

DRY SYSTEMS TECHNOLOGIES®

PERMISSIBILITY CHECKLIST M332-001-01

Page 1 of 13

DST DRY SYSTEM® MODEL M332 MSHA APPROVED DIESEL POWER PACKAGE

**230 HP CUMMINS 6CTAA8.3 DIESEL ENGINE
MSHA 07-EPA110001-0**

www.drysystemstech.com
E-mail: eng@drysystemstech.com

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01* DATED NOVEMBER 2015

Cummins 6CTAA8.3 Diesel Engine

1. [] It has been determined that the area, in which tests are to be performed, is in **FRESH AIR.**
2. [] The machine is equipped with a **CUMMINS Model 6CTAA8.3**, six-cylinder turbocharged and aftercooled diesel engine.

Air Intake System

The Air Intake System of this Power Package includes the following flameproof components: an intake manifold with a copper inlet gasket installed between the engine and the manifold, and a flame arrestor and intake assembly attached to the manifold inlet with a copper gasket installed between both components.

All additional components located upstream of the intake flame arrestor, including an inlet flange, a charge air cooler, a turbocharger compressor, an intake air cleaner and associated pipes, hoses and clamps are not considered flameproof components and do not need to be checked for permissibility.

3. [] **Illustration No. 1** depicts the air intake assembly. All components appear as depicted and there is no visible damage, cracks or dents on the components.
[WEEKLY]
4. [] Item No. 1 is a flameproof port that is installed into the cylinder head. This port is used to supply boost pressure to the injection pump. Check that it is tightly installed. A hose is connected and the center plug is securely held in place with a retaining ring.
[WEEKLY]
5. [] Item No. 2 is an intake manifold. It is securely attached to the air intake port of the Cummins engine.
[WEEKLY]
Item No. 3 is a copper gasket. It is securely installed between the inlet port of the Cummins engine and the intake manifold and all fasteners are in place and tight.
6. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "A"**.
[WEEKLY]
7. [] Item No. 5 is an optional flameproof port that maybe installed into the flame arrestor & intake assembly. This optional port is used to monitor the boost pressure on the air intake. If used, check that it is tightly installed. A hose is connected and the center plug is securely held in place with a retaining ring. If a flameproof port is not used, a pipe plug must be securely installed into the port.
[WEEKLY]

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 3

8. [] Item No. 6 is a flame arrestor & intake assembly. It is securely attached to the air intake port of the intake manifold.
[WEEKLY]
Item No. 4 is a copper gasket. It is securely installed between the inlet port of the intake manifold and the flame arrestor & intake assembly and all fasteners and locking devices are in place and tight.
9. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "B"**.
[WEEKLY]
10. [] Once every twelve-months, remove the flame arrestor & intake assembly. The flame arrestor core consists of a 4" wide stainless steel crimped ribbon element. There is no apparent damage and a 0.038" plug gauge will not pass through any of the triangular openings. The procedure is outlined on Illustration No. 5.
[12 MONTHS]
When re-installing the flame arrestor & intake assembly, all fasteners and locking devices are in place and tight on both flanges. Check the flame gap on **Joint "B"** as described under No 8-9. No further check is necessary on **Joint "C"**.

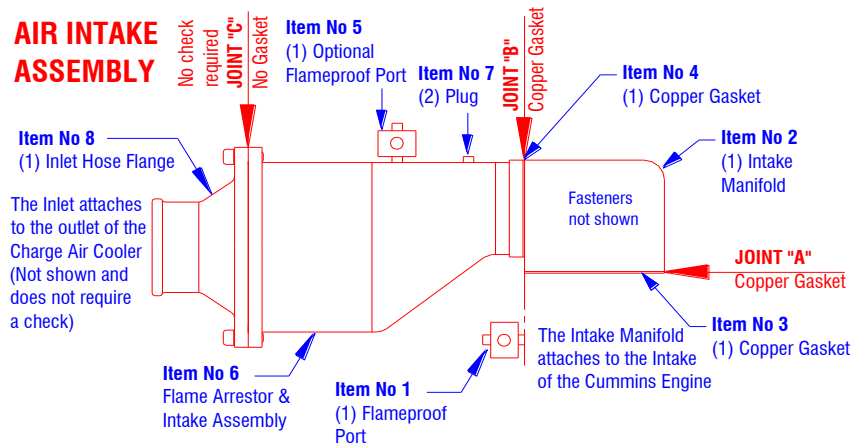


Illustration No. 1: Air Intake Assembly

- 11 [] Item No. 7 is a pipe plug. Check that it is installed into the flame arrestor & intake assembly and is tight.
[WEEKLY]
12. [] Item No. 8 is an inlet hose flange. It is attached to the inlet of the flame arrestor & intake assembly.
No permissibility check is required on **Joint "C"**.
No permissibility check is required on the air intake hoses, pipes, charge air cooler or other components located upstream of the flame arrestor.

Exhaust System

The Exhaust System of this Power Package includes the following flameproof components: a water-cooled exhaust manifold with copper gaskets installed at its inlet, a water-cooled metallic surface insulation installed on the exhaust side of the engine, a water-cooled turbocharger with a metal gasket at its inlet and outlet, an outlet adaptor and water-cooled bellows assembly, a water-cooled catalyst, a water-cooled elbow, a water-cooled heat exchanger with inlet/outlet box, an exhaust outlet pipe, an exhaust flame arrestor, and a DPM filter housing with a disposable DST low temperature filter element.

13. [] **Illustration No. 2** depicts the manifold section of the exhaust system located between the exhaust ports of the diesel engine and the turbocharger. All components appear as depicted and there is no visible damage, cracks or dents on the components.

[WEEKLY]

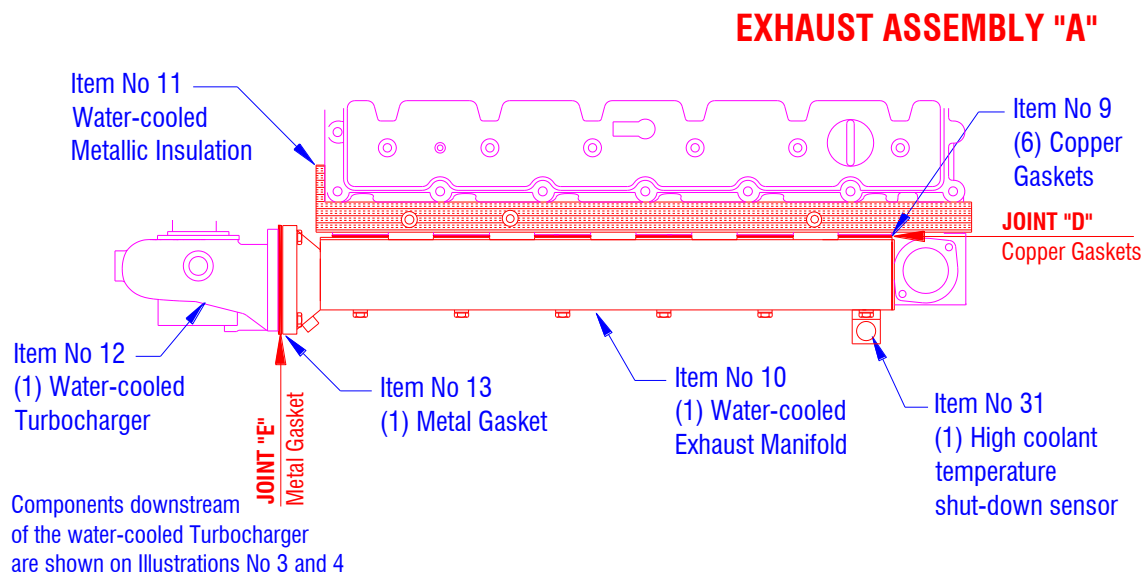


Illustration No. 2: Exhaust Assembly "A"

14. [] Item No. 10 is a water-cooled exhaust manifold. It is securely attached to the exhaust ports of the Cummins diesel engine. Items No. 9 are six copper gaskets. They are installed between the exhaust ports of the diesel engine and the exhaust manifold and all fasteners are in place and tight.
15. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "D"**.
16. [] Item No. 11 is a water-cooled metallic insulation. It is installed on the exhaust side of the cylinder head. Inspect the surface for apparent damage and all fasteners and washers are in place and tight.

[WEEKLY]

[WEEKLY]

[WEEKLY]

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 5

17. [] Item No. 12 is a water-cooled turbocharger. It is securely attached to the outlet port of the exhaust manifold.
 [WEEKLY]
- Item No. 13 is a metal gasket. It is installed between the exhaust manifold and the turbocharger and all fasteners and locking devices are in place and tight.
18. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "E"**.
 [WEEKLY]
19. [] **Illustration No. 3** depicts the exhaust system components located between the water-cooled turbocharger and the heat exchanger. All components appear as depicted and there is no visible damage, cracks or dents on the components.
 [WEEKLY]

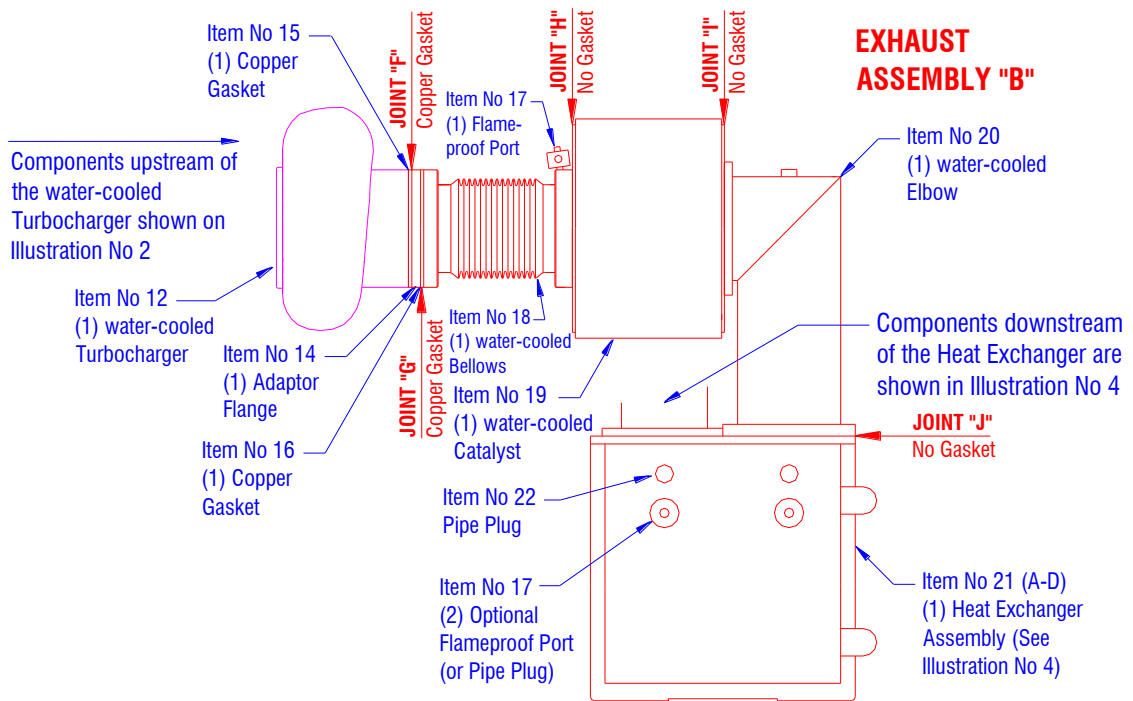


Illustration No. 3: Exhaust Assembly "B"

20. [] Item No. 14 is an adaptor flange. It is securely attached to the outlet of the water-cooled turbocharger.
 [WEEKLY]
- Item No. 15 is a copper gasket. It is installed between the turbocharger and the adaptor flange and all fasteners and locking devices are in place and tight.
21. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "F"**.
 [WEEKLY]

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 6

22. [] Item No. 18 is a water-cooled bellows assembly. It is securely attached to the outlet of the adaptor flange.
[WEEKLY]
Item No. 16 is a copper gasket. It is installed between the water-cooled bellows assembly and the adaptor flange and all fasteners and locking devices are in place and tight.
The bellows convolutes are not cracked or damaged and there is no indication of any coolant leak.
23. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "G"**.
[WEEKLY]
24. [] Check the bellows for external damage. If there is damage to the convolutes or any visible coolant leaks are detected, replace the complete bellows assembly. After 24 months, or 5,000 operating hours, remove and inspect the bellows assembly regardless of its apparent external condition. If there is damage to the inside convolutes or if leaks are detected, replace the complete bellows assembly. When re-installing the original or a replacement bellows assembly, all fasteners and locking devices are in place and tight on both flanges. Check the flame gap on **Joints "G" and "H"** as described under No 22-23 and No 26-27.
[SEE NOTE]
25. [] Item No. 17 is an optional flameproof port for monitoring the total backpressure and sampling of untreated (engine-out) carbon monoxide. It is tightly installed into the side port of the bellows flange. A hose is connected to the flameproof port and the center plug is securely held with a retaining ring.
[WEEKLY]
If a flameproof port is not installed, a pipe plug must be securely installed into the port.
26. [] Item No. 19 is a water-cooled catalyst. It is securely attached to the outlet of the bellows. No gasket is installed and all fasteners and locking devices are in place and tight.
[WEEKLY]
27. [] A 0.004" feeler gauge cannot be inserted into the **Joint "H"**.
[WEEKLY]
28. [] Item No. 20 is a water-cooled elbow. It is securely attached to the outlet of the catalyst. No gasket is installed and all fasteners and locking devices are in place and tight.
[WEEKLY]
29. [] A 0.004" feeler gauge cannot be inserted into the **Joint "I"**.
[WEEKLY]
30. [] Item No. 21-A is an inlet-outlet box of the heat exchanger assembly. Its inlet flange is securely attached to the outlet of the water-cooled elbow. No gasket is installed and all fasteners and locking devices are in place and tight.
[WEEKLY]
31. [] A 0.004" feeler gauge cannot be inserted into the **Joint "J"**.
[WEEKLY]

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015

DRY SYSTEMS TECHNOLOGIES®

www.drssystemstech.com E-mail: eng@drssystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 7

32. [] **Illustration No. 4** depicts the exhaust system components located between the heat-exchanger and the exhaust filter. All components appear as depicted and there is no visible damage, cracks or dents on the components.

[WEEKLY]

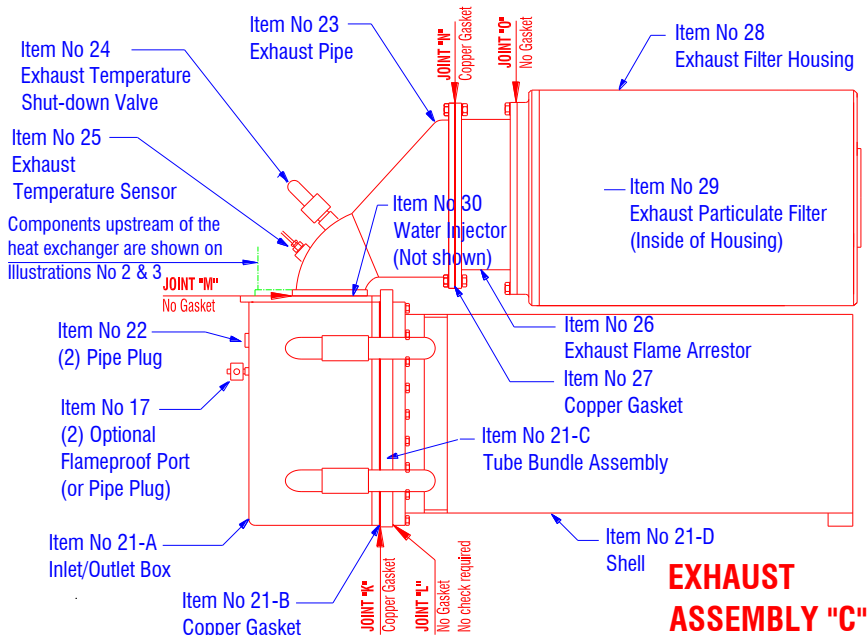


Illustration No. 4: Exhaust Assembly "C"

33. [] Item No. 21-C is the tube bundle weldment and item No. 21-D is the shell. The flange of the tube bundle weldment is mounted between the flange of the inlet outlet box and the shell. Item No. 21-B is a copper gasket. It is installed between the inlet-outlet box and the tube bundle flange. No gasket is installed between the shell and tube bundle flange. The three flanges are securely assembled as shown, using common fasteners and all fasteners and locking devices are in place and tight.

[WEEKLY]

34. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "K"** between the inlet-outlet box and the tube bundle. No check is required on **Joint "L"**.

[WEEKLY]

35. [] Items No. 17 are two (2) **OPTIONAL** flameproof ports that may be installed into the ports at the end of the inlet-outlet box. These **OPTIONAL** flameproof ports may be used in conjunction with an **OPTIONAL** pressure differential gauge for monitoring the heat exchanger pressures. If installed, check that flameproof ports are tightly installed into the inlet-outlet box. A hose is connected to each flameproof port and a center plug is securely held with a retaining ring.

[WEEKLY]

If flameproof ports are not installed, pipe plugs must be securely installed into the ports.

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 8

36. [] Items No. 22 are two (2) pipe plugs that are installed into the second set of ports at the end of the inlet-outlet box. Pipe plugs must be securely installed into the ports.
[WEEKLY]
37. [] Item No. 23 is an exhaust pipe. It is securely attached to the outlet flange of the inlet-outlet box. No gasket is installed and all fasteners and locking devices are in place and tight.
[WEEKLY]
38. [] A 0.004" feeler gauge cannot be inserted into the **Joint "M"**.
[WEEKLY]
39. [] Item No. 24 is an exhaust temperature shut-down valve. It is tightly installed into the exhaust outlet elbow and is part of the safety shut-down system.
[WEEKLY]
40. [] Item No. 25 is an optional exhaust temperature sensor for the gauge in the operator's cab. If a sensor is not installed, a pipe plug must be securely installed into the port.
[WEEKLY]
41. [] Item No. 30 is a water injector. It is tightly installed into the pipe threaded fitting on top of the inlet-outlet box.
[WEEKLY]
42. [] Item No. 26 is an exhaust flame arrestor. It is securely attached to the outlet elbow and all fasteners and locking devices are in place and tight.
[WEEKLY]
- Item No. 27 is a copper gasket. It is installed between the exhaust elbow and the flame arrestor and all fasteners and locking devices are in place and tight.
43. [] A 0.0015" feeler gauge cannot be inserted greater than 1/8" into the **Joint "N"**.
[WEEKLY]
44. [] Once every twelve-months, remove the exhaust flame arrestor. The flame arrestor core consists of a 4" wide stainless steel crimped ribbon element. There is no apparent damage and a 0.038" plug gauge will not pass through any of the triangular openings. The procedure is outlined on Illustration No. 5.
[12 MONTHS]
- When re-installing the exhaust flame arrestor assembly, all fasteners and locking devices are in place and tight on both flanges. Check the flame gap on **Joint "N"** as described under No. 42-43. No further check is necessary on **Joint "O"**.
45. [] Item No. 28 is an exhaust filter housing. It is securely attached to the exhaust flame arrestor and all fasteners and locking devices are in place and tight. No gasket is used on the joint between the exhaust flame arrestor and the exhaust filter housing and it is not considered flame proof.
[WEEKLY]
- No further check is necessary on **Joint "O"**.
46. [] Item No. 29 is an exhaust particulate filter element and **must be marked "DST M30"**.
[WEEKLY]

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 9

47. [] Remove the exhaust particulate filter from the exhaust filter housing. Avoid direct contact with diesel soot. The use of protective gloves is recommended.
[WEEKLY]
- Visually inspect the outlet side of the flame arrestor from the filter housing. There is no apparent damage to the crimped ribbon core of the exhaust flame arrestor.
- Visually inspect the exhaust particulate filter for damage or leaks. Reinstall the exhaust particulate filter into the exhaust filter housing, or replace it with a new M30 DST exhaust particulate filter if necessary.
- THE USE OF AFTERMARKET FILTERS WILL VOID THE MSHA APPROVAL.**

Safety Shut-down Devices

48. [] Two temperature safety shut-down valves are part of the diesel power package. They are a high exhaust temperature shutdown valve located on the exhaust outlet elbow and a high coolant temperature shutdown valve located on the manifold.
[WEEKLY]
- Both valves are tightly installed and connected to the safety shut-down system. The locations are depicted on Illustrations No. 2, and No 4.
49. Item No. 31 is a high coolant temperature safety shutdown valve. It must be removed and be tested every 6 months as described below:
[EVERY 6 MONTHS]
- a. [] Remove the high coolant temperature shutdown valve and the integral well. Plug the opening for the high coolant temperature shutdown valve with a pipe plug while performing this test. Do not separate the valve from the well. Place high coolant temperature shutdown valve into a 50%-50% mixture of water & ethylene glycol and heat the mixture. With the engine running, the high coolant temperature shutdown **valve must open between 205°F and 210°F and the engine must shut down before exceeding 210°F.**
- b. [] Reinstall the high coolant temperature shutdown valve into the proper location. Make sure that the valve is tightly installed and connected to the safety shut-down system.
50. The high exhaust temperature safety shutdown valve must be removed and be tested every 6 months as described below:
[EVERY 6 MONTHS]
- a. [] Remove the high exhaust gas temperature shutdown valve with an integral well. Do not separate the valve from the well. Close the port in the exhaust elbow with a pipe plug while performing this test. Place high exhaust temperature shutdown valve and well into a non-flammable liquid, such as non-flammable transmission fluid or non-flammable hydraulic fluid, and heat the fluid. With the engine running, the high exhaust gas temperature shutdown **valve must open between 275°F and 302°F and the engine must shut down before exceeding 302°F.**

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 10

- b. **OPTIONAL:** This method of testing is intended to expose the high exhaust gas temperature shutdown valve to the uncooled hot exhaust gases of the system instead of hot fluid. Remove hoses from water cleaner injector. Remove injector from heat exchanger inlet/outlet box. Remove the high exhaust gas temperature shutdown valve with an integral well. Do not separate the valve from the well. Close the port in the exhaust elbow with a pipe plug while performing this test. Assemble a standpipe from pipe fittings. This standpipe should be threaded into the water injector location. Suspend the high exhaust gas temperature shutdown valve with the hoses attached into this standpipe. A temperature measurement device such as a thermocouple or thermometer should also be placed in the standpipe. Operate the engine at moderate speed to subject the high exhaust gas temperature shutdown valve to the uncooled gases. Monitor the temperature. The high exhaust gas temperature shutdown valve must **open between 275°F and 302°F and the engine must shut down before exceeding 302°F.**
- c. Reinstall the high exhaust gas temperature shutdown valve into the proper location. Make sure that the valve is tightly installed and connected to the safety shut-down system.

System Operations Check

51. With the engine at a speed of 900-1100 rpm, activate the emergency shutdown valve. Upon activation, the intake air shutoff valve must operate immediately and **the engine must shut down within 15 seconds.**
[WEEKLY]
52. With the engine running, the transmission in neutral, all accessories dis-engaged, and the throttle pedal fully depressed, the engine speed indicated on the gauge in the operator's cab does not exceed 2,460 RPM
[WEEKLY]
53. Run the engine at torque stall. The total intake restriction shown on the gauge in the operator's cab must not exceed 25 inches H₂O and the total exhaust restriction shown on the gauge in the operator's cab must not exceed 60 inches H₂O.
[WEEKLY]

Flame Arrestor Inspection Procedure (Intake and Exhaust Flame Arrestor)

1. Remove the flame arrestor assembly.
2. Place the flame arrestor assembly on a flat surface with a contrasting background under the flame arrestor, such as brattice cloth or clean white cloth.
3. Adequate lighting is required. Cap lamp lighting is not sufficient.
4. Visually inspect each side of the flame arrestor for openings or spaces obviously greater than the triangular openings of the core.

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 11

5. Visually inspect each side of the core for places where the windings of the flame arrestor core appear to be separated such that gaps can be seen. If such gaps exist, they must be checked as following:
 - a.) The only measuring tool considered acceptable for performing this evaluation is a 0.038 inch diameter calibrated plug gauge. The plug gauge is to be mounted in a gauge holder and must project at least 1.00 inch out of the end.
 - b.) Grasp the gauge holder lightly between the index finger and the thumb. Place the wire tip at the point in question, making sure the plug gauge is vertical. Using only the weight of the gauge and holder, see if it will enter the apparent gap. Do not attempt to wiggle or push the gauge through the opening.
 - c.) If the plug gauge enters the opening, the flame arrestor core must not be used on permissible equipment.
6. Visually inspect the triangles in the flame arrestor core (both sides) for triangles that appear to be larger than the rest. If such conditions exist, these openings must be checked as previously described in section 5 a, b and c.
7. Finally, if the flame arrestor core passes all the above evaluations, a final check should be performed on at least 5 randomly selected triangles on each side of the core using the procedures described in section 5 a, b and c. In performing this check, the tip of the plug gauge must be placed against a specific triangular opening. If this special care is not taken, the evaluation will be invalid.

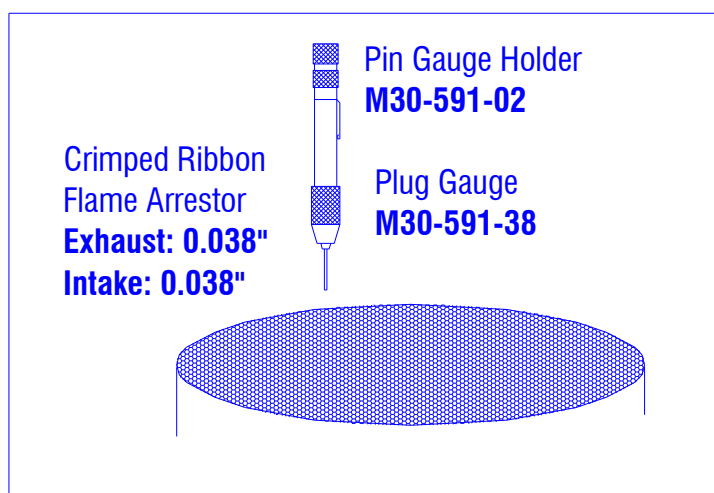


Illustration No. 5: Flame Arrestor Checking Procedure

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015

Alternate Safety Shutdown

If the alternate exhaust temperature shut-down valve (Sprinkler head, Item No. 31) is used, then the following check must be performed.

54. [] With the engine shutdown, remove the DPM filter from the housing.
[MONTHLY] Check the sprinkler head for damage, loose parts, scale coating, or corrosion. Verify the part number, Tyco 3231, and the temperature rating of 286 °F.
If the sprinkler head is used, confirm that the Amot exhaust temperature shutdown valve is not used and that a pipe plug, Item No. 32, is securely installed in its place.

Replacement procedure for a blown sprinkler head:

- Remove the DPM filter from the housing.
- Remove the blown sprinkler head from inside the filter housing.
- Install a new Tyco 3231 sprinkler head.
- Place the DPM filter in the filter housing. Close and properly secure the filter housing.

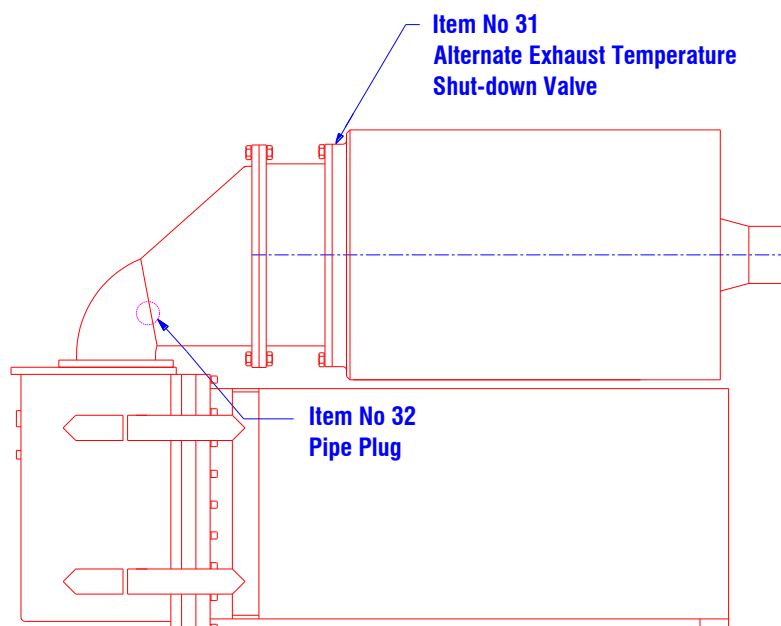


Illustration No. 6: Alternate Exhaust Shutdown Valve

DRY SYSTEMS TECHNOLOGIES®

www.drysystemstech.com E-mail: eng@drysystemstech.com

M332-001-01 * PERMISSIBILITY CHECKLIST * Page 13

Fuel Rate Check

55. [] The fuel injection rate adjustment mechanism and the engine governor setting are locked and sealed.
[WEEKLY]

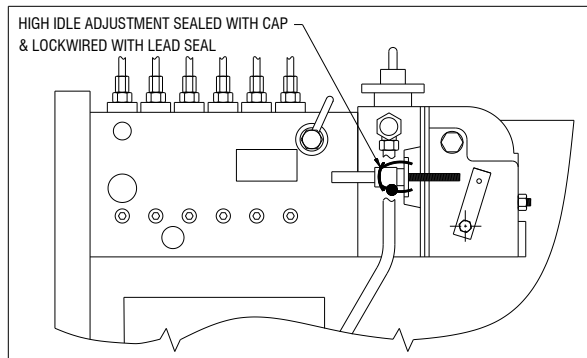


Illustration No. 7: Fuel Injection Pump

This Permissibility Checklist contains 55 Items on 13 Pages with 7 Illustrations.

DO NOT CHANGE WITHOUT MSHA APPROVAL

REVISION 01 * DATED NOVEMBER 2015