Additions, Revisions, or Updates

<table>
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<th>Platform</th>
<th>Section Title</th>
<th>Change</th>
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<td>DDC-SVC-MAN-0190</td>
<td>GHG17 HD DD</td>
<td>Aftertreatment Sensor Boss Repair</td>
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<td>Diesel Oxidation Catalyst</td>
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<td>Inlet Pipe Crack Repair</td>
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</tr>
</tbody>
</table>
2  Aftertreatment Sensor Boss Repair

Replacement of the Aftertreatment Device (ATD) is not necessary if the sensor boss threads are damaged during service. Detroit™ has released all ATD sensor bosses, along with the required Tungsten Inert Gas (TIG) welding rods to make repairs.

**NOTE:** This repair requires TIG welding and should be done by an experienced welding technician.

Use the tables below to identify the correct sensor boss, hole saw, and arbor needed to make the repair. The required TIG welding rod part numbers are also provided in Table 1. Either of the two welding rod part numbers are acceptable for this repair and can be ordered.

**Table 1.**

<table>
<thead>
<tr>
<th>Sensor Boss Description</th>
<th>Quantity</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Sensor Boss</td>
<td>1</td>
<td>23539604</td>
</tr>
<tr>
<td>Temperature Sensor Boss M12</td>
<td>1</td>
<td>23539605</td>
</tr>
<tr>
<td>Temperature Sensor Boss M14</td>
<td>1</td>
<td>23539606</td>
</tr>
<tr>
<td>Temperature Sensor Boss M16</td>
<td>1</td>
<td>23539607</td>
</tr>
<tr>
<td>NOx Sensor Boss M20</td>
<td>1</td>
<td>23539608</td>
</tr>
<tr>
<td>Soot Sensor Boss (1-Box) M22</td>
<td>1</td>
<td>23539925</td>
</tr>
<tr>
<td>Soot Sensor Boss (2-Box) M22</td>
<td>1</td>
<td>23539926</td>
</tr>
<tr>
<td>36 Inch Arcos™ 409 TIG Welding Rod</td>
<td>3</td>
<td>23539448</td>
</tr>
<tr>
<td>36 Inch Arcos™ 410 TIG Welding Rod</td>
<td>3</td>
<td>23539450</td>
</tr>
</tbody>
</table>

To remove the sensor boss, refer to Table 2 to identify the correct size hole saw diameter and part number.

**Table 2.**

<table>
<thead>
<tr>
<th>Sensor Boss</th>
<th>Carbide Tip Hole Saw Size</th>
<th>Grainger Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Sensor Boss</td>
<td>1-3/16 (30mm)</td>
<td>2CDD5</td>
</tr>
<tr>
<td>Temperature Sensor Boss M12</td>
<td>15/16 (24mm)</td>
<td>2CDD3</td>
</tr>
<tr>
<td>Temperature Sensor Boss M14</td>
<td>1-1/16 (27mm)</td>
<td>2CDD4</td>
</tr>
<tr>
<td>Temperature Sensor Boss M16</td>
<td>15/16 (24mm)</td>
<td>2CDD3</td>
</tr>
<tr>
<td>NOx Sensor Boss M20</td>
<td>1-3/8 (35mm)</td>
<td>4XG46</td>
</tr>
<tr>
<td>Soot Sensor Boss (1-Box) M22</td>
<td>1-7/16 (37mm)</td>
<td>2CDD8</td>
</tr>
<tr>
<td>Soot Sensor Boss (2-Box) M22</td>
<td>1-1/2 (38mm)</td>
<td>4XG47</td>
</tr>
</tbody>
</table>

Use the next table to select the correct arbor for the hole saw selected.
Table 3.

<table>
<thead>
<tr>
<th>Carbide Tip Hole Saw Size</th>
<th>Grainger Arbor Part Number</th>
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<tbody>
<tr>
<td>15/16 (24mm)</td>
<td>4XJ20</td>
</tr>
<tr>
<td>1-1/16 (27mm)</td>
<td></td>
</tr>
<tr>
<td>1-3/16 (30mm)</td>
<td></td>
</tr>
<tr>
<td>1-3/8 (35mm)</td>
<td>4XJ25</td>
</tr>
<tr>
<td>1-7/16 (37mm)</td>
<td></td>
</tr>
<tr>
<td>1-1/2 (38mm)</td>
<td></td>
</tr>
</tbody>
</table>

Repair as follows:

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

   **CAUTION: ELECTRICAL SHOCK**
   
   To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the Aftertreatment from the vehicle. Refer to section "Removal of the 1-BOX™ from the Vehicle".

   **NOTICE:** Always verify the new boss threads on the sensor before welding.

6. If the sensor boss is shielded as in Figure 1, the heat shield will need to be removed to gain access to the damaged boss. Figure 2 illustrates a sensor boss not surrounded by a heat shield.
Figure 1. Sensor Boss Surrounded by Heat Shield

Figure 2. Sensor Boss Not Surrounded by Heat Shield
7. If needed, use a die grinder to remove the shielding around the damaged sensor boss. The shielding should be removed as neatly as possible. It will need to be welded back in place once the sensor boss is replaced.

8. Use the sensor boss to pilot the hole saw. Start cutting the sensor boss weld; check the depth of the cut frequently to prevent the damaged sensor boss from falling inside the Aftertreatment device. See graphic below.

9. Clean off all metal shavings from around the sensor boss hole; avoid chips from entering the Aftertreatment device.

10. Verify the new sensor boss fits the sensor before welding in place. Tack weld the sensor boss in place, then complete the weld around the boss. See graphic below for an example of a newly welded sensor boss.
11. If a section of the heat shield was removed, tack weld the heat shield in place. See graphic below.

12. Once the heat shield is properly tack welded in place, complete the welding.
13. Install the sensor into the new sensor boss. Torque to the correct specification.
14. Install the Aftertreatment to the vehicle. Refer to section "Installation of the 1-BOX™ to the Vehicle".
15. Install the right side fairing. Refer to OEM procedures.

**CAUTION: ELECTRICAL SHOCK**

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

16. Connect the batteries.

**WARNING: PERSONAL INJURY**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

**WARNING: PERSONAL INJURY**

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.
WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

17. Start the engine.
18. Check for any exhaust leaks.
3 Diesel Oxidation Catalyst Inlet Pipe Crack Repair

Repair as follows:

NOTE: This repair requires TIG welding and should be done by an experienced welding technician.

NOTE: If the Diesel Oxidation Catalyst (DOC) inlet pipe has completely separated from the Aftertreatment, replacement of the 1-BOX is necessary.

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the aftertreatment from the vehicle. Refer to section "Removal of the 1-BOX™ from the Vehicle".
6. If necessary, remove the bolts securing the inboard and outboard heat shield to the aftertreatment and remove the heat shields.
7. Using an appropriately sized drill bit, drill-stop the crack.

8. Clean and prep the surface area of the crack.
9. Using Arcos 409 TIG welding rod part number 23539448, weld the crack. Ensure each drill-stop hole has been welded.

Figure 3. Example of Crack in DOC Inlet Pipe

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10. Allow the weld time to cool.
11. If removed, install the inboard and outboard heat shield. Torque the bolts to 10 N·m (7 lb·ft).
12. Install the Aftertreatment to the vehicle. Refer to section "Installation of the 1-BOX™ to the Vehicle".
13. Install the right side fairing. Refer to OEM procedures.

**CAUTION: ELECTRICAL SHOCK**

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

14. Connect the batteries.

**WARNING: PERSONAL INJURY**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

**WARNING: PERSONAL INJURY**

To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.
WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

15. Start the engine.
16. Check for any exhaust leaks.
4 Rear Cover Crack Repair

Repair as follows:

NOTE: This repair requires TIG welding and should be done by an experienced welding technician.

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the aftertreatment from the vehicle. Refer to section "Removal of the 1-BOX™ from the Vehicle".
6. Remove the Aftertreatment Control Module (ACM). Refer to section "Removal of the 1-BOX™ Aftertreatment Control Module".
7. Note the location of the nylon straps securing the ATS wiring to the ATS.
8. Remove the nylon straps securing the ATS wiring to the outlet side of the ATS.
9. Reposition all ATS wiring off the outlet side of the ATS to avoid damage.
10. Remove the bolts securing the ACM mounting bracket to the ATS.
11. Using an appropriately sized drill bit, drill-stop the crack. Ensure the drill bit only penetrates the heat shield. See graphic below.

12. Clean and prep the surface area of the crack. See graphic below.
13. Using Arcos 409 TIG welding rod part number 23539448, weld the crack. Ensure each drill-stop hole has been welded. See graphic below.

14. Allow the weld time to cool.
15. Install the ACM mounting bracket to the ATS. Torque the bolts to 25 N·m (19 lb·ft).
16. Install the ACM. Refer to section "Installation of the 1-BOX™ Aftertreatment Control Module".
17. Reposition all ATS wiring to its original location.
18. Install all nylon straps into their original location.
19. Install the aftertreatment to the vehicle. Refer to section "Installation of the 1-BOX™ to the Vehicle".
20. Install the right side fairing. Refer to OEM procedures.

**CAUTION: ELECTRICAL SHOCK**
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

21. Connect the batteries.

**WARNING: PERSONAL INJURY**
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

**WARNING: PERSONAL INJURY**
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

**WARNING: ENGINE EXHAUST**
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

22. Start the engine.
23. Check for any exhaust leaks.
5 Aftertreatment Sensor Boss Repair

Replacement of the Aftertreatment Device (ATD) is not necessary if the sensor boss threads are damaged during service. Detroit™ has released all ATD sensor bosses, along with the required Tungsten Inert Gas (TIG) welding rods to make repairs.

NOTE: This repair requires TIG welding and should be done by an experienced welding technician.

Use the tables below to identify the correct sensor boss, hole saw, and arbor needed to make the repair. The required TIG welding rod part numbers are also provided in Table 1. Either of the two welding rod part numbers are acceptable for this repair and can be ordered.

Table 4. Sensor Boss and Welding Rod Part Numbers

<table>
<thead>
<tr>
<th>Sensor Boss Description</th>
<th>Quantity</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Sensor Boss</td>
<td>1</td>
<td>23539604</td>
</tr>
<tr>
<td>Temperature Sensor Boss M12</td>
<td>1</td>
<td>23539605</td>
</tr>
<tr>
<td>Temperature Sensor Boss M14</td>
<td>1</td>
<td>23539606</td>
</tr>
<tr>
<td>Temperature Sensor Boss M16</td>
<td>1</td>
<td>23539607</td>
</tr>
<tr>
<td>NOx Sensor Boss M20</td>
<td>1</td>
<td>23539608</td>
</tr>
<tr>
<td>36 Inch Arcos™ 409 TIG Welding Rod</td>
<td>3</td>
<td>23539448</td>
</tr>
<tr>
<td>36 Inch Arcos™ 410 TIG Welding Rod</td>
<td>3</td>
<td>23539450</td>
</tr>
</tbody>
</table>

To remove the sensor boss, refer to Table 2 to identify the correct size hole saw diameter and part number.

Table 5. Hole Saw Diameter and Part Numbers

<table>
<thead>
<tr>
<th>Sensor Boss</th>
<th>Carbide Tip Hole Saw Size</th>
<th>Grainger Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Sensor Boss</td>
<td>1-3/16 (30mm)</td>
<td>2CDD5</td>
</tr>
<tr>
<td>Temperature Sensor Boss M12</td>
<td>15/16 (24mm)</td>
<td>2CDD3</td>
</tr>
<tr>
<td>Temperature Sensor Boss M14</td>
<td>1-1/16 (27mm)</td>
<td>2CDD4</td>
</tr>
<tr>
<td>Temperature Sensor Boss M16</td>
<td>15/16 (24mm)</td>
<td>2CDD3</td>
</tr>
<tr>
<td>NOx Sensor Boss M20</td>
<td>1-3/8 (35mm)</td>
<td>4XG46</td>
</tr>
</tbody>
</table>

Use the next table to select the correct arbor for the hole saw selected.

Table 6. Arbor Part Numbers

<table>
<thead>
<tr>
<th>Carbide Tip Hole Saw Size</th>
<th>Grainger Arbor Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/16 (30mm)</td>
<td>4XJ20</td>
</tr>
<tr>
<td>15/16 (24mm)</td>
<td></td>
</tr>
<tr>
<td>1-1/16 (27mm)</td>
<td></td>
</tr>
<tr>
<td>1-3/8 (35mm)</td>
<td>4XJ25</td>
</tr>
</tbody>
</table>

Repair as follows:

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.
CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the Aftertreatment from the vehicle. Refer to section "Removal of the GHG14 1-BOX™ From the Vehicle".

NOTICE: Always verify the new boss threads on the sensor before welding.

6. If the sensor boss is shielded as in Figure 1, the heat shield will need to be removed to gain access to the damaged boss. Figure 2 illustrates a sensor boss not surrounded by a heat shield.

Figure 5. Sensor Boss Surrounded by Heat Shield
Figure 6. Sensor Boss Not Surrounded by Heat Shield

7. If needed, use a die grinder to remove the shielding around the damaged sensor boss. The shielding should be removed as neatly as possible. It will need to be welded back in place once the sensor boss is replaced.

8. Use the sensor boss to pilot the hole saw. Start cutting the sensor boss weld; check the depth of the cut frequently to prevent the damaged sensor boss from falling inside the Aftertreatment device. See graphic below.

9. Clean off all metal shavings from around the sensor boss hole; avoid chips from entering the Aftertreatment device.
10. Verify the new sensor boss fits the sensor before welding in place. Tack weld the sensor boss in place, then complete the weld around the boss. See graphic below for an example of a newly welded sensor boss.

11. If a section of the heat shield was removed, tack weld the heat shield in place. See graphic below.

12. Once the heat shield is properly tack welded in place, complete the welding.
13. Install the sensor into the new sensor boss. Torque to the correct specification.
14. Install the Aftertreatment to the vehicle. Refer to section "Installation of the GHG14 1-BOX™ to the Vehicle".
15. Install the right side fairing. Refer to OEM procedures.
CAUTION: ELECTRICAL SHOCK  
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

16. Connect the batteries.

WARNING: PERSONAL INJURY  
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY  
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST  
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area.

Engine exhaust is toxic.

17. Start the engine.
18. Check for any exhaust leaks.
6 Diesel Oxidation Catalyst Inlet Pipe Crack Repair

**NOTE:** This repair requires TIG welding and should be done by an experienced welding technician.

**NOTE:** If the Diesel Oxidation Catalyst (DOC) inlet pipe has completely separated from the Aftertreatment, replacement of the 1-BOX is necessary.

Repair as follows:

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

   **CAUTION: ELECTRICAL SHOCK**
   To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the aftertreatment from the vehicle. Refer to section "Removal of the GHG14 1-BOX™ From the Vehicle".
6. If necessary, remove the bolts securing the inboard and outboard heat shield to the aftertreatment and remove the heat shields.
7. Using an appropriately sized drill bit, drill-stop the crack.

   **Figure 7. Example of Crack in DOC Inlet Pipe**

8. Clean and prep the surface area of the crack.
9. Using Arcos 409 TIG welding rod part number 23539448, weld the crack. Ensure each drill-stop hole has been welded.
Figure 8. Weld Repair to DOC Inlet Pipe

10. Allow the weld time to cool.
11. If removed, install the inboard and outboard heat shield. Torque the bolts to 10 N·m (7 lb·ft).
12. Install the Aftertreatment to the vehicle. Refer to section "Installation of the GHG14 1-BOX™ to the Vehicle".
13. Install the right side fairing. Refer to OEM procedures.

CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

14. Connect the batteries.

WARNING: PERSONAL INJURY
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- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.
WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

15. Start the engine.
16. Check for any exhaust leaks.
7 Rear Cover Crack Repair

Repair as follows:

**NOTE:** This repair requires TIG welding and should be done by an experienced welding technician.

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

2. **CAUTION: ELECTRICAL SHOCK**
   To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

3. Disconnect the batteries.

4. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.

5. Allow the Aftertreatment System (ATS) time to cool.

6. Remove the aftertreatment from the vehicle. Refer to section "Removal of the GHG14 1-BOX™ From the Vehicle".

7. If needed, remove the Selective Catalytic Reduction (SCR) inlet and SCR outlet NOX sensors.
   Refer to section "Removal of the GHG14 Selective Catalytic Reduction Inlet NOx Sensor"
   Refer to section "Removal of the GHG14 Selective Catalytic Reduction Outlet NOx Sensor"

8. If needed, remove the NOx sensor mounting bracket, by removing the bolts.

9. Note the location of the nylon straps securing the ATS wiring to the ATS.

10. Remove the nylon straps securing the ATS wiring to the outlet side of the ATS.

11. Reposition all ATS wiring off the outlet side of the ATS to avoid damage.

12. Using an appropriately sized drill bit, drill-stop the crack. Ensure the drill bit only penetrates the heat shield. See graphic below.

13. Clean and prep the surface area of the crack. See graphic below.
13. Using Arcos 409 TIG welding rod part number 23539448, weld the crack. Ensure each drill-stop hole has been welded. See graphic below.

14. Allow the weld time to cool.
15. Install the NOx sensor mounting bracket to the ATS. Torque the bolts to 25 N·m (19 lb·ft).
16. If removed, install the SCR inlet and SCR outlet NOx sensors.
   Refer to section "Installation of the GHG14 Selective Catalytic Reduction Inlet NOx Sensor"
   Refer to section "Installation of the GHG14 Selective Catalytic Reduction Outlet NOx Sensor"
17. Reposition all ATS wiring to its original location.
18. Install all nylon straps into their original location.
19. Install the aftertreatment to the vehicle. Refer to section "Installation of the GHG14 1-BOX™ to the Vehicle".
20. Install the right side fairing. Refer to OEM procedures.

17. Reposition all ATS wiring to its original location.
18. Install all nylon straps into their original location.
19. Install the aftertreatment to the vehicle. Refer to section "Installation of the GHG14 1-BOX™ to the Vehicle".
20. Install the right side fairing. Refer to OEM procedures.

CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

21. Connect the batteries.

WARNING: PERSONAL INJURY
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• Always start and operate an engine in a well ventilated area.
• If operating an engine in an enclosed area, vent the exhaust to the outside.
• Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

22. Start the engine.
23. Check for any exhaust leaks.
8 Aftertreatment Sensor Boss Repair

Replacement of the Aftertreatment Device (ATD) is not necessary if the sensor boss threads are damaged during service. Detroit™ has released all ATD sensor bosses, along with the required Tungsten Inert Gas (TIG) welding rods to make repairs.

**NOTE:** This repair requires TIG welding and should be done by an experienced welding technician.

Use the tables below to identify the correct sensor boss, hole saw, and arbor needed to make the repair. The required TIG welding rod part numbers are also provided in Table 1. Either of the two welding rod part numbers are acceptable for this repair and can be ordered.

**Table 7.**

<table>
<thead>
<tr>
<th>Sensor Boss Description</th>
<th>Quantity</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Sensor Boss</td>
<td>1</td>
<td>23539604</td>
</tr>
<tr>
<td>Temperature Sensor Boss M12</td>
<td>1</td>
<td>23539605</td>
</tr>
<tr>
<td>Temperature Sensor Boss M14</td>
<td>1</td>
<td>23539606</td>
</tr>
<tr>
<td>Temperature Sensor Boss M16</td>
<td>1</td>
<td>23539607</td>
</tr>
<tr>
<td>NOx Sensor Boss M20</td>
<td>1</td>
<td>23539608</td>
</tr>
<tr>
<td>36 Inch Arcos™ 409 TIG Welding Rod</td>
<td>3</td>
<td>23539448</td>
</tr>
<tr>
<td>36 Inch Arcos™ 410 TIG Welding Rod</td>
<td>3</td>
<td>23539450</td>
</tr>
</tbody>
</table>

To remove the sensor boss, refer to Table 2 to identify the correct size hole saw diameter and part number.

**Table 8.**

<table>
<thead>
<tr>
<th>Sensor Boss</th>
<th>Carbide Tip Hole Saw Size</th>
<th>Grainger Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Sensor Boss</td>
<td>1-3/16 (30mm)</td>
<td>2CDD5</td>
</tr>
<tr>
<td>Temperature Sensor Boss M12</td>
<td>15/16 (24mm)</td>
<td>2CDD3</td>
</tr>
<tr>
<td>Temperature Sensor Boss M14</td>
<td>1-1/16 (27mm)</td>
<td>2CDD4</td>
</tr>
<tr>
<td>Temperature Sensor Boss M16</td>
<td>15/16 (24mm)</td>
<td>2CDD3</td>
</tr>
<tr>
<td>NOx Sensor Boss M20</td>
<td>1-3/8 (35mm)</td>
<td>4XG46</td>
</tr>
</tbody>
</table>

Use the next table to select the correct arbor for the hole saw selected.

**Table 9.**

<table>
<thead>
<tr>
<th>Carbide Tip Hole Saw Size</th>
<th>Arbor Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/16 (30mm)</td>
<td>4XJ20</td>
</tr>
<tr>
<td>15/16 (24mm)</td>
<td></td>
</tr>
<tr>
<td>1-1/16 (27mm)</td>
<td></td>
</tr>
<tr>
<td>1-3/8 (35mm)</td>
<td>4XJ25</td>
</tr>
</tbody>
</table>

Repair as follows:

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.
CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the Aftertreatment from the vehicle. Refer to section "Removal of the 1-BOX™ from the Vehicle".

NOTICE: Always verify the new boss threads on the sensor before welding.

6. If the sensor boss is shielded as in Figure 1, the heat shield will need to be removed to gain access to the damaged boss. Figure 2 illustrates a sensor boss not surrounded by a heat shield.

Figure 9. Sensor Boss Surrounded by Heat Shield
Figure 10. Sensor Boss Not Surrounded by Heat Shield

7. If needed, use a die grinder to remove the shielding around the damaged sensor boss. The shielding should be removed as neatly as possible. It will need to be welded back in place once the sensor boss is replaced.

8. Use the sensor boss to pilot the hole saw. Start cutting the sensor boss weld; check the depth of the cut frequently to prevent the damaged sensor boss from falling inside the Aftertreatment device. See graphic below.

9. Clean off all metal shavings from around the sensor boss hole; avoid chips from entering the Aftertreatment device.
10. Verify the new sensor boss fits the sensor before welding in place. Tack weld the sensor boss in place, then complete the weld around the boss. See graphic below for an example of a newly welded sensor boss.

![Graphic of a newly welded sensor boss]

11. If a section of the heat shield was removed, tack weld the heat shield in place. See graphic below.

![Graphic of a heat shield being tack welded]

12. Once the heat shield is properly tack welded in place, complete the welding.
13. Install the sensor into the new sensor boss. Torque to the correct specification.
14. Install the Aftertreatment to the vehicle. Refer to section "Installation of the 1-BOX™ to the Vehicle".
15. Install the right side fairing. Refer to OEM procedures.
CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

16. Connect the batteries.

WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

17. Start the engine.
18. Check for any exhaust leaks.
9 Diesel Oxidation Catalyst Inlet Pipe Crack Repair

NOTE: This repair requires TIG welding and should be done by an experienced welding technician.

NOTE: If the Diesel Oxidation Catalyst (DOC) inlet pipe has completely separated from the Aftertreatment, replacement of the 1-BOX is necessary.

Repair as follows:

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

   CAUTION: ELECTRICAL SHOCK

   To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the aftertreatment from the vehicle. Refer to section "Removal of the 1-BOX™ from the Vehicle".
6. If needed, remove the bolts securing the inboard and outboard heat shield to the Aftertreatment.
7. Using an appropriately sized drill bit, drill-stop the crack.

8. Clean and prep the surface area of the crack.
9. Using Arcos 409 TIG welding rod part number 23539448, weld the crack. Ensure each drill-stop hole has been welded.

Figure 11. Example of Crack in DOC Inlet Pipe
10. Allow the weld time to cool.
11. If removed, install the inboard and outboard heat shield. Torque the bolts to 10 N·m (7 lb·ft).
12. Install the Aftertreatment to the vehicle. Refer to section "Installation of the 1-BOX™ to the Vehicle".
13. Install the right side fairing. Refer to OEM procedures.

**CAUTION: ELECTRICAL SHOCK**
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

14. Connect the batteries.

**WARNING: PERSONAL INJURY**
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

**WARNING: PERSONAL INJURY**
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.
WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area. Engine exhaust is toxic.

15. Start the engine.
16. Check for any exhaust leaks.
10 Rear Cover Crack Repair

Repair as follows:

NOTE: This repair requires TIG welding and should be done by an experienced welding technician.

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.

**CAUTION: ELECTRICAL SHOCK**

To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

2. Disconnect the batteries.
3. Remove the right side fairing. Refer to the Original Equipment Manufacturer (OEM) procedures.
4. Allow the Aftertreatment System (ATS) time to cool.
5. Remove the aftertreatment from the vehicle. Refer to section "Removal of the 1-BOX™ from the Vehicle".
6. If needed, remove the Diesel Exhaust Fluid (DEF) metering unit. Refer to section "Removal of the Diesel Exhaust Fluid Metering Unit".
7. If needed, remove the Selective Catalytic Reduction (SCR) outlet NOx sensor. Refer to section "Removal of the EPA10 Selective Catalyst Reduction Outlet NOx Sensor".
8. Remove the bolts securing the DEF metering unit mounting bracket to the aftertreatment.
9. Note the location of the nylon straps securing the ATS wiring to the ATS.
10. Remove the nylon straps securing the ATS wiring to the outlet side of the ATS.
11. Re-locate all ATS wiring off the outlet side of the ATS to avoid damage.
12. Using an appropriately sized drill bit, drill-stop the crack. Ensure the drill bit only penetrates the heat shield. See graphic below.

13. Clean and prep the surface area of the crack. See graphic below.
14. Using Arcos 409 TIG welding rod part number 23539448, weld the crack. Ensure each drill-stop hole has been welded. See graphic below.

15. Allow the weld time to cool.
16. Install the DEF metering unit mounting bracket to the aftertreatment. Torque the bolts to 25 N·m (19 lb·ft).
17. If removed, install the Selective Catalytic Reduction (SCR) outlet NOx sensor. Refer to section "Installation of the EPA10 Selective Catalyst Reduction Outlet NOx Sensor".
18. If removed, install the (DEF metering unit. Refer to section "Installation of the Diesel Exhaust Fluid Metering Unit".
19. Reposition all ATS wiring to its original location.
20. Install all nylon straps into their original location.
21. Install the Aftertreatment to the vehicle. Refer to section "Installation of the 1-BOX™ to the Vehicle".
22. Install the right side fairing. Refer to OEM procedures.

CAUTION: ELECTRICAL SHOCK
To avoid injury from electrical shock, use care when connecting battery cables. The magnetic switch studs are at battery voltage.

23. Connect the batteries.

WARNING: PERSONAL INJURY
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- Always start and operate an engine in a well ventilated area.
- If operating an engine in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system or emission control system.

WARNING: PERSONAL INJURY
To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

WARNING: ENGINE EXHAUST
To avoid injury from inhaling engine exhaust, always operate the engine in a well-ventilated area.
Engine exhaust is toxic.

24. Start the engine.
25. Check for any exhaust leaks.