values are for normal routine operations. If doing component rebuilds or any other abnormal machine component assembly/disassembly, please contact the factory for these values for specific instances.

 TA15358A	 TA15358B	 TA15356-1
Does not apply X	**12PT Alloy Capscrew ✓**	**Grade 8 Bolt ✓**

NOTICE

Please note the additional tables for exceptions to the torque values for items such as Lift Arm Ballcaps, Super Nuts and steering pin bolts with drilled grease passages.

Please direct any questions to Product Support.

Capscrew and Bolt-Nut Torque Specifications Chart

Standard SAE G8 and Alloy Steel and Hex Socket Capscrews

Size	Thread	GRADE 8 Fasteners		Alloy Steel 12PT. and Hex Socket Capscrews	
		USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m
		**Lubed	**Lubed	**Lubed	**Lubed
1/4 (0.25)	20 UNC	9	13	12	16
	28 UNF	10	14	14	19
5/16 (0.3125)	18 UNC	18	25	24	33
	24 UNF	20	27	27	37
3/8 (0.375)	16 UNC	33	45	45	61
	24 UNF	37	50	50	68
7/16 (0.4375) (* See Note below)	14 UNC	52	71	70	95
	20 UNF	58	79	79	107
1/2 (0.5) (* See Note below)	13 UNC	80	109	108	146
	20 UNF	90	122	122	165
5/8 (0.625)	11 UNC	159	216	203	275
	18 UNF	180	244	230	312
3/4 (0.75)	10 UNC	282	383	361	490
	16 UNF	315	427	403	546
1 (1.0) (*** See Note below)	8 UNC	682	925	872	1182
	14 UNS	764	1,036	977	1325
1-1/8 (1.125)	7 UNC	966	1310	1235	1674
	12 UNF	1083	1468	1385	1878
1-1/4 (1.25) (**** See Note below)	7 UNC	1,363	1,848	1744	2365
	12 UNF	1,509	2,046	1930	2617
1-1/2 (1.5)	6 UNC	2,371	3,215	3033	4113
	12 UNF	2,668	3,618	3413	4628

* **See Special Torque Specifications for ROPS super nut.**

** **See page 4 for specifications for "LUBED" – engine oil on threads and shoulder.**

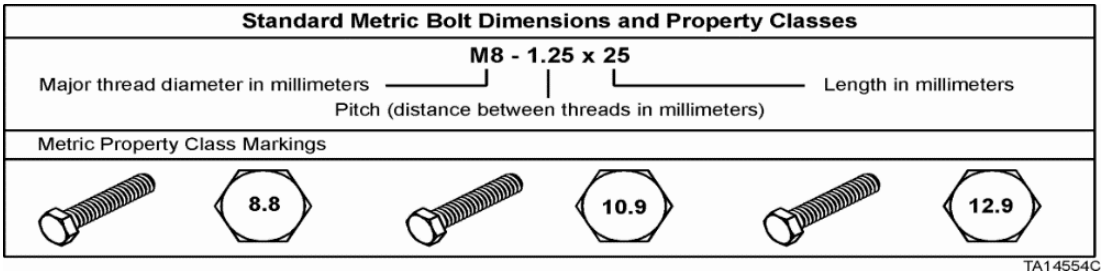
*** **See Special Torque Specifications for 950/1150 steering pins.**

*** **This bolt is UNS (with 14 threads per inch), it is NOT UNF. It is a unique thread count bolt.**

**** **See Special Torque Specifications for loader lift arms and 1350/1850/2350 steering pins.**

Standard Metric Bolts and Grades (SAE J1701M)

Size (mm)	Pitch (mm)	Property Class 8.8		Property Class 10.9		Property Class 12.9	
		USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m	USA Units lb-ft	Metric Units N-m
		** Lubed	** Lubed	** Lubed	** Lubed	** Lubed	** Lubed
6	1.00	6	8	8	11	10	13
7	1.00	10	13	14	19	16	22
8	1.25	14	19	20	27	24	32
10	1.50	28	38	40	54	47	63
12	1.75	49	66	70	94	81	110
14	2.00	77	105	111	150	130	176
16	2.00	121	164	173	235	202	274
18	2.50	167	226	239	324	279	378
20	2.50	244	331	337	458	394	535
24	3.00	422	572	584	791	682	925



Capscrew and Bolt-Nut Torque Specifications

Special Torque Specifications

Alloy Steel 12PT. Capscrew for Wheel Loader Lift Arm Ballcaps

Size	Type	Thread	USA Units lb-ft	Metric Units N-m	Application
			**Lubed	**Lubed	
1-1/4 (1.250)	12PT. capscrew F-C on head	7 UNC	1900	2577	LHD, L-950, L-1150, L-1350, L-1850, and L-2350 (Lift arm ball caps only)
1-1/4 (1.250)	12PT. capscrew B-7 on head	12 UNF	1320	1790	L-1000-L-1100 (Lift arm ball caps only)

Steering Pins (Hex Head Bolt)

Size	Type	Thread	USA Units lb-ft	Metric Lubed N-m	Application
			** Lubed	** Lubed	
1 (1.0)	Bolt (drilled center)	8UNC	425	576	LHD, L-950, D-950, L-1150 (Steering Pins)
1-1/4 (1.250)	Bolt (drilled center)	7UNC	850	1152	L-1350, L-1850, L-2350 (Steering Pins)

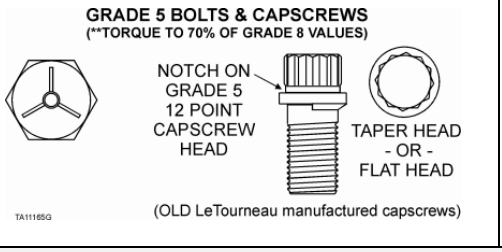
Aluminum 12pt. Capscrews used for Motor Pinion Balancing

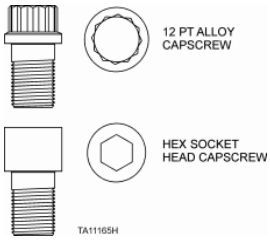
Size	Type	Thread	USA Units (lb-ft)		Metric Units (N-m)	
			Dry	**Lubed	Dry	**Lubed
¾ (0.75)	Aluminum	16 UNF	114	86	155	117
¾ (0.75)	Aluminum 2024-T4	16 UNF	150	113	203	153
15/16 (.9375)	Aluminum 6061 T6	12 NF	217	163	294	221
15/16 (.9375)	Aluminum 2024-T4	12 NF (2 START)	285	214	387	290

2-Thread (2-Start) Steel 12PT. Capscrews

Size	Type	Thread	USA Units lb-ft	Metric Units N-m
			** Lubed	** Lubed
3/8 (.3750)	12PT.	24 NF	25	34
9/16 (.5625)	12PT.	18 NF	87	119
15/16 (.9375)	12PT.	14 NF	428	584
1-5/16 (1.325)	12PT.	12 NF	1216	1660

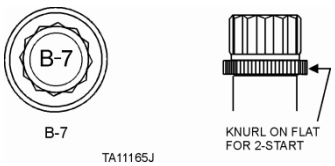
Bolt and Capscrew Markings on Head





Typical Markings on Alloy Capscrew Heads

Typical B-7, 2-Start



** See “Key Items” for specifications for “LUBED” – engine oil on threads and shoulder.

Capscrew and Bolt-Nut Torque Specifications

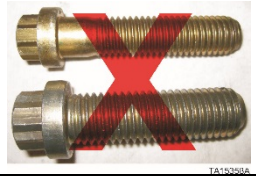
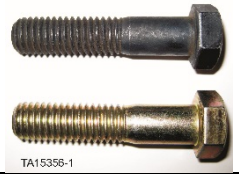
Key Items

- "LUBED" is defined as having the threads and under the head lubricated with engine oil. Engine oil is defined as SAE 30 or 40 weight oil, including multi viscosity grades 5W-30 through 15W-40. No other lubricant (such as anti seize, MolyKote, copper coat, grease, etc.) is permitted unless specifically called out in a Komatsu procedure.

****LUBED = Lubricated with engine oil on threads and under head**
(SAE 30 or 40 weight oil, including multi viscosity grades 5W-30 through 15W-40)

NOTE: No other lubricant (such as anti seize, never seize, MolyKote, copper coat, grease, etc.) is permitted unless specifically called out in a Komatsu procedure.

- All capscrews and bolts should be started by hand until a minimum of three (3) threads are engaged prior to any air impact equipment being used.
- If a procedure in a Rebuild Manual, Repair and Overhaul or Operating and Service Manual calls for the use of Loctite® threadlocker on the threads, the torque specification for "lubed" should be used. The threads on both the fastener and mating part should be thoroughly cleaned with a proper solvent prior to use of Loctite®. The Loctite® thread sealant should only be used on the threads - not the head.
- Certain applications in components such as drivers or lift arm ball caps may specify a FERRY brand of capscrew. Use only FERRY brand capscrews in these applications.
- Komatsu, recommends that any old 12PT. Komatsu-fabricated (fabrication was stopped many years ago) capscrew (refer to illustration under BOLT AND CAPSCREW MARKINGS ON HEAD) be replaced at the time of repair with alloy capscrews. If new capscrews are not available, then the Komatsu-fabricated capscrews should only be torqued to Grade 5 specifications (70% of Grade 8 value - lubed).
- The torque specifications on the charts on page 2 only apply to Grade 8 bolts, metric bolts and 12PT. black-colored alloy steel capscrews. Capscrews with gold-colored zinc chromate plating are excluded from these specifications and these capscrews should not be used on loaders or dozers except for driver covers.

		
Does not apply X	**12PT Alloy Capscrew ✓**	**Grade 8 Bolt ✓**

- CLEANING: It is mandatory to remove all paint, rust and debris from all mating surfaces, surfaces under the head of the bolt or capscrew and threads prior to installation and torquing of all bolts and capscrews.

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