DIESEL

TRAINING

MANUAL

WEST VIRGINIA OFFICE OF

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MINERS' HEALTH SAFETY & TRAINING

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CONTENTS & AGENDA

WV QUALIFIED DIESEL INSTRUCTOR TRAINING CONTACTS

History and Progress of Diesels in West Virginia

Diesels in West Virginia

- Prohibited from use in WV until 2004
- Waited until improvements in engine exhaust conditioning equipment developed
- WV Rule requires use of oxidizing catalyst
- Strictly limits diesel emissions
- WV regulates both NO2 and NO
- <u>2017</u> The WV Diesel Regs were changed from Title 196 Series 1 to Title 56 Series 23.

- 2017 Changed to allow the Operator to replace a DPM filter or Catalyst of the same make and model without contacting the WVOMHST.
- 2017 Changed to allow that a ASE certified mechanic can make repairs and adjustments to fuel injection systems or engine timing. (Before July 2017 the mechanic had to be certified by the Engine Manufacture).

- 2017 – Changed to allow the 100 hour service to now be done at 200 hours.
- 2017 – Stall test changed from five 1 minute tests to three 30 second tests (untreated and treated)
- 2017 – Annual 8 hour Diesel equipment operator training no longer required.
- 2018 - Regulations changed to allow the use of Underground Diesel Generator.

MSHA's Current Diesel Emission Limits

- Carbon Monoxide (CO) ceiling is 50 ppm
- Nitrogen Dioxide (NO2) ceiling is 5 ppm
- Nitrogen Monoxide (NO) not regulated
- Diesel Particulate Matter (DPM) is 2.5 g/hr
- Action taken at 50% of ceiling

WV's Current Diesel Emission Limits

- Carbon Monoxide (CO) ceiling is 35 ppm
- Nitrogen Dioxide (NO2) ceiling is 3 ppm
- Nitrogen Monoxide (NO) ceiling is 25 ppm
- Diesel Particulate Matter (DPM) is .12 mg/m3 per minute
- Action taken at 75% of ceiling

Summary

More Than 900 Diesel Machines Are Approved in WV And New Machines Arrive Weekly. West Virginia Is Fast Becoming the Nation's Leader in Underground Use of Diesel Equipment Even With High Emission Standards.

DIESEL ENGINE FUNDAMENTALS VIDEOS

1. CUMMINGS DIESEL VIDEO
2. DIESEL POWERED VEHICLES (MSHA) VIDEO

Diesel Exhaust

What Is Diesel Exhaust?

- Highly Complex Mixture
- Organic and Inorganic Compounds
- Gas and Particulate Phases
- Gases - Irritate and Toxic
- Particulates - Thousands of Chemicals Absorbed, Suspected Carcinogens, Mutagens and Teratogens

Main Constituents

- Carbon Monoxide
- Nitrogen Dioxide
- NOx
- Particulate
- Carbon Dioxide
- Hydrocarbons
- Sulfur Oxides

Carbon Monoxide

- CO - Colorless, Odorless, Tasteless Gas
- Silent Killer - No Warning Properties
- Targets the Blood
- Hemoglobin - 200-300 Times the Affinity
- Chemical Asphyxiation

Carbon Monoxide - Early Signs

- Headache
- Dizziness
- Weakness
- Vision Problems
- Confusion

Carbon Monoxide - Symptoms

- Nausea
- Vomiting
- Reddened Skin
- Ears Ringing
- Difficulty Breathing

Carbon Monoxide - Continued

- 200 PPM - 1 hour
- 400 PPM - 1/2 hour
- 600 PPM - 15 minutes
- 600 PPM - 2 to 3 Hours - Fatal
- Blood Saturation & Concentration - Increases Effects

Nitrogen Dioxide

- Red - Brown Gas
- Irritating Odor
- Nitrogen Tetroxide - N_2 O_4
- Reacts to Form Nitrous and Nitric Acid
- Irritates Mucous Membrane
- Pulmonary Edema

Nitrogen Dioxide - 60 - 150 PPM

- Delayed Symptoms - 6 to 24 hours
- Tightness and Burning - Chest
- Shortness of Breath
- Sleeplessness
- Restlessness
- Dyspnea (labored breathing)
- Cyanosis (bluish skin from lack of blood O2)

Nitrogen Dioxide - Continued

- 100 - 150 PPM ... 30 - 60 minutes
- 200 PPM and above .... Very Short Periods
- Pulmonary Edema ... Permanent Disability
- Respiratory Track irritation
- Cough
- Headache
- Loss of Appetite

Continued

- Dyspepsia - Indigestion
- Corrosion of the Teeth
- Loss of Strength

Diesel Particulate -Acute effects

- Eye Irritant
- Mucus membrane
- Cough
- Respiratory Irritation (Including Allergic Responses)

Diesel Particulate- Chronic Effects

- Premature Death from Cardiovascular, Cardiopulmonary, and Respiratory Causes
- Lung Cancer?

Hydrocarbons - Aldehydes

- Nasal and Eye Irritation
- Strong Sensitizer
- Headaches
- Skin Rash
- Respiratory problems

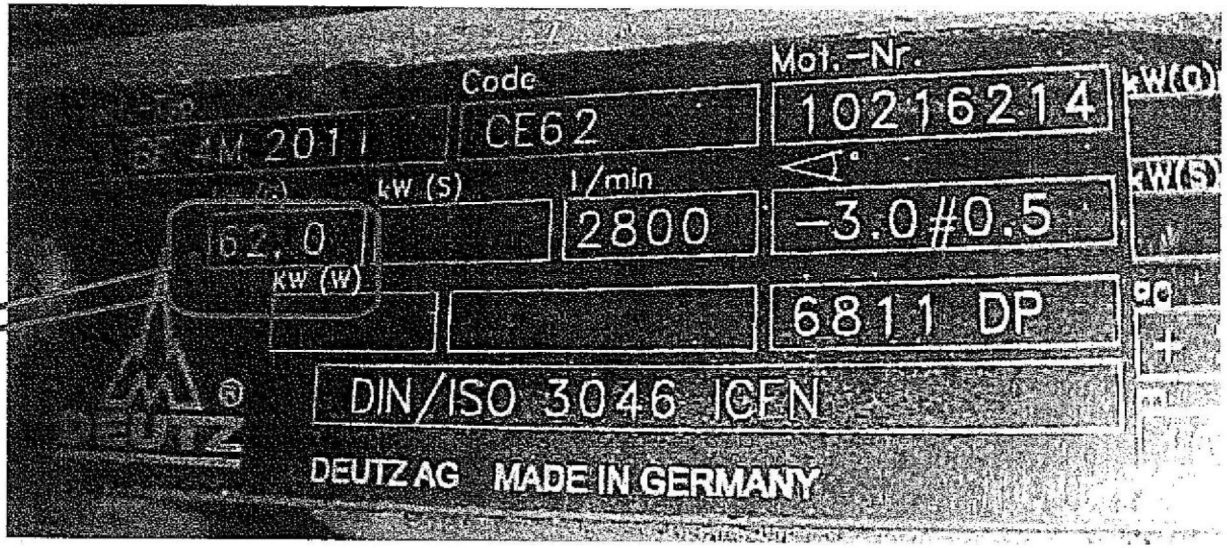
Hydrocarbons - Phenols

- Colorless Solids
- Strong Corrosive Action on the Body
- Burns
- Dermatitis

MSHA Exposure Limits

- Carbon Monoxide - 50 PPM (35 PPM for WV)
- Nitrogen Dioxide - 5 PPM Ceiling (3 PPM for WV)
- Carbon Dioxide - .5% (same for WV)
- Nitric Oxide is regulated by WV (25 PPM)

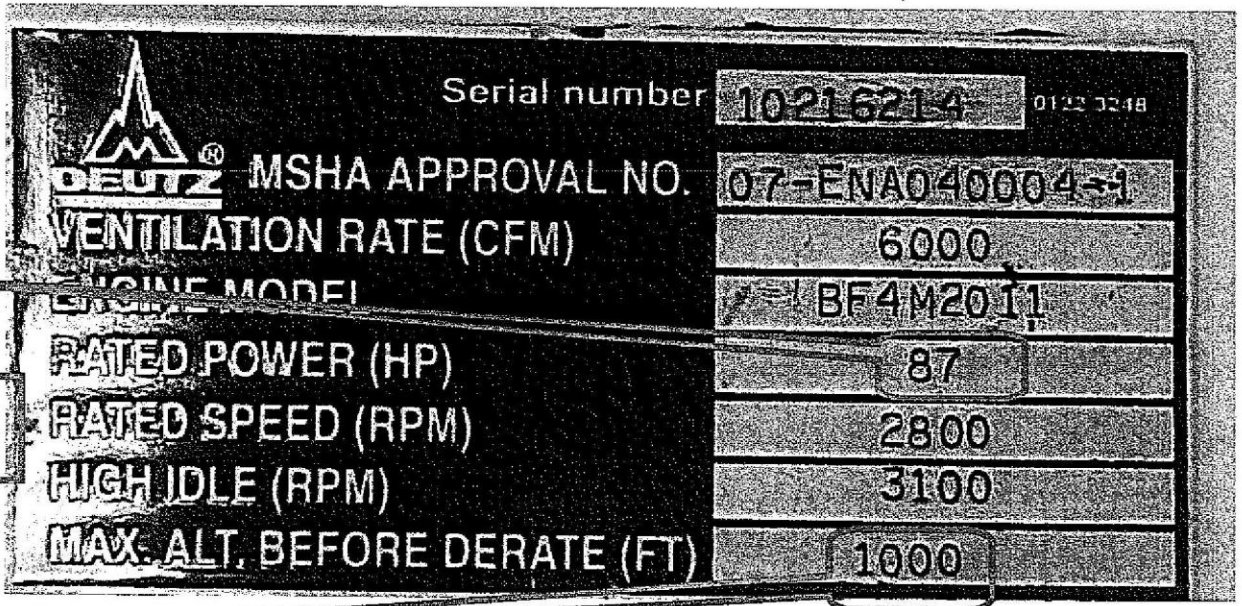
Wolf Run Mining
Engine #1
S/N 10216214



62 X 1.34 =83.08HP,

a de-rate of 4.6%

[100% minus (83 divided by 87 HP)]



4.6% X 328'=1508 feet

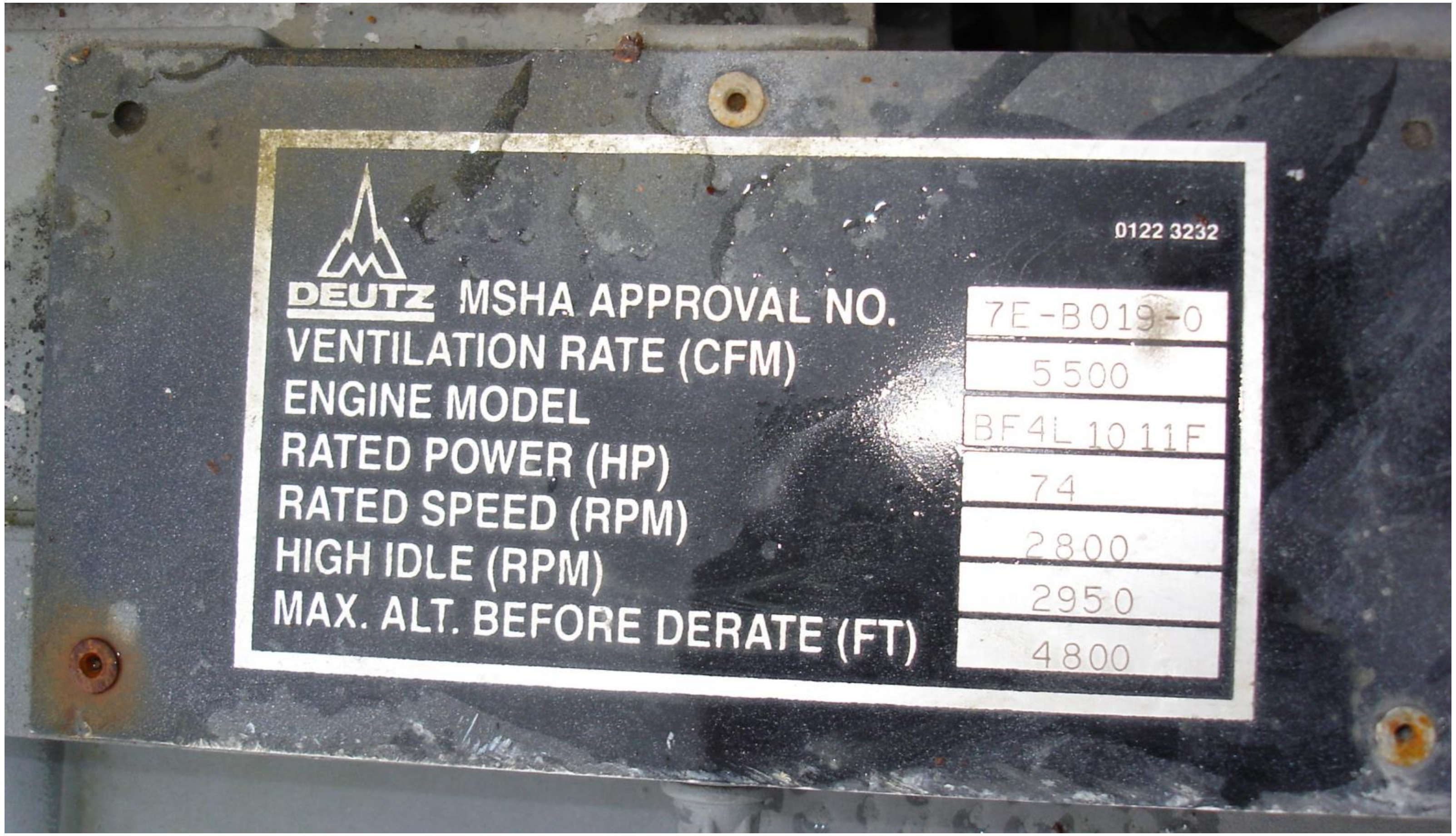
1508' plus 1000' = <u>2508</u> feet max. alt.
before another de-rate needed

WHAT COMPONENTS MAKE UP THE EXHAUST TREATMENT SYSTEM

- OXIDATION CATALYST
  - REMOVES CO BY 83% MINIMUM
    - AMBIENT CO CANNOT EXCEED 35 PPM CEILING, ACTION MUST BE TAKEN AT 26 PPM
- DPM FILTER
  - CAPABLE OF REDUCING DPM BELOW .12 MG/M^3
- EXHAUST COOLER
  - REDUCES EXHAUST EXIT TEMPERATURE BELOW 302 DEGREES FAHRENHEIT

West Virginia Approval Tag

MSHA Approval Tag



Factors That Affect Diesel Emissions

Intake Air System Restriction

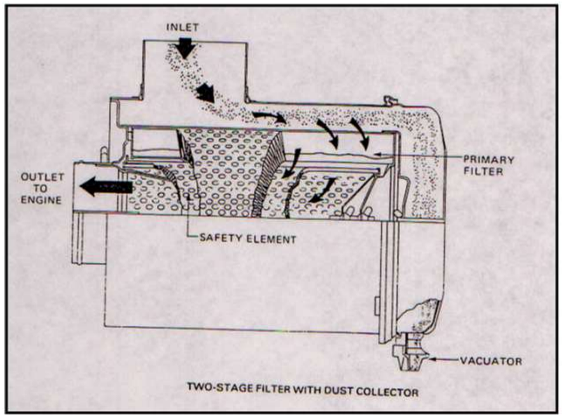
- Intake restriction -- most common cause for over-fueling and increased emissions

Air Intake System Restriction and Fuel Flow

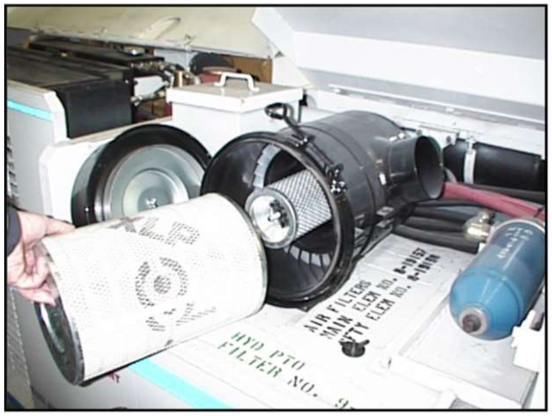
- The engine is designed to have unrestricted airflow into the engine
- Fuel flow is adjusted according to the available air
- Any significant additional restriction on the intake system upsets this balance causing over fueling and excessive harmful emissions

Over Fueling

- **Excessive intake restriction causes significant increase in carbon monoxide and soot emissions -- restriction (>50” WG)**
- **When increased carbon monoxide and black smoke are detected, the intake air cleaner may need replaced**
- **A <u>mostly blocked</u> intake system can lead to carbon monoxide increases of 50-250% and increases in smoke by up to 500% !**



TWO-STAGE FILTER WITH DUST COLLECTOR



Leaking Intake System

- Dust and coal particles may be ingested into the intake system

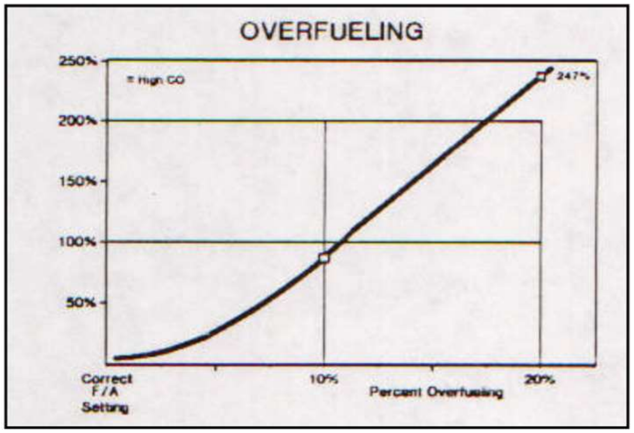
- This is referred to as “dusting”
- The engine may be destroyed in as little as a single shift

- The impact on emissions is due to the damage of components, which in turn cause excessive blow-by of oil and low engine compression

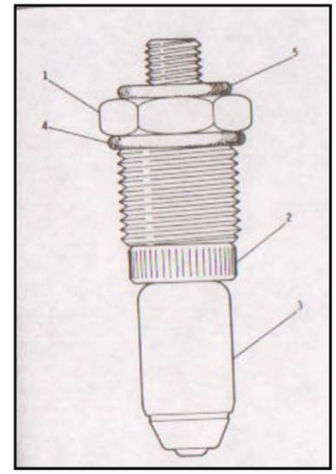
Fuel Injection Pump Setting

- Over fueling also occurs when the maximum fuel injection rate is too high because the fuel rack is improperly set
- Most likely found right after engine repair work was performed
- This over fueling is not normally observed after the machine has been in service for a while

- Any increase of the amount of fuel injected by 10% can double carbon monoxide and diesel particulate



Fuel Injector Failure



- **Fuel injectors are sealed and do not require much attention. However, they do fail at times, due to water in the fuel or other contamination**
  - Causes increased hydrocarbons and carbon monoxide due to poor combustion, noticeable by increased smell
  - Noticeable loss of power, especially when more than one injector is defective

Engine Temperature

- A cold engine produces higher carbon monoxide, unburned hydrocarbon and particulate matter emissions
- Start-up of a cold engine, blue smoke, associated with a strong odor may be observed
- This is unburned fuel and will quickly go away as the engine warms up
- Most engines operate more efficiently and cleaner at higher operating temperature

Coolant Temperature

- A thermostat limits the amount of cooling below a certain coolant temperature, usually around 175°F
- If the thermostat is removed, the engine will cool down too far at light load and run dirtier
- Diesel engines are normally expected to operate at temperatures of up to 210°F

Refueling

- The Fuel Buffalo enables the fuel to remain clean during transition to fuel tank

- Keep the tank topped off to minimize the moisture buildup in the tank

Catalyst Failure

- **The catalyst is designed to last the duration of the engine and contains no wear parts**

- **Likely failure would be caused by:**
  - excessive idling of the vehicle
  - contaminated fuel or
  - unauthorized aftermarket fuel additives

- **Since the catalyst performance is checked at least weekly, any failure would be detected promptly**

Exhaust Particulate Filter Failure

- **Some causes of exhaust particulate filter failure:**
  - Improper installation of the particulate filter element
  - Missing particulate filter element
  - Filter element damaged during shipping or handling

- **In either case, the harmful hydrocarbon emissions and the diesel particulate emissions would significantly increase**
- **The first indication of a leaking or otherwise damaged exhaust particulate filter is soot deposit downstream of the filter**

Summary

- Many factors can adversely affect diesel emissions
- Intake restriction is the most common
- Strictly maintain engine and exhaust conditioning equipment
- Regularly monitor the mine atmosphere
- Remember, excessive diesel emissions are harmful

TITLE 56, SERIES 23
WEST VIRGINIA OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

RULES FOR OPERATING DIESEL EQUIPMENT IN UNDERGROUND MINES IN WEST VIRGINIA

NOTE: This rule was filed as an emergency rule and a legislative rule. The effective date of the emergency rule is July 10, 2018. The legislative rule will go before the Legislature during the 2019 Session.

The change to this rule permits the use of diesel generators in underground mines so long as the generator is vented directly to the return and at least one person is present within sight and sound of the generator. A section has also been added addressing electrical safety rules applicable to diesel generators that are similar to MSHA's regulations governing diesel generators.

§56-23-1. General.

1.1. Scope. -- This legislative rule establishes the standards, procedural and interpretative guidelines under which diesel powered equipment may be used in an underground coal mine in the state of West Virginia.

1.2. Authority. -- W. Va. Code §§22A-2A-1001 and 22A-2A-308(a).

1.3. Filing Date - ____________________.

1.4. Effective Date -- ___________________.

1.5. Sunset Provision. -- This rule shall terminate and have no further force or effect upon the expiration of 5 years from its effective date.

§56-23-2. Definitions.

2.1. Unless the context in which a word or phrase appears clearly requires a different meaning, all terms used in this rule that are not defined herein shall have the meanings set forth in W. Va. Code §22A-1-2.

2.2. "ASE certified diesel mechanic" means a diesel mechanic certified by the National Institute for Automotive Service Excellence.

2.3. "Board" means the board of coal mine health and safety continued by W. Va. Code §22A-6-3.

2.4. "Certificate of approval" means a formal document issued by MSHA stating that a complete assembly has met the requirements of part 36, title thirty of the code of federal regulations, 30 CFR §36.1, *et seq*., for mobile diesel-powered transportation equipment and authorizing the use and attachment of an official approval plate so indicating.

2.5. "Diesel fuel tank" means a closed metal vessel specifically designed for the storage or transport of diesel fuel.

2.6. "Diesel fuel transportation unit" means a self-propelled or portable wheeled vehicle used to transport a diesel fuel tank.

2.7. "Diesel engine" means any compression ignition internal combustion engine using the basic diesel cycle where combustion results from the spraying of fuel into air heated by compression.

2.8. "Diesel power package" means a diesel engine with an intake system, exhaust system, and a safety shutdown system installed that meets the specific requirements for MSHA approval of diesel power packages intended for use in approved equipment in areas of underground coal mines where electric equipment is required to be permissible.

2.9. "Director" means the director of the office of miners' health, safety and training or his or her authorized representative.

2.10. "Exhaust emission" means any substance emitted to the atmosphere from the exhaust port of the combustion chamber of a diesel engine.

2.11. "Exhaust emissions control and conditioning system" means a device or combination of devices that will collect and treat diesel exhaust emissions at the exhaust port of the engine, and will reduce the volume of, or eliminate emissions of, diesel particulate matter, carbon monoxide and oxides of nitrogen in accordance with the requirements and standards of the commission established in accordance with the provisions of W. Va. Code §22A-2A-403.

2.12. "ISO 8178-1" means an international standard set by the International Organization for Standardization that specifies the standard reference temperature for geometrical product specification and verification.

2.13. "MSHA" means the mine safety and health administration of the United States Department of Labor.

2.14. "Office of miners' health, safety and training" means the West Virginia office of miners' health, safety and training continued by W. Va. Code §22A-1-1.

2.15. "Permanent underground diesel fuel storage facility" means a facility designed and constructed to remain at one location for the storage or dispensing of diesel fuel, which does not move as mining progresses.

2.16. "Safety can" means a metal container intended for storage, transport or dispensing of diesel fuel, with a nominal capacity of five gallons, listed or approved by a nationally recognized independent testing laboratory.

2.17. "Temporary underground diesel fuel storage area" means an area of a mine provided for the short-term storage of diesel fuel in a fuel transportation unit, which moves as mining progresses.

2.18. "Underground diesel generator" means any machine powered with an approved diesel power package and electrical components used as an alternative electrical power source.

§56-23-3. Underground Use.

3.1. Underground use of inby and outby diesel-powered equipment, including mobile equipment, stationary equipment and equipment of all horsepower ratings, may only be approved, operated and maintained as provided in this rule, except for emergency fire-fighting equipment to be used specifically for that purpose.

3.2. All diesel-powered equipment shall be attended while in operation with the engine running in underground mines. For purposes of this rule, "attended" shall mean a diesel equipment operator is within sight or sound of the diesel-powered equipment.

3.3. Inby and outby diesel-powered equipment may be used in underground mines if the inby or outby diesel-powered equipment uses an engine approved or certified by MSHA, as applicable, for inby or outby use that, when tested at the maximum fuel-air ratio, does not require an MSHA Part 7 approval plate ventilation rate exceeding 75 c.f.m. per rated horsepower. Should MSHA promulgate new regulations that change the MSHA part 7 approval plate ventilation rate, the cfm requirement per rated horsepower will be revised either up or down on a direct ratio basis upon the recommendation of the director.

§56-23-4. Diesel-Powered Equipment Package.

4.1. All diesel-powered equipment shall be approved by the director as a complete diesel-powered equipment package, which shall be subject to all of the requirements, standards and procedures set forth in this rule.

4.2. Diesel engines shall be certified or approved, as applicable, by MSHA and maintained in accordance with MSHA certification or approval and the director's approval.

4.3. All approved diesel powered equipment packages shall be listed on an inventory sheet submitted to the director with a copy maintained at the mine. The following information shall be provided on the inventory list:

4.3.1. Name, address and permit number of the mine.

4.3.2. The telephone number and name of the contact person responsible for maintenance and testing of the diesel equipment.

4.3.3. The following specific information for each engine:

4.3.3.a. Manufacturer, serial number and model of the equipment using the power-package.

4.3.3.b. Manufacturer, model number and serial number of the engine.

4.3.3.c. MSHA 7E approval number.

4.3.3.d. Rated HP and RPM.

4.3.3.e. DPM gr/hr rating and mg over m to the third power.

4.3.3.f. Ventilation rate.

4.3.4. The following specific information for each filter system:

4.3.4.a. Manufacturer and model of the filter system.

4.3.4.b. MSHA Efficiency Rating of the specific filter system(s) or an accepted third party rating.

4.3.4.c. System type and composition (i.e., Passively Regenerated Cordierite, etc.).

4.3.4.d. The manufacturer/model of regeneration system (if applicable).

4.4. The mine operator shall be permitted to replace a filter or catalyst of the same make and model without contacting the office of miners' health, safety and training. A record must be maintained of all of the pertinent data and available for inspection.

§56-23-5. Exhaust Emissions Control.

5.1. Underground diesel-powered equipment shall include an exhaust emissions control and conditioning system that has been laboratory tested with the diesel engine, except as provided in section 5.3., using the ISO 8178-1 test and has resulted in diesel particulate matter emissions that do not exceed an average concentration of 0.12 mg over m to the third power when diluted by one hundred percent of the MSHA Part 7 approval plate ventilation rate for that diesel engine. Should MSHA promulgate new regulations that change the MSHA Part 7 approval plate ventilation rate, the dilution percentage relative to the approval plate ventilation rate will be adjusted either up or down on a direct ratio basis upon recommendation of the director.

5.2. The exhaust emissions control and conditioning system shall be required to successfully complete a single series of laboratory tests conducted at a laboratory accepted by the director for each diesel engine, except as provided in section 5.3.

5.3. An exhaust emissions control and conditioning system may be approved for multiple diesel engine applications through a single series of laboratory tests, known as the ISO 8178-1 test, only if data is provided to the director that reliably verifies that the exhaust emissions control and conditioning system will meet, for each diesel engine, the in-laboratory diesel particulate matter standard established by this section. Data provided to satisfy this provision shall include diesel particulate matter production rates for the specified engine as measured during the ISO 8178-1 test, if available. If ISO 8178-1 test data for diesel particulate matter production is not available for a specified engine, comparable data may be provided to the director that reliably verifies that the exhaust emissions control and conditioning system will meet, for the specified diesel engine, the in-laboratory diesel particulate matter standard established by this section. This standard shall only be used for in-laboratory testing for approval of diesel-powered equipment for use underground.

5.4. The exhaust emissions control and conditioning system shall include the following:

5.4.1. A diesel particulate matter (DPM) filter that has proven capable of at least a seventy-five percent reduction of diesel particulate matter,

5.4.2. An oxidation catalyst or other gaseous emissions control device capable of reducing undiluted carbon monoxide emissions to 100 ppm or less under all conditions of operation at normal engine operating temperature range.

5.4.3. An engine surface temperature control capable of maintaining significant external surface temperatures below three hundred two degrees Fahrenheit.

5.4.4. A system capable of reducing the exhaust gas temperature below three hundred two degrees Fahrenheit.

5.4.5. An automatic engine shutdown system that will shut off the engine before the exhaust gas temperature reaches three hundred two degrees Fahrenheit and, if waterjacketed components are used, before the engine coolant temperature reaches two hundred twelve degrees Fahrenheit. A warning shall be provided to alert the equipment operator prior to engine shutdown.

5.4.6. A spark arrestor system.

5.4.7. A flame arrestor system.

5.4.8. A sampling port for measurement of undiluted and untreated exhaust gases as they leave the engine.

5.4.9. A sampling port for measurement of treated undiluted exhaust gases before they enter the mine atmosphere.

5.4.10. For inby diesel equipment, any additional requirements of MSHA regulations at 30 CFR Part 36 (relating to mobile diesel-powered transportation equipment for gassy noncoal mines and tunnels).

5.5. On-board engine performance and maintenance diagnostics systems shall be capable of continuously monitoring and giving readouts for subsections 5.5.1. thru 5.5.8. of this section. The diagnostics system shall identify levels that exceed the engine and/or component manufacturer's recommendation or the applicable MSHA or director's requirements as to the following:

5.5.1. Engine speed;

5.5.2. Operating hour meter;

5.5.3. Total intake restriction;

5.5.4. Total exhaust backpressure;
5.5.5. Cooled exhaust gas temperature;
5.5.6. Coolant temperature;
5.5.7. Engine oil pressure;
5.5.8. Engine oil temperature.

§56-23-6. Ventilation.

6.1. Minimum quantities of air where diesel-powered equipment is operated shall be maintained pursuant to this section.

6.2. Each specific model of diesel-powered equipment shall be approved by the director before it is taken underground. The director shall require an approval plate that must be attached to each piece of the diesel-powered equipment. The approval plate shall specify the minimum ventilating air quantity for the specific piece of diesel-powered equipment. The minimum ventilating air quantity shall be determined by the director based on the amount of air necessary at all times to maintain the exhaust emissions at levels not exceeding the exposure limits established in section 7 of this rule.

6.3. The minimum quantities of air in any split where any individual unit of diesel-powered equipment is being operated shall be at least that specified on the approval plate for that equipment. Air quantity measurements to determine compliance with this requirement shall be made at the individual unit of diesel-powered equipment.

6.4. Where multiple units are operated, the minimum quantity shall be at least one hundred percent of MSHA's Part 7 approval plate quantities for each unit operating in that split. Air quantity measurements to determine compliance with this requirement shall be made at the most downwind unit of diesel-powered equipment that is being operated in that air split. Should MSHA promulgate new regulations that change the MSHA Part 7 approval plate ventilation rate, the minimum quantity where multiple units are operated shall be revised on a direct ratio basis upon recommendation of the director.

6.5. The minimum quantities of air on any split where any diesel-powered equipment is operated shall be in accordance with the minimum air quantities required in sections 6.1 and 6.2 and shall be specified in the mine diesel ventilation plan.

§56-23-7. Exhaust Gas Monitoring and Control.

7.1. In monitoring and controlling exhaust gases, the ambient concentration of exhaust gases in the mine atmosphere shall not exceed 35 ppm ceiling for carbon monoxide (CO), 25 ppm ceiling for nitric oxide (NO) and 3 ppm ceiling for nitrogen dioxide (NO2). The concentration of these exhaust gases shall be measured at the equipment operator's or equipment attendant's position and inby the last piece of diesel-powered equipment operating in the same split of air. Measurements shall be made weekly or more often if necessary by a qualified person and shall be conducted pursuant to the requirements of this section.

7.2. Measurement of exhaust gases shall be made with a sampling instrument no less precise than detector tubes.

7.3. If the concentration of any of the gases listed in section 7.1 is seventy-five percent or more of its exposure limit, changes to the use of the diesel equipment, the mine ventilation or other modifications to the mining process shall be made.

7.4. If the concentration of any of the gases listed in section 7.1 exceeds the exposure limit, the diesel equipment operating in that split shall be removed from service immediately and corrective action taken. After corrective action has been taken by the mine operator, the diesel equipment may be returned to service in its regular operating mode for emissions testing purposes only, and emissions testing shall be conducted immediately to assure that the concentration does not exceed seventy-five per cent of the exposure limit. Corrective action must be taken until the concentration does not exceed seventy-five percent of the exposure limit before the diesel equipment can be returned to full operation.

7.5. In addition to the other maintenance requirements set forth in this rule, the mine operator shall comply with the following requirements:

7.5.1. Repair or adjustment of the fuel injection system, engine timing or exhaust omissions control and conditioning systems shall only be performed by qualified mechanics authorized by the engine manufacturer or ASE certified diesel mechanics.

7.5.2. Complete testing of the emissions system in accordance with section 20 of this rule shall be conducted prior to any piece of diesel-powered equipment being put into service, after any repair or adjustment to the fuel delivery system, engine timing or exhaust emissions control and conditioning system.

7.5.3. Service and maintenance of the intake air filter exhaust particulate filter and the exhaust system shall be performed at specific time intervals based on the component manufacturer's recommendation, compliance with the engine or emissions control operation specifications and, as needed, based on the on-board diagnostics and/or emissions test results. Accurate records shall be maintained of all such service and maintenance.

§56-23-8. Fuel Storage Facilities.

8.1. An underground diesel fuel storage facility shall be any facility designed and constructed to provide for the storage of any mobile diesel fuel transportation unit(s) or the dispensing of diesel fuel.

8.2. Diesel-powered equipment shall be used underground only with fuel that meets the standards of the most recently approved EPA guidelines for over-the-road-fuel. Additionally, the fuel shall also meet the ASTM D975 fuel standards with a flash point of one hundred degrees Fahrenheit or greater at standard temperature and pressure. The operator shall maintain a copy of the most recent delivery receipt from the supplier that will prove that the fuel used underground meets the standard listed above.

8.3. Underground diesel fuel storage facilities shall meet the following general requirements:

8.3.1. Fixed underground diesel fuel storage tanks are prohibited.

8.3.2. No more than five hundred gallons of diesel fuel shall be stored in each underground diesel fuel storage facility.

8.4. Underground diesel fuel storage facilities shall be located as follows:

8.4.1. At least one hundred feet from shafts, slopes, shops and explosives magazines;

8.4.2. At least twenty-five feet from trolley wires, haulage ways, power cables and electric equipment not necessary for the operation of the storage facilities; and

8.4.3. In an area that is as dry as practicable.

8.5. Underground diesel fuel storage facilities shall meet the construction requirements and safety precautions enumerated in this section.

8.5.1. Underground diesel fuel storage facilities shall meet all of the following:

8.5.1.a. Be constructed of noncombustible materials and provided with either self-closing or automatic closing doors.

8.5.1.b. Be ventilated directly into the return air course using noncombustible materials.

8.5.1.c. Be equipped with an automatic fire suppression system complying with section 12 of this rule. The director may approve an alternate method of complying with section 12 of this rule on a mine by mine basis.

8.5.1.d. Be equipped with at least two portable twenty-pound multipurpose dry-chemical type fire extinguishers.

8.5.1.e. Be marked with conspicuous signs designating combustible liquid storage.

8.5.1.f. Be included in the pre-shift examination.

8.5.2. Welding or cutting other than that performed in accordance with subdivisions 8.5.2.a. and 8.5.2.b. below shall not be done within fifty (50) feet of a diesel fuel storage facility. When it is necessary to weld, cut or solder pipelines, cylinders, tanks or containers that may have contained diesel fuel, the following requirements shall apply:

8.5.2.a. Cutting or welding shall not be performed on or within containers or tanks that have contained combustible or flammable materials until such containers or tanks have been thoroughly purged and cleaned or inerted and a vent or opening is provided to allow for sufficient release of any buildup pressure before heat is applied.

8.5.2.b. Diesel fuel shall not be allowed to enter pipelines or containers that have been welded, soldered, brazed or cut until the metal has cooled to ambient temperature.

§56-23-9. Transfer of Diesel Fuel.

9.1. Diesel fuel shall be transferred as provided in this section.

9.2. When diesel fuel is transferred by means of a pump and a hose equipped with a nozzle containing a self-closing valve, a powered pump may be used only if:

9.2.1. The hose is equipped with a nozzle containing a self-closing valve without a latch-open device; and

9.2.2. The pump is equipped with an accessible emergency shutoff switch.

9.3. Diesel fuel shall not be transferred using compressed gas.

9.4. Diesel fuel shall not be transferred to the fuel tank of diesel-powered equipment while the equipment's engine is running.

9.5. Diesel fuel piping systems shall be designed and operated as dry systems.

9.6. All piping, valves and fittings shall meet the following:

9.6.1. Be capable of withstanding working pressures and stresses.

9.6.2. Be capable of withstanding four times the static pressures.

9.6.3. Be compatible with diesel fuel.

9.6.4. Be maintained in a manner that prevents leakage.

9.7. Vertical pipelines shall have manual shutoff valves installed at the surface filling point and at the underground discharge point.

9.8. Unburied diesel fuel pipelines shall not exceed three hundred feet in length and shall have shutoff valves located at each end of the unburied pipeline.

9.9. Horizontal pipelines shall not be used to distribute fuel throughout the mine.

9.10. Diesel fuel piping systems shall be used only to transport fuel from the surface directly to a single underground diesel fuel transfer point.

9.11. When boreholes are used, the diesel fuel piping system shall not be located in a borehole with electric power cables.

9.12. Diesel fuel pipelines located in any shaft shall be included as part of the required examination of the shaft.

9.13. Diesel fuel piping systems located in entries shall not be located on the same side of the entry as electric cables or power lines.

9.14. Diesel fuel pipelines shall not be located in any trolley-haulage entry, except that they may cross the entry perpendicular if buried or otherwise protected in steel conduit or an equivalent from damage and sealed.

9.15. Diesel fuel piping systems shall be protected to prevent physical damage.

§56-23-10. Containers.

10.1. Containers for the transport of diesel fuel shall meet the requirements of this section.

10.2. Diesel fuel shall be transported only in containers specifically designed for the transport of diesel fuel.

10.3. No more than one safety can, conspicuously marked, shall be transported on a vehicle at any time.

10.4. Containers other than safety cans used to transport diesel fuel shall be provided with the following:

10.4.1. Devices for venting.

10.4.2. Self-closing caps.

10.4.3. Vent pipes at least as large as the fill or withdrawal connection, whichever is larger, but not less than one and one-fourth inch nominal inside diameter.

10.4.4. Liquid-tight connections for all container openings that are identified by conspicuous markings and closed when not in use.

10.4.5. Shutoff valves located within one inch of the tank shell on each connection through which liquid can normally flow.

10.5. When tanks are provided with openings for manual gauging, liquid-tight caps or covers shall be provided and shall be kept closed when not open for gauging.

10.6. Containers used for the transport of diesel fuel shall not exceed a capacity of five hundred gallons.

10.7. Containers, other than safety cans, used for the transport of diesel fuel shall be permanently fixed to the transportation unit; provided, however, that the director may develop criteria on a mine by mine basis that allows for approved diesel fuel transportation units to be transported on (or by) a secondary transportation unit to their respective work areas.

10.8. Diesel fuel transportation units shall be transported individually and not with any other cars, except that two diesel fuel transportation units up to a maximum of five hundred gallons each may be transported together.

10.9. Diesel fuel shall not be transported on conveyor belts.

10.10. When transporting diesel fuel in containers other than safety cans, a fire extinguisher shall be provided on each end of the transportation unit. The fire extinguishers shall be multipurpose type dry-chemical fire extinguishers containing a nominal weight of twenty pounds.

10.11. Diesel fuel transportation units shall have a fire suppression system that meets the requirements of section 11 of this rule.

10.12. In mines where trolley wire is used, diesel fuel transportation units shall be provided with insulating material to protect the units from energized trolley wire, and the distance between the diesel fuel transportation unit and the trolley wire shall not be less than twelve inches, or the trolley wire shall be de-energized when diesel fuel transportation units are transported through the area.

10.13. Unattended diesel fuel transportation units shall be parked only in underground diesel fuel storage facilities.

10.14. Safety cans shall be used for emergency fueling only.

10.15. Safety cans shall be clearly marked, have a maximum capacity of five gallons and be constructed of metal and equipped with a nozzle and self-closing valves.

§56-23-11. Fire Suppression for Equipment and Transportation.

11.1. Fire suppression systems for diesel-powered equipment and fuel transportation units shall meet the requirements of this section.

11.2. The system must be an automatic multipurpose dry-powder type fire suppression system suitable for the intended application and listed or approved by a nationally recognized independent testing laboratory. Installation requirements are as follows:

11.2.1. The system shall be installed in accordance with the manufacturer's specifications and the limitations of the listing or approval.

11.2.2. The system shall be installed in a protected location or guarded to minimize physical damage from routine operations.

11.2.3. Suppressant agent distribution tubing or piping of the system shall be secured and protected against damage, including pinching, crimping, stretching, abrasion and corrosion.

11.2.4. Discharge nozzles of the system shall be positioned and aimed for maximum fire suppression effectiveness in the protected areas. Nozzles shall also be protected against the entrance of foreign materials such as mud, coal dust or rock dust that could prevent proper discharge of suppressant agent.

11.3. The fire suppression system shall provide automatic fire detection and suppression for all of the following:

11.3.1. The engine, transmission, hydraulic pumps and tanks, fuel tanks, exposed brake units, air compressors and battery areas, as applicable, on all diesel-powered equipment.

11.3.2. Fuel containers and electric panels or controls used during fuel transfer operations on fuel transportation units.

11.4. The fire suppression system shall include a system fault and fire alarm annunciator that can be seen and heard by the equipment operator.

11.5. The fire suppression system shall provide for automatic engine shutdown. Engine shutdown and discharge of suppressant agent may be delayed for a maximum of fifteen (15) seconds after the fire alarm annunciator alerts the operator.

11.6. At least two manual actuators shall be provided with at least one manual actuator at each end of the equipment. If the equipment is provided with an operator's compartment, one of the mechanical actuators shall be located in the compartment within easy reach of the operator. For stationary equipment, the two manual actuators shall be located with at least one actuator on the stationary equipment and at least one actuator a safe distance away from the equipment and in intake air.

§56-23-12. Fire Suppression for Storage Areas.

12.1. Fire suppression systems for diesel fuel storage areas shall meet the requirements of this section.

12.2. The system shall be an automatic multipurpose dry-powder type fire suppression system or other system of equal capability, suitable for the intended application and listed or approved by a nationally recognized independent testing laboratory. The system shall meet the following installation requirements:

12.2.1. The system shall be installed in accordance with the manufacturer's specifications and the limitations of the listing or approval.

12.2.2. The system shall be installed in a protected location or guarded to minimize physical damage from routine operation.

12.2.3. Suppressant agent distribution tubing or piping of the system shall be secured and protected against damage, including pinching, crimping, stretching, abrasion and corrosion.

12.2.4. Discharge nozzles of the system shall be positioned and aimed for maximum fire suppression effectiveness in the protected areas. Nozzles must also be protected against the entrance of foreign materials such as mud, coal dust and rock dust that could prevent proper discharge of suppressant agent.

12.3. The fire suppressant system shall provide automatic fire detection and suppression for the fuel storage tanks, containers, safety cans, pumps, electrical panels and control equipment in fuel storage areas.

12.4. Audible and visual alarms to warn of fire or system faults shall be provided at the protected area and at a surface location that is always staffed when persons are underground. A means shall also be provided for warning all endangered persons in the event of fire.

12.5. Fire suppression systems shall include two manual actuators with at least one located within the fuel storage facility and at least one located a safe distance away from the storage facility and in intake air.

12.6. The fire suppression system shall remain operative in the event of electrical system failure.

12.7. If electrically operated, the detection and actuation circuits shall be monitored and provided with status indicators showing power and circuit continuity. If not electrically operated, a means shall be provided to indicate the functional readiness status of the system.

12.8. Fire suppression devices shall be visually inspected at least once each week by a person qualified to make such inspections.

12.9. Each fire suppression device shall be tested and maintained.

12.10. A record shall be maintained of the inspection required by this section. The record of the weekly inspections shall be maintained at an appropriate location for each fire suppression device.

12.11. All miners normally assigned to the active workings of a mine shall be instructed about any hazards inherent to the operation of all fire suppression devices installed and, where appropriate, the safeguards available for each device.

§56-23-13. **Use of Certain Starting Aids Prohibited.**

13.1. The use of volatile or chemical starting aids is prohibited.

§56-23-14. **Fueling.**

14.1. Fueling of diesel-powered equipment shall not be conducted in the intake escapeway unless the mine design and entry configuration make it necessary. In those cases where fueling in the intake escapeway is necessary, the mine operator shall submit a plan for approval to the director outlining the special safety precautions that will be taken to insure the protection of miners. Such plan shall specify a location, (such as end of the tail track or adjacent to the load out point), where fueling will be conducted in the intake escapeway and all other safety precautions that will be taken, which shall include an examination of the area for spillage or fire by a qualified person.

14.2. Diesel fuel and other combustible materials shall be cleaned up and not be permitted to accumulate anywhere in an underground mine or on diesel-powered or electric equipment located therein.

14.3. At least one person specially trained in the cleanup and disposal of diesel fuel spills shall be on duty at the mine when diesel-powered equipment or mobile fuel transportation equipment is being used or when any fueling of diesel-powered equipment is being conducted.

§56-23-15. Fire and Safety Training.

15.1. All underground employees at the mine shall receive special instruction related to fighting fires involving diesel fuel. This training may be included in annual refresher training under MSHA regulations at 30 CFR Part 48 (relating to training and retraining of miners) or included in the fire drills required under MSHA regulations at 30 CFR 75.1101-23 (relating to program of instruction; location and use of fire fighting equipment; location of escapeways, exits and routes of travel; evacuation procedures; fire drills.)

15.2. All miners shall be trained in precautions for safe and healthful handling and disposal of diesel-powered equipment filters. All used intake air filters, exhaust diesel particulate matter filters and engine oil filters shall be placed in their original containers or other suitable enclosed containers and removed from the underground mine to the surface no less than once in a twenty-four (24) hour period. Arrangements will be made for safe handling and disposal of these filters within a timely manner after they have reached the surface.

§56-23-16. Maintenance.

16.1. Diesel-powered equipment shall be maintained in an approved and safe condition as described in this rule or shall be removed from service.

16.2. An operator choosing to use diesel equipment in an underground coal mine must develop a maintenance plan and submit his or her plan to the director for approval. Failure of the mine operator to comply with the maintenance requirements of this section may result in the revocation of the director's approval of the complete diesel-powered equipment package, provided appropriate notification has been given to the mine operator and the procedures of this section have been taken. Upon receiving such notice, the mine operator shall have thirty days to submit a plan to achieve and maintain compliance. Such plan shall be evaluated by the director, and, upon approval, the mine operator shall implement the plan. The director shall monitor the mine operator's compliance. At any time the director determines that the mine operator is unable or unwilling to comply, the director shall revoke the mine operator's approval, which would in turn prohibit use of all diesel equipment at that mine.

16.3. To acquire and maintain approval of a complete diesel-powered equipment package, the mine operator shall comply with the following requirements:

16.3.1. All service, maintenance and repairs of approved complete diesel-powered equipment packages shall be performed by mechanics that are trained and qualified in accordance with section 24 of this rule.

16.3.2. Service and maintenance of approved complete diesel-powered equipment packages shall be performed according to:

16.3.2.a. The specified routine maintenance schedule;

16.3.2.b. On-board performance and maintenance diagnostics readings;

16.3.2.c. Emissions test results; and

16.3.2.d. Component manufacturer's recommendations.

§56-23-17. Records.

17.1. A record shall be made of all emissions tests, preoperational examinations and maintenance and repairs of complete diesel-powered equipment packages. The records made pursuant to this section shall meet the requirements of this section.

17.2. The person performing the emissions test, examination, maintenance or repair shall certify by date, time, engine hour reading and signature that the emissions test, examination, maintenance or repair was made.

17.3. Records of emissions tests and examinations shall include the specific results of such tests and examination.

17.4. Records of maintenance and repairs shall include the work that was performed, any fluids or oil added, parts replaced or adjustments made and the results of any subsequently required emissions testing.

17.5. Records of preoperational examinations shall be retained for the previous one hundred-hour maintenance cycle.

17.6. Records of emissions tests, two hundred (200) hour maintenance tests and repairs shall be countersigned once each week by the certified mine electrician or mine foreman.

17.7. All records required by this section shall be retained for at least one year at a surface location at the mine and made available for inspection by the director, district mine inspector and by miners and their representatives.

§56-23-18. Duties of Operator.

18.1. Prior to using a piece of diesel-powered equipment during a shift, an equipment operator shall conduct an examination as follows:

18.1.1. Check the exhaust emissions control and conditioning system components to determine that the components are in place and not damaged or leaking.

18.1.2. Assure that the equipment is clean and free of accumulations of combustibles.

18.1.3. Assure that the machine is loaded safely.

18.1.4. Check for external physical damage.

18.1.5. Check for loose or missing connections.

18.1.6. Check engine oil level.

18.1.7. Check transmission oil level.
18.1.8. Check other fluid levels, if applicable.
18.1.9. Check for hydraulic, coolant and oil leaks.
18.1.10. Check fan, water pump and other belts.
18.1.11. Check the fan for damage.
18.1.12. Check guards.
18.1.13. Check the fuel level.
18.1.14. Check for fuel leaks.
18.1.15. Comply with record keeping requirements pursuant to section 17 of this rule.

18.2. After the engine is started and warmed up, the equipment operator shall conduct an examination as follows:

18.2.1. Check all on-board engine performance and maintenance diagnostics system gauges for proper operation and in-range readings. The equipment operator shall immediately shut down the engine and notify the operator if the on-board readings indicate any of the following:

18.2.1.a. Intake restriction at full engine speed is greater than the manufacturer's recommendation.

18.2.1.b. Exhaust restriction at full engine speed is greater than the manufacturer's recommendation.

18.2.1.c. Coolant temperature is at or near two hundred twelve degrees Fahrenheit.
18.2.1.d. Low engine oil pressure.
18.2.1.e. High engine oil temperature.

18.2.2. Check safety features, including, but not limited to, the throttle, brakes, steering, lights and horn.

18.2.3. Comply with record keeping requirements pursuant to section 17 of this rule.

§56-23-19. Scheduled Maintenance.

19.1. At intervals not exceeding two hundred (200) hours of engine operation, a qualified mechanic shall perform the following maintenance and make all necessary adjustments or repairs or remove the equipment from service:

19.1.1. Wash or steam-clean the equipment.

19.1.2. Check for and remove any accumulations of coal, coal dust or other combustible materials.

19.1.3. Check the equipment for damaged or missing components or other visible defects.
19.1.4. Conduct electrical and safety component inspections.

19.1.5. Replace engine oil and filter. An independent analysis shall be conducted of the engine oil.

19.1.6. Check the transmission oil level and add oil, if necessary.
19.1.7. Check hydraulic oil level and add oil, if necessary.
19.1.8. Check the engine coolant level and add coolant, if necessary.
19.1.9. Check all other fluid levels and add fluid, if necessary.
19.1.10. Check for oil, coolant and other fluid leaks.

19.1.11. Inspect the cooling fan, radiator and shroud. Remove any obstructions and make necessary repairs.

19.1.12. Check all belts. Tighten or replace, if necessary.
19.1.13. Check the battery and service as necessary.
19.1.14. Check the automatic fire suppression system.
19.1.15. Check the portable fire extinguisher.
19.1.16. Check the lights.
19.1.17. Check the warning devices.
19.1.18. With the engine operating, check and replace or repair the following:
19.1.18.a. Oil pressure.
19.1.18.b. Intake air restriction at full engine speed.
19.1.18.c. Exhaust gas restriction at full engine speed.
19.1.18.d. Exhaust flame arrestor.
19.1.18.e. All gauges and controls.

19.1.19. Conduct repeatable loaded engine-operating test in accordance with section 20 of this rule.

19.1.20. Evaluate and interpret the results of all of the above tests and examinations and make all necessary repairs or remove equipment from service.

19.1.21. Comply with recordkeeping requirements pursuant to section 17 of this rule.

§56-23-20. Emissions Monitoring and Control.

20.1. Emissions for diesel-powered equipment shall be monitored and controlled as provided in this section.

20.2. When any diesel-powered machine first enters service at a mine, baseline emission values shall be determined by a qualified mechanic. Unless the director approves an alternate procedure, the qualified mechanic shall:

20.2.1. Verify that the seal on the engine fuel injector pump is in place and that the proper fuel pump is on the equipment.

20.2.2. Install a new clean intake air cleaner, measure and record the intake restriction pressure.

20.2.3. Check the level of engine oil.

20.2.4. Change the engine lubrication oil if not fresh.

20.2.5. Check the level of the transmission fluid.

20.2.6. Flush the exhaust system, if needed. Measure and record the exhaust back pressure. If exhaust gas backpressure is above that recommended by the manufacturer, then steps must be taken to bring the exhaust gas back pressure within the manufacturer's recommended limit prior to beginning the test described in this section.

20.2.7. Test the brakes.

20.2.8. Place the equipment into an intake entry.

20.2.9. Set the brakes and chock the wheels.

20.2.10. Start the engine and allow it to warm up to operating temperature.

20.2.11. For mobile equipment, shift into the highest gear and put the engine at full throttle, or for stationary equipment, induce a load and put the engine at full throttle.

20.2.12. Start the CO sampler and measure and record CO levels every thirty seconds for ninety seconds.

20.2.13. Comply with recordkeeping requirements pursuant to section 17 of this rule.

20.2.14. An alternative to the testing provided in the aforementioned subsections may be developed by the director.

Note: CO baseline emissions must be representative of MSHA's approval data.

§56-23-21. Diagnostic Testing.

21.1. At intervals not exceeding once every two hundred (200) hours of engine operation, a qualified mechanic shall perform equipment maintenance diagnostic testing of each piece of diesel-powered equipment in the mine. The qualified mechanic shall:

21.1.1. Verify the identification numbers on the equipment;

21.1.2. Check the level of the engine lubricating oil;

21.1.3. Check the level of the transmission fluid;

21.1.4. Set the brakes and chock the wheels;

21.1.5. Install the portable CO sampling device into the untreated exhaust port coupling;

21.1.6. Start the engine and allow it to warm up to operating temperature;

21.1.7. Check the intake restriction and the exhaust back pressure at high idle speed;

21.1.8. If the intake restriction is more than the manufacturer's maximum recommended intake restriction, replace the intake filter with a clean one;

21.1.9. If exhaust gas backpressure is above that recommended by the manufacturer, then steps must be taken to bring the exhaust gas back pressure within the manufacturer's recommended limit prior to beginning the test described in this section;

21.1.10. For mobile equipment, shift into the highest gear and put the engine at full throttle, or for stationary equipment, induce a load and put the engine at full throttle.

21.1.11. Start the CO sampler and record CO levels every thirty (30) seconds for ninety (90) seconds;

21.1.12. Install the portable CO sampling device into the treated exhaust port coupling and repeat steps 21.1.l and 21.1.k;

21.1.13. If the average CO reading for treated exhaust gas is greater than 100 ppm, the equipment has failed and must be serviced and retested before it is returned to regular service; and

21.1.14. Comply with recordkeeping requirements pursuant to section 17 of this rule.

21.1.15. An alternative to the testing provided in subsections 21.1.1 thru 21.1.15. may be developed and/or approved by the director.

§56-23-22. Training and General Requirements.

22.1. To use diesel equipment in an underground mine the mine operator shall submit a training plan to the director for approval.

22.2. All training course instructors and all training plans required by this section and sections 23 and 24 of this rule shall be approved by the director. Operator training and qualification shall meet the requirements of this section.

22.3. Training shall be conducted in the basics of the operation of a diesel engine, federal and state regulations governing their use, company rules for safe operations, specific features of each piece of equipment and the ability to recognize problems and shall be provided to each equipment operator and the mine health and safety committee if one exists. This training shall be designed to bring every operator to a level of good understanding of diesel equipment operation. Each operator will be qualified by attending a minimum eight-hour course, including classroom training on diesel fundamentals and equipment-specific hands-on training on the job.

22.4. Upon successful completion of both training sessions, the operator shall be issued a Certificate of Qualification (MSHA 5000-23) that qualifies him or her to operate a specific type of diesel-powered equipment. An operator may be qualified to operate more than one type of equipment by completing additional equipment-specific training covering differences specific to each additional type of equipment.

22.5. The mine operator shall furnish all required training. The employees will suffer no loss of pay for attending training.

22.6. The minimum eight-hour training required by section 22.3 shall include instruction in the following classroom subjects:

22.6.1. Engine fundamentals, which shall include an introduction to the function of a diesel engine and recognition of all major components and their functions.

22.6.2. Diesel regulations, which shall include an introduction to federal and state regulations governing the use of diesel equipment.

22.6.3. Diesel emissions, which shall include an introduction to diesel emissions and their adverse health effects.

22.6.4. Factors that affect diesel emissions, which shall include a detailed presentation of engine faults and diesel fuel quality and their effect on emissions and the preventive actions that can be taken to minimize emissions levels.

22.6.5. Emissions control devices, which shall include a detailed presentation of the different emissions control devices employed to reduce emissions and details about actions the operator must take to keep the devices in working order.

22.6.6. Diagnostic techniques, which shall include a presentation of techniques that can be employed by the operator to assure the equipment is in safe operating condition and instruction about how to recognize and diagnose certain engine faults that may cause increases in emissions.

22.6.7. The preoperational inspection, which shall include a presentation of the purpose, benefits and requirements of the preoperational inspection.

22.6.8. Ventilation, which shall include an introduction to special ventilation requirements for areas where diesel-powered equipment will operate.

22.6.9. Fire suppression system, which shall include an introduction to the fire suppression system and its function and when and how to activate the fire suppression manually.

22.6.10. Operating rules, which shall include a detailed presentation of the driving rules, safe driving speeds, traffic control devices and equipment limitations.

22.6.11. Emergency procedures, which shall include discussion of emergency situations, such as fire, diesel fuel spills, component failure, loss of ventilation air and emergency escape procedures and discussion of the potential use of the diesel-powered vehicle as an emergency escape vehicle in case of a mine emergency situation.

22.6.12. Record keeping and reporting procedures, which shall include a presentation on required record keeping and reporting procedures for problems or unsafe conditions, high emissions levels and preoperational inspections made by the equipment operator.

§56-23-23. **Equipment-Specific Training.**

23.1. Equipment-specific hands-on orientation training shall be given in an area of the mine where the equipment will be operated. This orientation shall be specific to the type and make of the diesel machine and shall be presented in small groups. The following subjects shall be included in the training:

23.1.1. Equipment layout, which shall include familiarization with the layout of the equipment, the operator's compartments and the controls.

23.1.2. Pre-operation inspection, which shall include familiarization with the pre-operation inspection procedure and review of specific details of the inspection and location of the components to be inspected.

23.1.3. Equipment limitations, which shall include instruction relating to equipment performance, speeds, capacities and blind areas.

23.1.4. Operating areas, which shall include instruction relating to areas in which the equipment may be operated.

23.1.5. Operation, which shall include familiarization with the controls, gauges and warning devices and safe operating limits of all indicating gauges.

23.1.6. Refueling procedure, which shall include familiarization with fuel handling, permissible refueling areas, spill prevention, cleanup and potential hazards from diesel fuel.

23.1.7. Emergency devices, which shall include instruction relating to the location and use of the fire extinguisher and fire suppression devices.

23.1.8. Driving practice, which shall include supervised operation of the equipment.

§56-23-24. **Diesel Mechanic Training.**

24.1. Diesel mechanic training and qualification shall meet the requirements of this section.

24.2. Diesel mechanics shall be trained and qualified to perform maintenance, repairs and testing of the features of diesel equipment certified by MSHA and the director.

24.3. To be qualified, a diesel mechanic must successfully complete a minimum of sixteen hours of a training program approved by the director regarding the general function, operation, maintenance and testing of emissions control and conditioning components. The diesel mechanic must be qualified to perform these tasks on the specific machines used at the mine or mines where they are employed. Additional engine-specific training shall be provided to diesel mechanics in accordance with a plan approved by the director.

24.4. Annual retraining programs of eight (8) hours for diesel mechanics shall be required and approved by the director. The annual retraining shall include refresher training as well as new procedure and new technology training as necessary. Such training shall be separate from refresher training pursuant to MSHA regulations at 30 CFR Part 48 (relating to training and retraining of miners) and electrical training required by MSHA. The mine operator shall furnish all required training and refresher training. The employees will suffer no loss of pay for attending training and refresher training.

24.5. The minimum sixteen-hour diesel mechanic training programs shall be submitted for approval to the director and shall include training in the following minimum subject requirements:

24.5.1. Federal and state requirements regulating the use of diesel equipment.

24.5.2. Company policies and rules related to the use of diesel equipment.

24.5.3. Emissions control system design and component technical training.

24.5.4. On-board engine performance and maintenance diagnostics system design and component technical training.

24.5.5. Service and maintenance procedures and requirements for the emissions control systems.

24.5.6. Emissions testing procedures and evaluation and interpretation of test results.

24.5.7. Troubleshooting procedures for the emissions control systems.

24.5.8. Fire protection systems test and maintenance.

24.5.9. Fire and ignition sources and their control and elimination.

24.5.10. Fuel system maintenance and safe fueling procedures.

24.5.11. Intake air system design and components technical training and maintenance procedures.

24.5.12. Engine shutdown device tests and maintenance.

24.5.13. Special instructions regarding components, such as the fuel injection system, that shall only be repaired and adjusted by a qualified mechanic who has received special training and is authorized to make such repairs or adjustments by the component manufacturer or ASE certified diesel mechanic.

24.5.14. Instruction on record keeping requirements for maintenance procedures and emissions testing.

24.5.15. Other subjects determined by the director to be necessary to address specific health and safety needs.

24.6. Individuals successfully completing the approved sixteen (16) hour diesel mechanic training will be considered to be a trained operator providing he or she has received the necessary task training on the specific piece of diesel equipment.

§56-23-25. **Operation of Diesel-Powered Equipment.**

25.1. In addition to other requirements of this rule, diesel-powered equipment shall be operated pursuant to the standards set forth in this rule.

25.2. All diesel-powered equipment shall be attended while in operation with the engine running in underground mines.

25.3. Unnecessary idling of diesel-powered equipment shall be prohibited.

25.4. All roadways where diesel-powered equipment is operated shall be maintained as free as practicable from bottom irregularities, debris and wet or muddy conditions that will affect control of the equipment.

25.5. Operating speeds shall be consistent with conditions of roadways, grades, clearances, visibility and traffic and type of equipment used.

25.6. Equipment operators shall have full control of the mobile equipment while it is in motion.

25.7. Traffic rules, including speed, signals and warning signs, shall be standardized at each mine and posted.

25.8. All diesel-powered equipment shall be maintained in a safe and healthful operating condition. Equipment in an unsafe or unhealthful condition or not maintained in accordance with the engine or emissions control operating specifications shall be removed from service immediately and shall not be returned to service until all necessary corrective actions have been taken.

§56-23-26. **Diesel Inspectors; Employment; Training.**

26.1. The office of miners' health, safety and training shall assign a diesel inspector in each region of the state's four regional offices.

26.2. The diesel inspector may be assigned other duties as prescribed by the director.

26.3. The office of miners' health, safety and training shall provide the diesel inspectors with specific training on this rule; also they shall train and equip the diesel inspectors with the proper equipment so that the inspectors may effectively test for diesel emissions and properly enforce this rule as prescribed by the director.

26.4. The diesel inspectors shall be trained in accordance with criteria as established and approved by the director.

26.5. After the implementation of this rule, the office of miners' health, safety and training shall employ additional diesel inspectors as needed.

§56-23-27. **Diesel Inspector -- Training Course.**

27.1. Training for diesel inspectors shall include, but is not limited to, the following:

27.1.1. Engine Fundamentals – Components and Operation of a Diesel Engine.

27.1.2. Fuel Standards – Fuel Requirements and Effect of Various Fuels on DPM Emissions.

27.1.3. Diesel Regulations – State and Federal.

27.1.4. DPM – Health Effects.

27.1.5. Factors that increase/decrease DPM emissions.

27.1.6. Emission Control Techniques – Operation, Maintenance and Testing.

27.1.7. Diagnostics – Instruments, Testing and Evaluation.

27.1.8. Inspection Techniques – Enforcement.
27.1.9. Ventilation.
27.1.10. Fire Suppression Systems – Operation, Testing and Maintenance.
27.1.11. Emergency Procedures – Firefighting, Spills/Containment.
27.1.12. Fuel Handling/Storage.
27.1.13. Manufacturer Training.
27.1.14. Training Requirements – Plans, Record Keeping.

§56-23-28. Operation of Underground Diesel Powered Electric Generators.

28.1. While being operated, the diesel generator shall be vented directly to the return air course.

28.2. At least one person shall be present within sight and sound while the generator is in operation (engine running) and he/she shall have a multi-gas detector capable of detecting nitric oxide (NO), nitrogen dioxide (NO_2) and carbon monoxide (CO).

28.3. All current state rules and statutes relating to the use of diesel-powered equipment and electricity remain in force.

28.4. Prior to the initial operation of the diesel generator underground, the operator shall give the director or his/her authorized representative ten (10) days' written notice. In case of an emergency, the operator shall notify the director or his/her authorized representative as soon as possible prior to its initial use.

§56-23-29. Electrical Provisions for Diesel-Powered Electrical Generators.

29.1. Electrical provisions for diesel-powered electrical generators used as an alternative to power centers for moving equipment in, out, and around the mine and to perform work in areas where permissible equipment is not required, must comply with the following:

29.1.1. A grounding resistor rated for the phase-to-phase voltage of the system must be provided to limit the ground-fault current to not more than 0.5 amperes.

29.1.1.a. The grounding resistor(s) must be located:

29.1.1.a.1. Between the wye-connected generator neutral and the generator frame or

29.1.1.a.2. Between the wye-connected generator neutral and the generator frame and between the wye-connected transformer secondary and the transformer frame when an isolation transformer(s) is used and the generator is supplying power to the other equipment or

29.1.1.a.3. Between the wye-connected generator neutral and the generator frame when an auto-transformer is used.

29.2. Each three-phase output circuit of the generator must be equipped with a sensitive ground fault relay. The protective relay must be set to cause the circuit interrupting device that supplies power to the primary windings of each transformer to trip and shut down the diesel engine when a phase-to-frame fault of not more than 90 milliamperes occurs.

29.3. The neutral grounding resistor shall be provided with backup ground fault protection that will shut down the diesel engine if a ground fault occurs with the neutral grounding resistor open.

29.4. Each three-phase output circuit that supplies power to equipment must be equipped with an instantaneous sensitive ground-fault relay that will cause its respective circuit interrupting device(s) to trip and cause shutdown of the diesel engine when a phase-to-frame fault occurs. The grounded-phase protection must be set at not more than 90 milliamps. Current transformers used for the ground-fault protection must be single window-type and must be installed to encircle all three phase conductors. Equipment safety grounding conductors must not pass through or be connected in series with ground-fault current transformers.

29.5. Each three-phase circuit interrupting device must be provided with a means to provide short-circuit, overcurrent, grounded-phase, under-voltage, and ground wire monitoring protection. The instantaneous only trip unit for the circuit interrupting device(s) in use must be adjusted to trip at not more than seventy-five percent (75%) of the minimum available short circuit current at the point where the portable cable enters the equipment, specified in Table 56-23A found at the end of this rule.

29.6. The equipment portable cable length(s) must not exceed the length(s) specified in Table 56-23B found at the end of this rule.

29.7. Permanent label(s) listing the maximum circuit interrupting device setting(s) and maximum portable cable length(s) must be installed on each instantaneous trip unit or be maintained near each three-phase circuit interrupting device. The permanent label(s) must be maintained legibly.

29.8. The circuit interrupting device that supplies three-phase power circuit(s) to the equipment being powered must be limited to the use of only one circuit interrupting device at a time when equipment is being moved in, out, and around the mine.

29.9. The grounding system must include an MSHA-accepted ground wire monitor system to assure that grounding conductor is connected to the frames of all equipment and to the frame of the generator. Double grounding will not be accepted in lieu of ground monitoring.

29.10. All trailing cables extending from the generator to equipment must comply with the design of trailing cables for medium-voltage circuits.

29.11. Trailing cables for medium-voltage circuits shall include grounding conductors, a ground check conductor, and grounded metallic shields around each power conductor or a ground metallic shield over the assembly, except that on equipment employing cable reels, cables without shields may be used if the insulation is rated 2,000 volts or more.

29.12. A strain relief device must be provided on each end of the trailing cables that extends between the generator and the piece of equipment being powered.

29.13. Prior to moving each piece of equipment or performing work, a functional test of each ground fault and ground wire monitor system must be performed by a qualified electrician. The ground-fault circuit must be tested without subjecting the circuit to an actual grounded phase condition. A record of each test must be maintained and made available to authorized representatives of the director and to the miners in such mine.

29.14. The diesel generator must be provided with power quality monitoring. This shall include volt meter(s), ammeters and a frequency meter to determine the power quality of all three phases.

Table 56-23A

Conductor Size AWG or MGM	Maximum Allowable Circuit Breaker Instantaneous Setting (Ampheres)
14	50
12	75
10	150
8	200
6	300
4	500
3	600
2	800
1	1,000
1/0	1,250
2/0	1,500
3/0	2,000
4/0	2,500
250	2,500
300	2,500
350	2,500
400	2,500
450	2,500
500	2,500

TABLE 56-23B
SPECIFICATIONS FOR PORTABLE CABLES LONGER THAN 500 FEET

Conductor Size -- AWG or MCM	Max. Allowable Length (Feet)	Normal Ampacity at 60° C. Copper Temperature (40° C. Ambient)	Resistance at 60° C. Copper Temperature (Ohms)
6	550	50	0.512
4	600	70	.353
3	650	80	.302
2	700	95	.258
1	750	110	.220
1/0	800	130	.185
2/0	850	150	.157
3/0	900	175	.130
4/0	1,000	200	.116
250	1,000	220	.098
300	1,000	240	.082
350	1,000	260	.070
400	1,000	280	.061
450	1,000	300	.054
500	1,000	320	.050

Pre-Operational Inspection Locomotive

Plan for Safety

Pre-Operational Inspection

- Assure park brake is set
- Assure machine is clean and free of accumulations of combustibles
- Check for unsecured equipment and materials on locomotive
- Check for physical external damage
- Look for loose or missing connections

Pre-Operational Inspection

- Check for leaks - hydraulic, coolant, fuel and oil leaks
- Check guards
- Check sanders
- Check jack, bar, fire extinguisher, reflectors, manual un-coupler bar, and safety chain

Pre-Operational Inspection

- Check exhaust emissions control and conditioning system components to determine that they are in place and operational
- Check fan, water pump and other belts
- Check coolant level

Start Engine

- Check oil pressure
- Check all gauges for safe operating ranges
- Allow engine to warm-up
- Put engine into <u>high idle</u>
- Check intake restriction
- Check exhaust gas back pressure
- Check coolant temperature

Pre-op Checks After Start-Up

- Check two-way communications
- Notify a mechanic if the intake restriction, exhaust gas backpressure, coolant temperature, oil pressure or oil temperature are not in the normal range as indicated on gauge

Continue Warm Engine Checks

- Set parking brake
- Make sure the equipment is positioned correctly
- Secure machine against movement
- Put machine into high gear and check service brake and park brake
- Do not operate unsafe equipment

Record and Sign

- Complete pre-operational checklist
- Record Engine hours:__________hrs.
- Next 200-hour check due:______hrs.
- Operator:____________________________
- Date:_______________________________
- Time:________________________AM/PM

MINE:____________________________________

DIESEL EQUIPMENT
PRE-OPERATION CHECKLIST

MACHINE:________________________________

	Beginning	Ending
DATE	_______________	_______________
HOUR METER	___________	____________

Next 200-hour Service Due
at ___________________hour meter reading.

Do not operate this diesel equipment if hour meter exceeds this number. Report to immediate supervisor for maintenance / servicing.

PRE-OPERATION CHECKLIST

_______ **Assure the park brake is set**
_______ Assure that the equipment is clean and free of accumulations of combustibles
_______ Check for loose, unsecured materials stored or hauled on equipment
_______ Check for external physical damage and reflectors on all sides
_______ Check for loose, leaking or missing filter on exhaust conditioning system
_______ Check fire suppression system status panel (power light should blink)
_______ Check engine oil level
_______ Check other fluid levels if applicable
_______ Check for hydraulic, coolant, fuel or oil leaks
_______ Fluids added ____
_______ Check fan, water pump belt and other belts
_______ Check guards
_______ Check lifting jack & bar, (and lug wrench)
_______ Check fire extinguisher
_______ Check lights and horn
_______ Check self-closing fuel filler cap and cap vent
_______ Check fuel level and indicate amount 1/4 1/2 3/4 Full
_______ **Start the engine and avoid low idle**
_______ Check engine oil pressure as engine warms
_______ Check all on-board gauges for proper operation and in-range readings
_______ Immediately shut down the engine and notify the supervisor if the on-board readings fail
_______ Check Intake Restriction at full engine speed and record ___inches. Normal is 6 to22 inches
_______ Check Exhaust Restriction at full engine speed and record ___ inches. Normal is 6 to26 inches
_______ Check Coolant Temperature
_______ Check for High Engine Oil Temperature
_______ Check transmission oil level
_______ Check the brakes
_______ Check the steering
_______ **Record engine hours___________**
_______ **Next 200-hour service due at_______________hours**
_______ Be sure passengers are safely loaded

Date_______________ Time___________a.m. / p.m.
Operator's signature:

____

COMPANY RULES
FOR NORMAL DIESEL OPERATION
AND USE DURING EMERGENCIES

(Topics for discussion and inclusion into customized operator training programs)

DRIVING RULES

What speed, engine RPM's, and transmission gear should be used?

Drive on right (or left) side?

Method to keep equipment out of low or close clearance areas:

When and where will idling be considered unnecessary?

Maximum number of vehicles inside air-locked areas (based upon ventilation volume and equipment requirements):

Maximum number of vehicles on each split of ventilation current?

TRAFFIC CONTROL

What signs, barriers or methods prevent entering low areas?

Will regular-shaped traffic control signs, stop, yield, do-not-enter, etc. be utilized?

Method of communications with dispatcher if traveling on track:

Method of controlling roadway dust:

Schedule for maintaining roadways:

FAN OUTAGES

Procedure to follow:

COMPANY RULES
FOR NORMAL DIESEL OPERATION
AND DURING EMERGENCIES

(Topics for discussion and inclusion into customized operator training programs)

EMERGENCY ESCAPE VEHICLE

A readily available vehicle must be maintained for persons inby the dumping point on working sections.

Your plan or method to assure a readily available vehicle is provided:

FIGHTING FIRES OR FLOODS

Procedure to use and ventilate equipment required for fire fighting (i.e. bulk rockduster trailer or water car pulled to fire scene with diesel tow tractor):

Procedure to use and ventilate diesel pumps or emergency power sources brought to flood scenes:

DIESEL SPILLS

Who are the trained person(s) responsible to clean up diesel spills?

Day shift:
Evening shift:
Midnight shift:

Storage location of diesel clean-up materials:

What protective clothing and spill clean-up materials are provided?

SECTION L – <u>DIESEL FUEL AND FUELING</u>

1. **<u>Diesel Fuel Requirements</u>** *EPA GUIDELINES* **(Review WV Requirements and Regulations).** *POWER POINT*
2. **<u>Fuel Storage / Transport of Fuel –</u> (Review WV Requirements and Regulations).** *POWER POINT*

SECTION M – <u>DIESEL TESTING INSTRUMENT HANDS ON TRAINING</u>

1. ECOM ANALYZER TRAINING.
2. 5 GAS DETECTOR TRAINING.
3. EXHAUST LEAKS.
4. SURFACE AND EXHAUST TEMP.
5. BACHARACH SMOKE DOT TESTER.

SECTION N – 90 SECOND LOAD TEST TRAINING

1. Test Simulation
2. Logging Test Data

MINE:___________________________________

DIESEL EQUIPMENT
200-HOUR
MAINTENANCE RECORD

MACHINE:_______________________________

	Beginning	Ending
DATE	__________________	__________________
HOUR METER	_____________	_____________

200-HOUR MAINTENANCE CHECKLIST-

Engine Serial Number _____________

______**Set the park brake** and wash or steam clean the equipment

______Check for and remove any accumulated coal or fluids

______Inspect brakes, safety chains, reflectors

______Repair damaged or missing intake or exhaust components, heat shields or shutdown controls

______Check electrical equipment, E-stop, breakers, fuses, battery switch and repair as necessary

______Change engine oil and filter

______Check transmission fluid and add if necessary

______Check hydraulic fluid and add if necessary

______Check all other fluid levels and add if necessary

______Check for and repair oil, coolant or other fluid leaks

______Check the cooling fan, radiator, and fan shroud for obstructions or bent blades and repair

Tighten or replace all belts as necessary

______Check battery and service as needed

______Check automatic fire suppression system and recharge or repair if defective

______Check portable fire extinguisher(s) and replace if missing or defective

______Check front and rear headlights, horn, dash instruments and replace or repair if defective

Keep brake set, secure the machine against movement and start the engine

______Check the oil pressure

______Check intake restriction at full engine speed and replace intake filter(s) if necessary. Normal intake restriction is __________ inches.

______Check engine back pressure at full engine speed and replace or clean the soot filter if necessary. Normal back pressure is ________ inches.

______Test engine shutdown controls and repair or replace if defective

______Conduct 90 SECOND untreated and treated load tests and record readings

______Evaluate emission test data, make necessary repairs or remove the equipment from service

______Measure smoke in the treated exhaust to check soot filter performance. Be sure smoke number is less than 3. Current smoke number is______.

______Be sure surface **and** exhaust gas temperatures are less than 302 degrees F.

______Perform all additional service as required by the manufacturer's service instructions

______Fill out this 200-Hour Record, the CO Emissions Form, and the Repair & Maintenance Form

Engine hours at time of service ________ Date ______________Time __________ a.m. / p.m.

Signature of qualified diesel mechanic___________________________________**Date**__________

Countersigned

by__________________________________Mine Foreman__or Mine Electrician__ Date_________

Attach emissions printout here or emissions chart if available

200-Hour Carbon Monoxide Emissions Form

For Diesel Powered Equipment

Engine # ________________________

Form must be filled out by a qualified diesel mechanic as part of the CO emissions record. Engine must be at operating temperature before test. Emissions readings should be taken for 90 seconds at 30 second intervals once oxygen drops to 10% or when CO 2 is between 8 to 10% (10 to 12% for engine without turbo).

At start of test:

Engine Speed ...._____RPM
Engine Temperature ...._____ F
Transmission Temperature ...._____ F
Maximum Intake Restriction (at high Idle) ...._____" wg
Maximum Exhaust Back Pressure (at high idle).........................._____" wg
Maximum Exhaust Temperature ...._____ F

	CO2/CO2	Untreated CO	Treated CO
1st 30 seconds	___/___	_____	_____
2nd 30 seconds	___/___	_____	_____
3rd 30 seconds	___/___	_____	_____

Average Untreated CO _______ Treated CO _______

Engine hour reading ________ Date _____________ Time ________ a.m. / p.m.
Person performing
emissions test ____

Countersigned
by ____Mine Foreman __ or Mine Electrician

Date_______________

Diesel Powered Equipment Repair and Maintenance Form

MACHINE:________________________________

Note: Diesel Mechanics should use this form to list all repairs or maintenance performed during each 200-hour scheduled service, or any additional maintenance or repair required between service intervals.

Description of maintenance or repair

1.____

____

2.____

____

3.____

____

4.____

____

5.____

____

6.____

____

7.____

____

8.____

____

9.____

____

10.____

Engine Hour Reading ____________ Date____________ Time________a.m.__p.m.__

Person performing
maintenance or repair)s ____Date_________

Countersigned
by___________________________Mine foreman__ or Mine electrician__Date_________

MINE:______________________________

DIESEL EQUIPMENT
WEEKLY EMISSIONS RECORD

MACHINE:______________________________

	Beginning	Ending
DATE	________________	________________
HOUR METER	___________	____________

WEEKLY EMISSIONS REPORT FOR DIESEL EQUIPMENT

West Virginia Rule §56-23-7. Exhaust Gas Monitoring and Control.

7.1. In monitoring and controlling exhaust gases, the ambient concentration of exhaust gases in the mine atmosphere shall not exceed 35 ppm ceiling for carbon monoxide (CO), 25 ppm ceiling for nitric oxide (NO) and 3 ppm ceiling for nitrogen dioxide (NO2). The concentration of these exhaust gases shall be measured at the equipment operator's or equipment attendant's position and inby the last piece of diesel-powered equipment operating in the same split of air. Measurements shall be made weekly or more often if necessary by a qualified person and shall be conducted pursuant to the requirements of this section.

Ambient Diesel Emissions

MACHINE:____

Measurements at operator's station (ppm)..........................____ CO......____ NO......___ NO2....____O2
Measurements 6 to 10 feet downwind and in same split (ppm)..____ CO......____ NO......___ NO2…____O2
Tailpipe filtered CO reading ______ppm

Automatic Fire Suppression System *(MSHA REGULATION)*
OK________
Defective________
List system defects found and corrections made ________________________________

____

Comments____

Engine hour reading ________ Date _______ Time _______ a.m. / p.m.

Person performing emissions test
and fire suppression check____

Countersigned
By ____

Mine Foreman ___ or Mine Electrician ____ Date ____________

Other WV Regulations to Consider

Communications for track equipment:

§22A-2-37. Haulage roads and equipment; shelter holes; prohibited practices; signals; inspection.

(t) (5) All self-propelled track equipment shall be equipped with two-way communications.

Welding tanks:

§22A-2-46. Welding and cutting.

(d) Transportation of oxygen and gas tanks or cylinders shall be permitted on self-propelled machinery or belt conveyors specially equipped for safe holding of the containers in transportation. In no instance shall such transportation be permitted in conjunction with any mantrip, unless such mantrip is especially equipped with a compartment, lined with at least four inches of foam rubber or the equivalent, and capable of tightly securing the tank inside the manufactured frame of the vehicle.

Towing disabled rubber-tired equipment:

§36-45-4. Transportation of Disabled Underground Rubber Tired Mining Equipment.

4.1. Ninety (90) days after the effective date of these rules and regulations a solid triangular tow bar or suitable device approved by the director shall be used to tow disabled underground rubber tired mining equipment in all areas of the mine outby working sections, provided however, other means of towing disabled equipment may be used if it is necessary to transport such disabled equipment short distances to the nearest location where a solid triangular tow bar or other device approved by the director can be safely affixed to the disabled equipment.

4.2. No person shall be permitted to ride in disabled underground rubber tired mining equipment while it is being towed using a solid triangular tow bar unless the towed vehicle is equipped with operative brakes and steering functions and controls and a protective canopy.

4.3. Pushing a disabled vehicle will not be allowed unless it becomes necessary to move such disabled vehicle out of the road of travel or to enable access to the use of a solid triangular tow bar.

4.4. No person shall be allowed to push a disabled vehicle from the operators deck end.

Pre-operation checklist tag on equipment:

§36-18-5. Pre-Operational Equipment Check.

5.1. Each working shift prior to its operation, all self-propelled section equipment to be operated during that shift shall be examined by the equipment operator for safety defects and/or unsafe conditions.

5.2. Pre-Operational equipment examination required under 5.1 of this rule shall include the following items at a minimum. In addition, a list of these items shall be maintained on such equipment.

- 5.2.1. Stop/Start Control
- 5.2.2. Panic Bar
- 5.2.3. Tram Controls
- 5.2.4. Steering
- 5.2.5. Service Brakes
- 5.2.6. Automatic Emergency Brakes
- 5.2.7. Lights
- 5.2.8. Warning Devices
- 5.2.9 Canopies Where Required
- 5.2.10. ATRS System and Boom Controls on Roof Bolting Machines

<u>NOTE:</u> MUST FOLLOW OTHER WV HAULAGE AND HAULAGE EQUIPMENT REGULATIONS (Chapter 22 of Mine Laws)

A. L. LEE
CORPORATION

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UNDERGROUND MINING EQUIPMENT SINCE 1967

Personnel Carriers

Rail Equipment

Utility Vehicles

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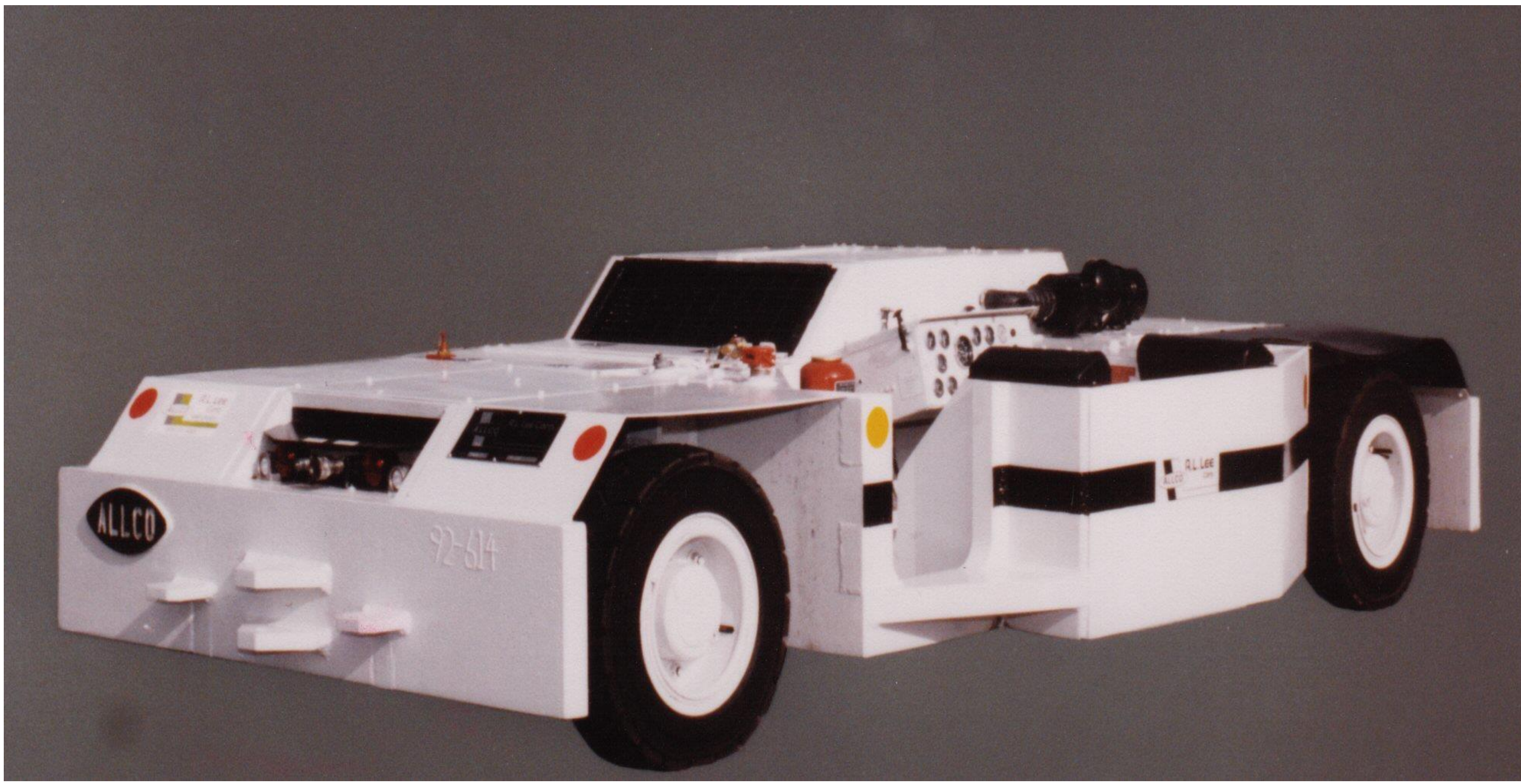
WV COMPLIANT DIESEL MINI-TRAC

A.L. LEE MODEL 255
4WD PERSONNEL CARRIER

MODEL 2400T
12 TON TRACTOR
“AN INDUSTRY STANDARD”



A.L. LEE DIESEL FIFTH WHEEL ROCKDUSTER

DIESEL GENERATOR

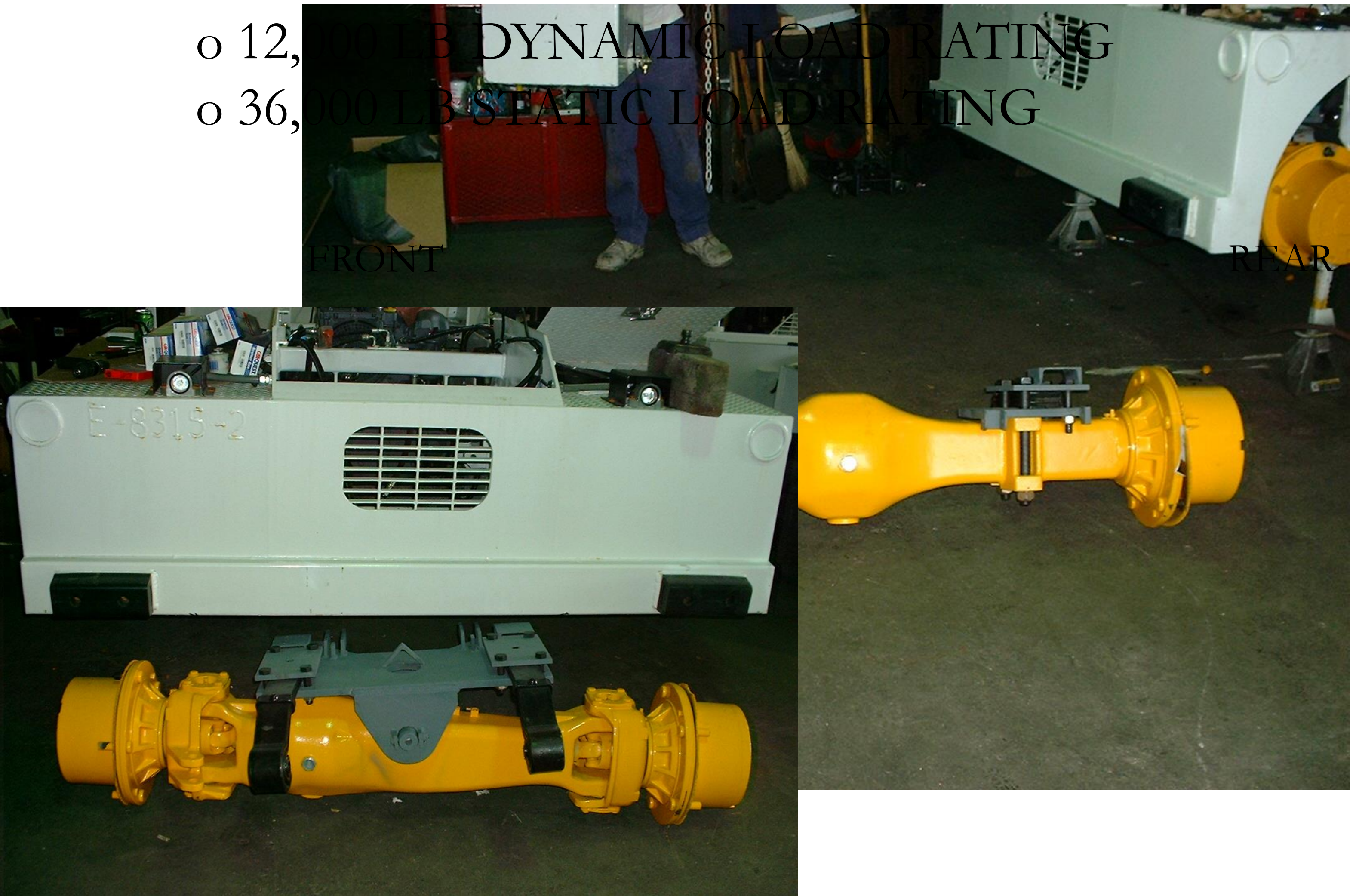
A.L. LEE MODEL 255 PERSONNEL CARRIER DRIVE LINE AND SUSPENSION

TRANSMISSION

- ITL PS 760 INDUSTRIAL TRANSMISSION WITH 4 SPEED POWER SHIFT
- 120 HP INPUT RATING
- 590 FT-LB INPUT TORQUE RATING
- 14 GPM OIL FLOW RATE

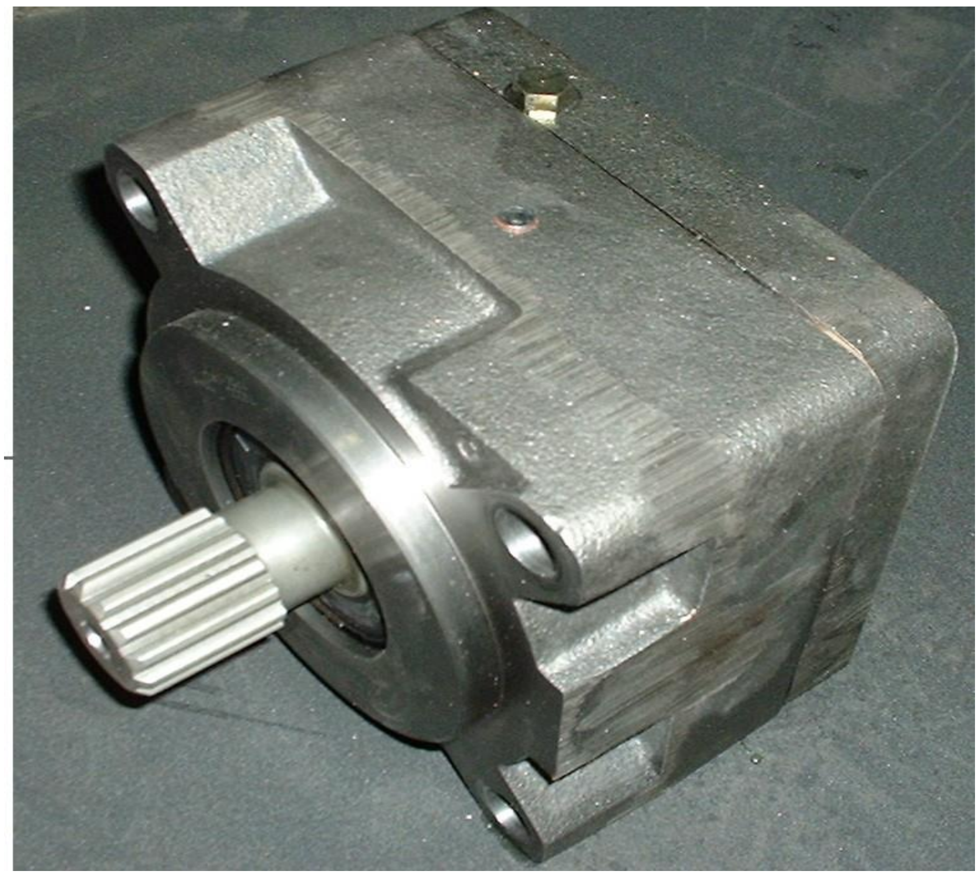
ITL AXLES

- ITL PLANETARY AXLES, FRONT AND REAR
- INTERNAL WET DISC SERVICE BRAKES
- 12,000 LB DYNAMIC LOAD RATING
- 36,000 LB STATIC LOAD RATING



PARK BRAKE

MAINTENANCE FREE AUSCO DRIVE LINE WET PARK BRAKE



WHY IS IT SO IMPORTANT TO USE WET BRAKES ON DIESEL EQUIPMENT?

- INTERNAL WET BRAKES DO NOT HAVE TO BE PROTECTED WITH AUTOMATIC FIRE SUPPRESSIO NOZZLES!
- DRY BRAKES REQUIRE A FIRE SUPPRESSION NOZZLE PER EACH BRAKE HEAD!

TYPES OF SUSPENSION

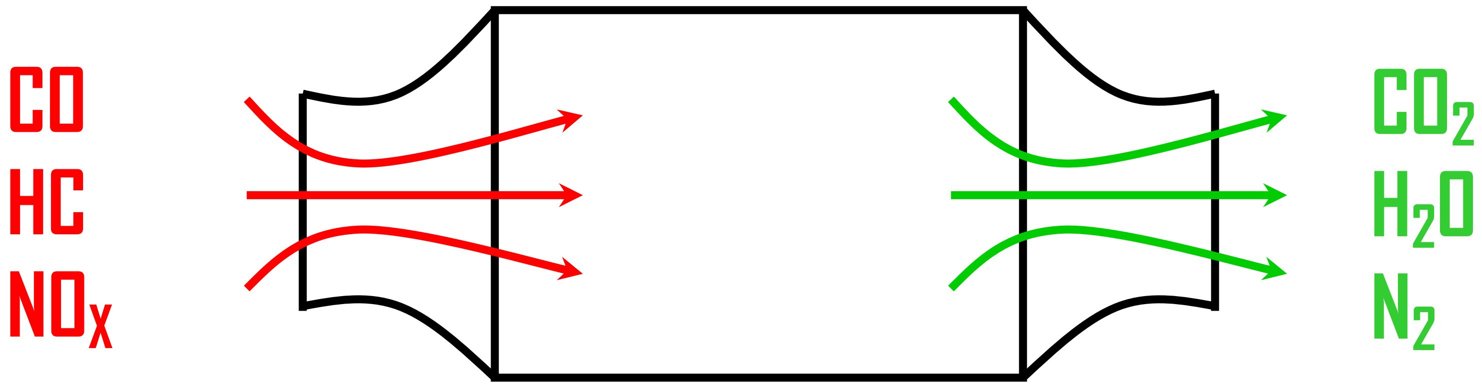
COIL SPRING

AIR BAG

WHAT COMPONENTS MAKE UP THE EXHAUST TREATMENT SYSTEM

- OXIDATION CATALYST
  - REMOVES CO BY 83% MINIMUM
    - AMBIENT CO CANNOT EXCEED 35 PPM CEILING, ACTION MUST BE TAKEN AT 26 PPM
- DPM FILTER
  - CAPABLE OF REDUCING DPM BELOW .12 MG/M^3
- EXHAUST COOLER
  - REDUCES EXHAUST EXIT TEMPERATURE BELOW 302 DEGREES FAHRENHEIT

OXIDATION CATALYST
REDUCES CO BY 83% MINIMUM



NUMBERS BELOW REPRESENT A DEUTZ 78 HP BF4L2011

Raw Exhaust
150 - 200 PPM CO

Treated Exhaust
15 – 20 PPM CO

Conversion of emissions occurs as hot exhaust **gases** contact the catalyst surface

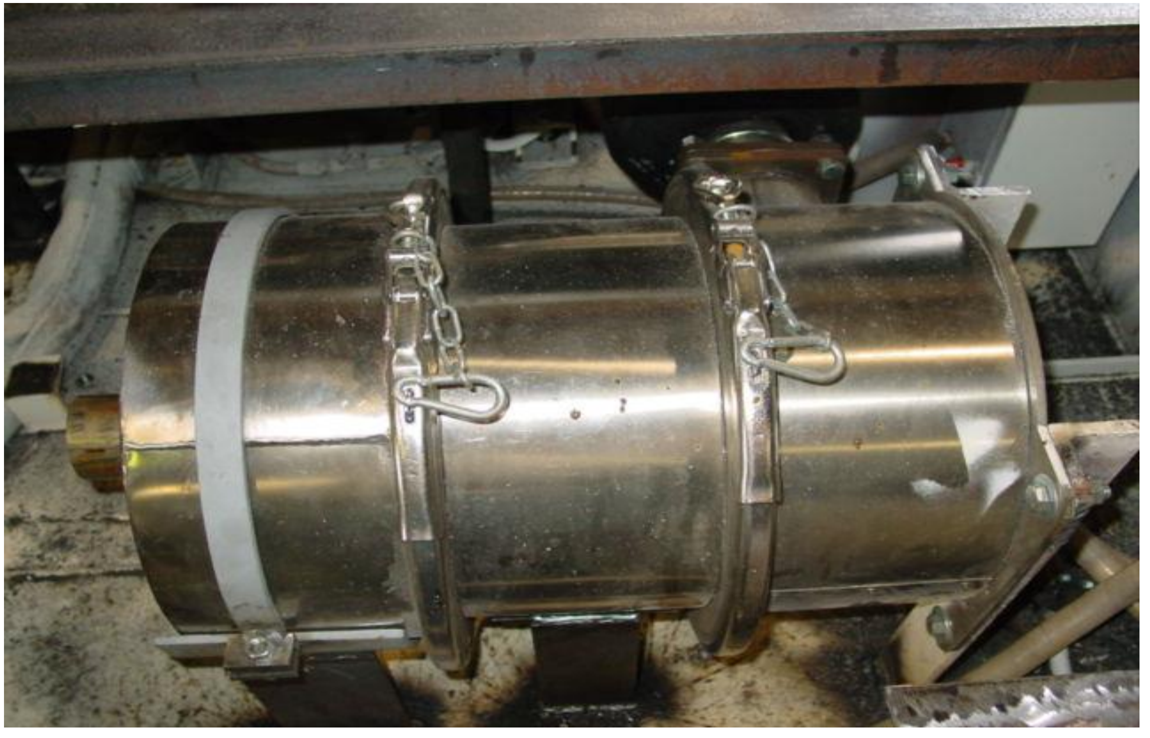
OXIDATION CATALYST MAINTENANCE

- MANUFACTURERS CLAIM THAT A CATALYST SHOULD LAST UP TO 10,000 HOURS
- IF THE DPM FILTER IS ALLOWED TO STOP UP, IT COULD IN TURN PLUG THE OXIDATION CATALYST
- IF THE OXIDATION CATALYST BECOMES CLOGGED IT SHOULD BE REMOVED AND WASHED OUT WITH SOAP AND WATER

DPM FILTER

DEUTZ BF4L2011 TIER 2 HAS A RAW DPM OF 3.7 GRAMS PER HOUR

- REDUCES DPM BY 87%
  - SURFACE TEMPERATUE CANNOT EXCEED 302 DEGREES FAHRENHEIT



DPM SHOWN DISASSEMBLED

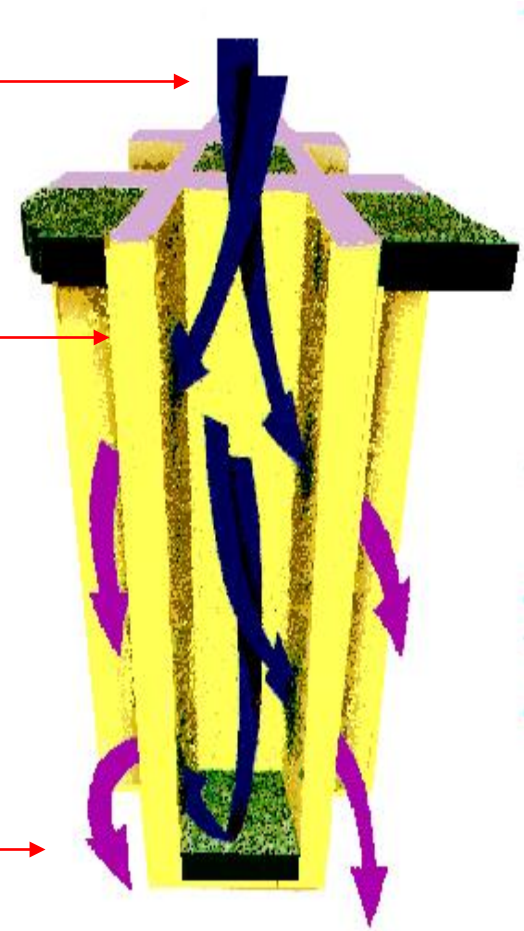
HOW DOES THE DPM FILTER WORK?

DPM COLLECTS ON THE FILTER WALLS

RAW EXHAUST GASES

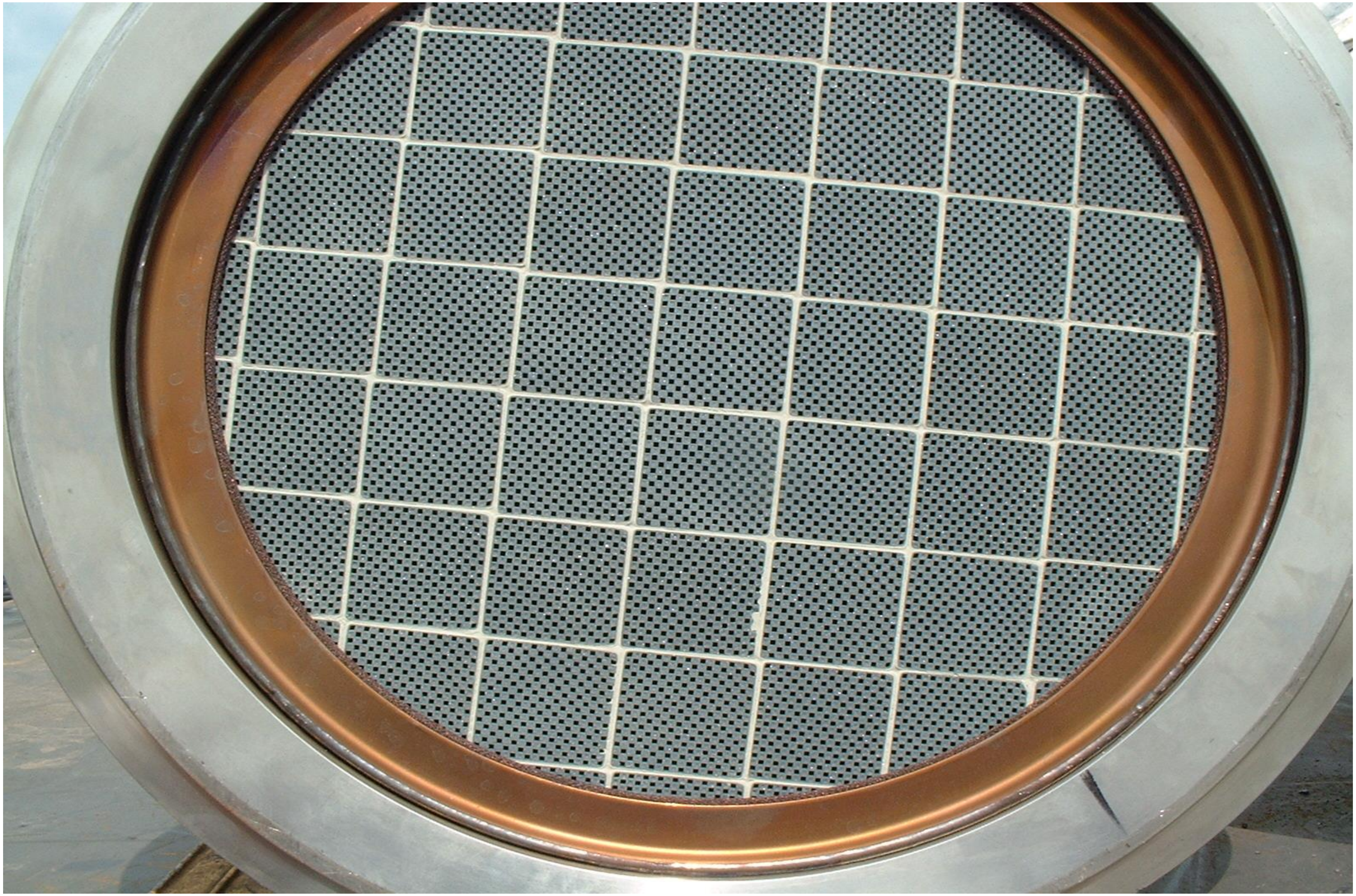
POROUS CERAMIC FILTER WALLS

TREATED EXHAUST GASES



INLET OF FILTER

EXHAUST SIDE OF FILTER



CERAMIC FILTER TYPES

PASSIVE

DPM WILL BURN OFF WHEN EXHAUST TEMPERATURES REACH 800 DEGREES FAHRENHEIT. EQUIPMENT WITH EXHAUST TEMPERTURES OF 800 DEGREES FOR 25% OF THE TIME CAN USE PASSIVE FILTERS. (TRACTORS AND SCOOPS ARE GOOD CANDIDATES)

ASSISTED

FILTER MUST BE TAKEN OFF THE MACHINE AND REGENERATED ON A CLEANING STATION (COOKER).

ACTIVE SYSTEMS ARE THE MOST COMMON

ACTIVE FILTER SYSTEMS ARE THE MOST COMMON AND ARE USED ON ALL A.L. LEE PERSONNEL CARRIERS AND FORK LIFTS. ACTIVE FILTERS SHOULD BE CLEANED EVERY
8 – 10 HOURS

HOW DO YOU KNOW WHEN TO CLEAN THE DPM FILTER?

- OBSERVE THE BACK PRESSURE GAUGE. THE DEUTZ BF4L2011 HAS A MAXIXMUM BACKPRESSURE OF 30” OF WATER. CHECK BACKPRESSURE BY SHIFTING TO NEUTRAL WITH ENGINE AT HIGH IDLE.
- THE FILTER SHOULD BE CLEANED WHEN THE BACKPRESSURE EXCEEDS 24”.
- IF THE BACKPRESSURE EXCEEDS 30” THE MACHINE WILL AUTOMATICALLY SHUT DOWN

DPM Filter Backpressure Gauge

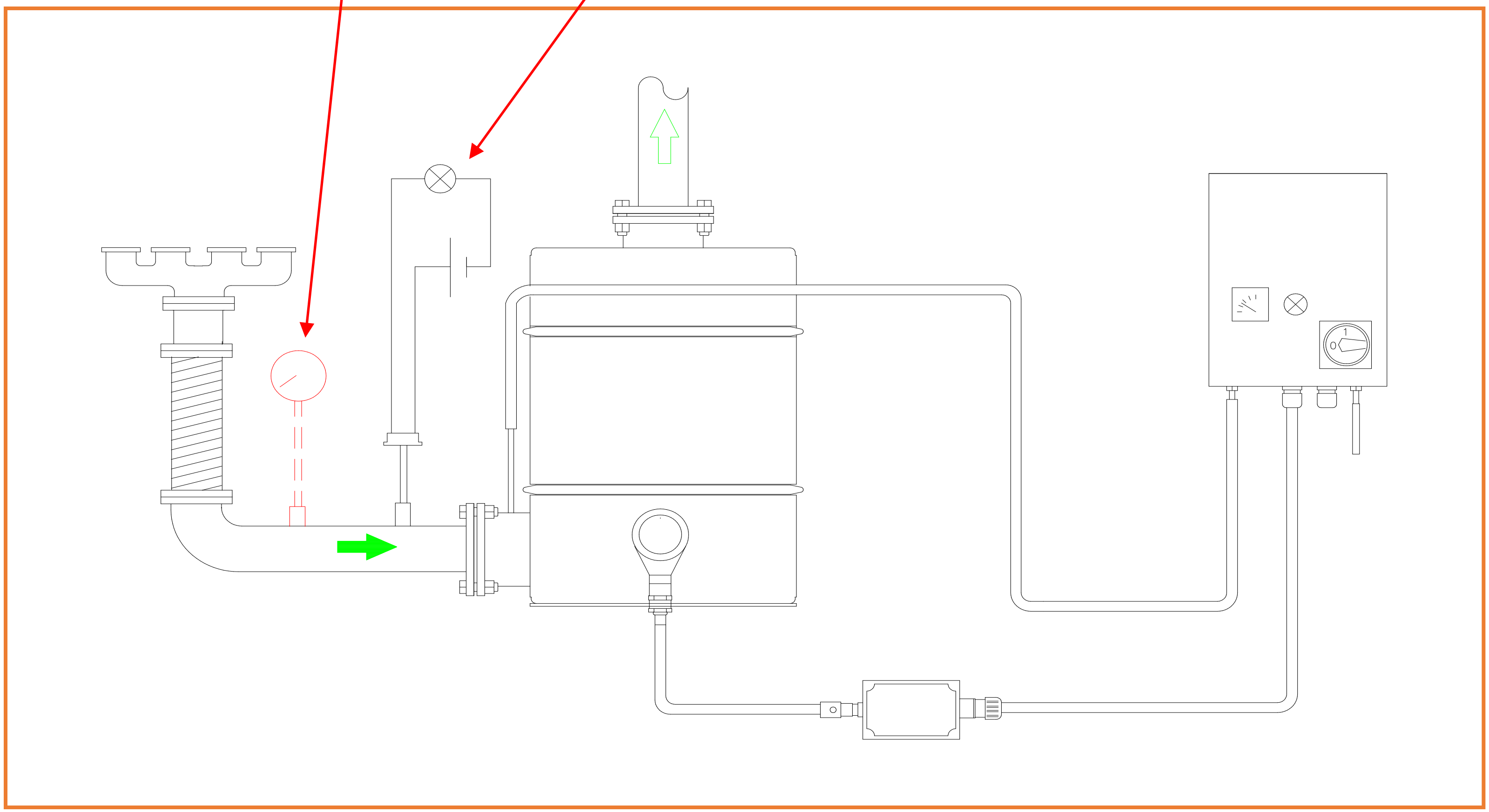
Limited to 30 inches H_2O (W.C.) Backpressure.

BACK-PRESSURE IS NOT LINEAR!

WHERE IS THE BACKPRESSURE MEASURED?

BACK PRESSURE GAUGE

BACK PRESSURE ALARM



A REGENERATION STATION IS USED TO CLEAN THE FILTER

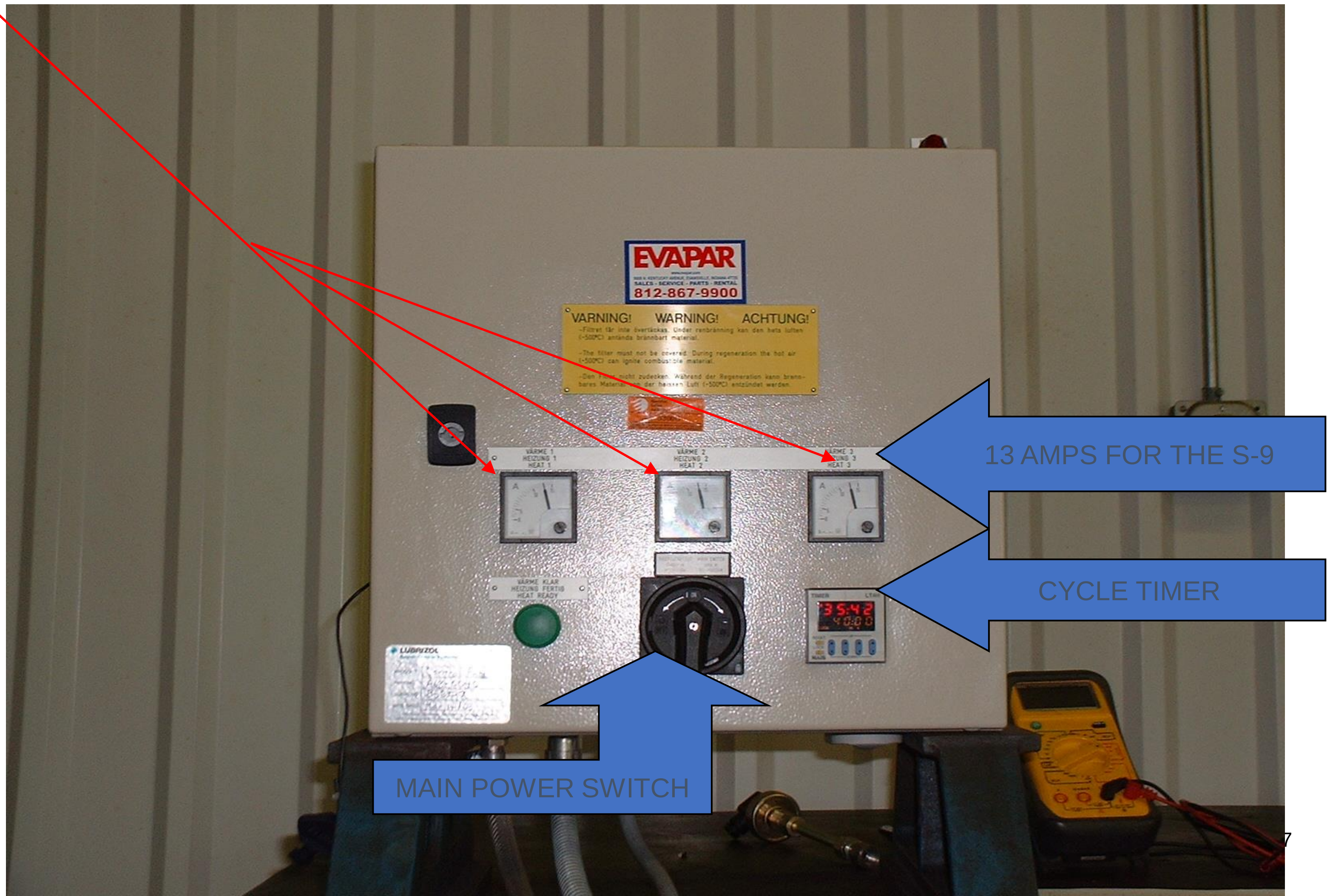
CONTROL PANEL- SUPPLIES POWER TO HEATER BASE

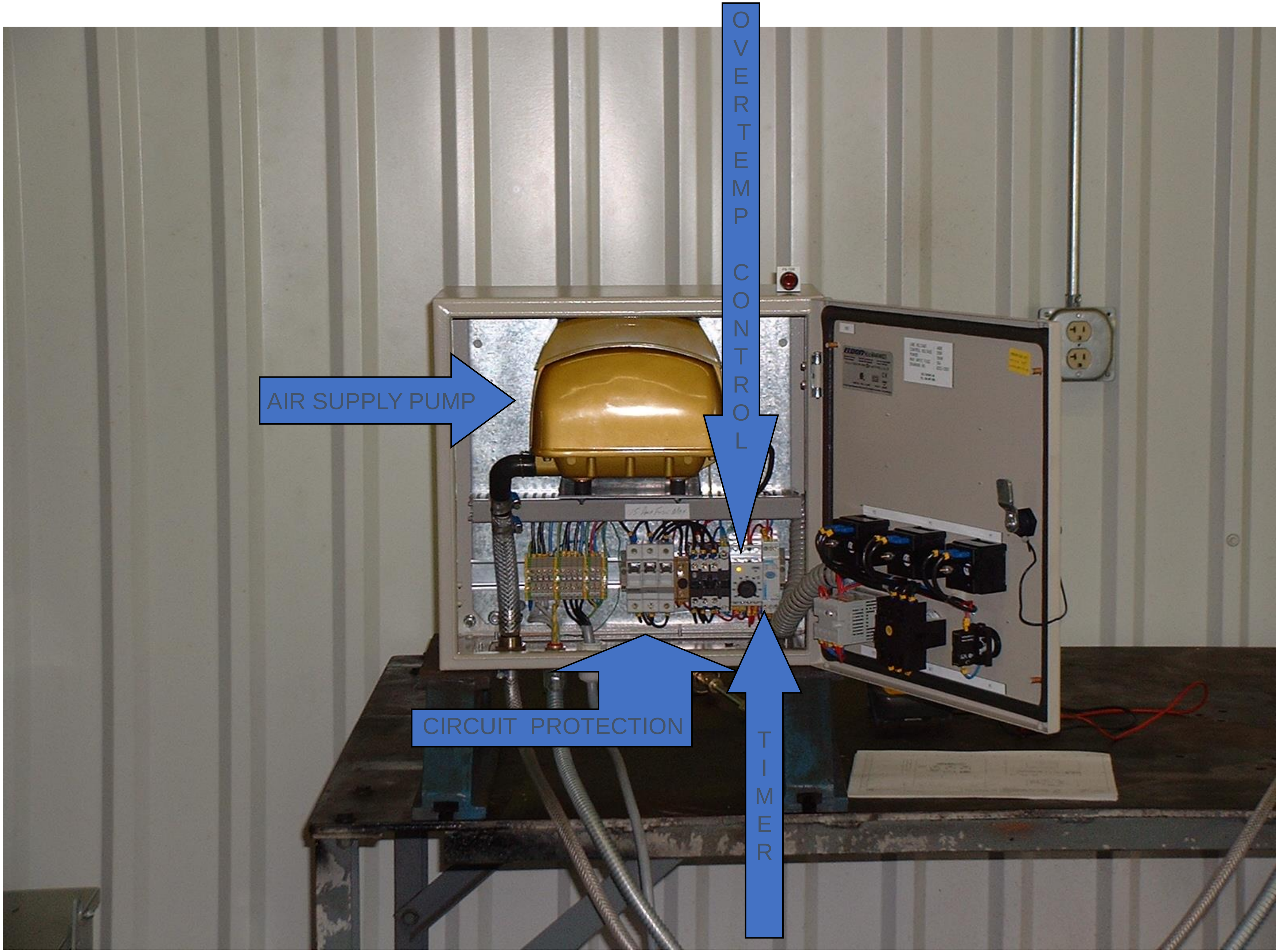
HEATER BASE -
CONSISTS OF 3 HEATER COILS

CONTROL PANEL

REGENERATION TAKES 1 HOUR FOR THE S-9 FILTER SYSTEM

EACH AMP GAUGE REPRESENTS A COIL IN THE HEATER BASE




OVERTEMP CONTROL
AIR SUPPLY PUMP
CIRCUIT PROTECTION
TIMER

COMBICLEAN CLEANING SYSTEM

AFTER REGENERATION FILTERS SHOULD BE BLOWN OUT 100 PSI - 6 INCHES FROM FILTER FACE

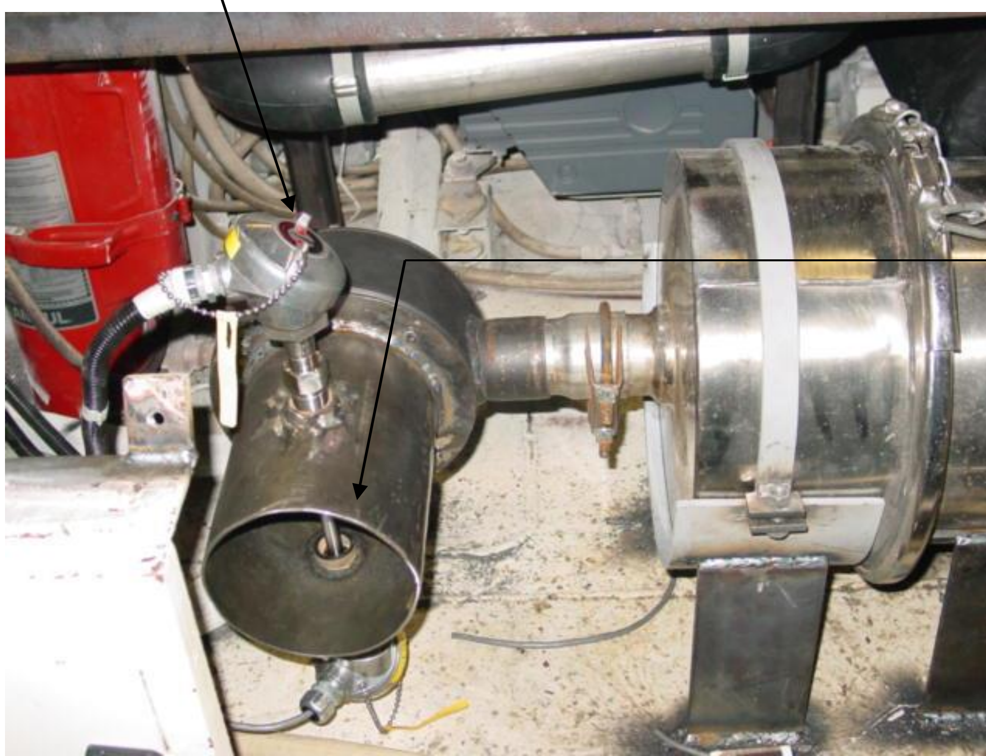
BLOW MATERAL INTO BAG!!

DO NOT USE HIGH PRESSURE WATER!!!!!!!!!

Exhaust Coolers

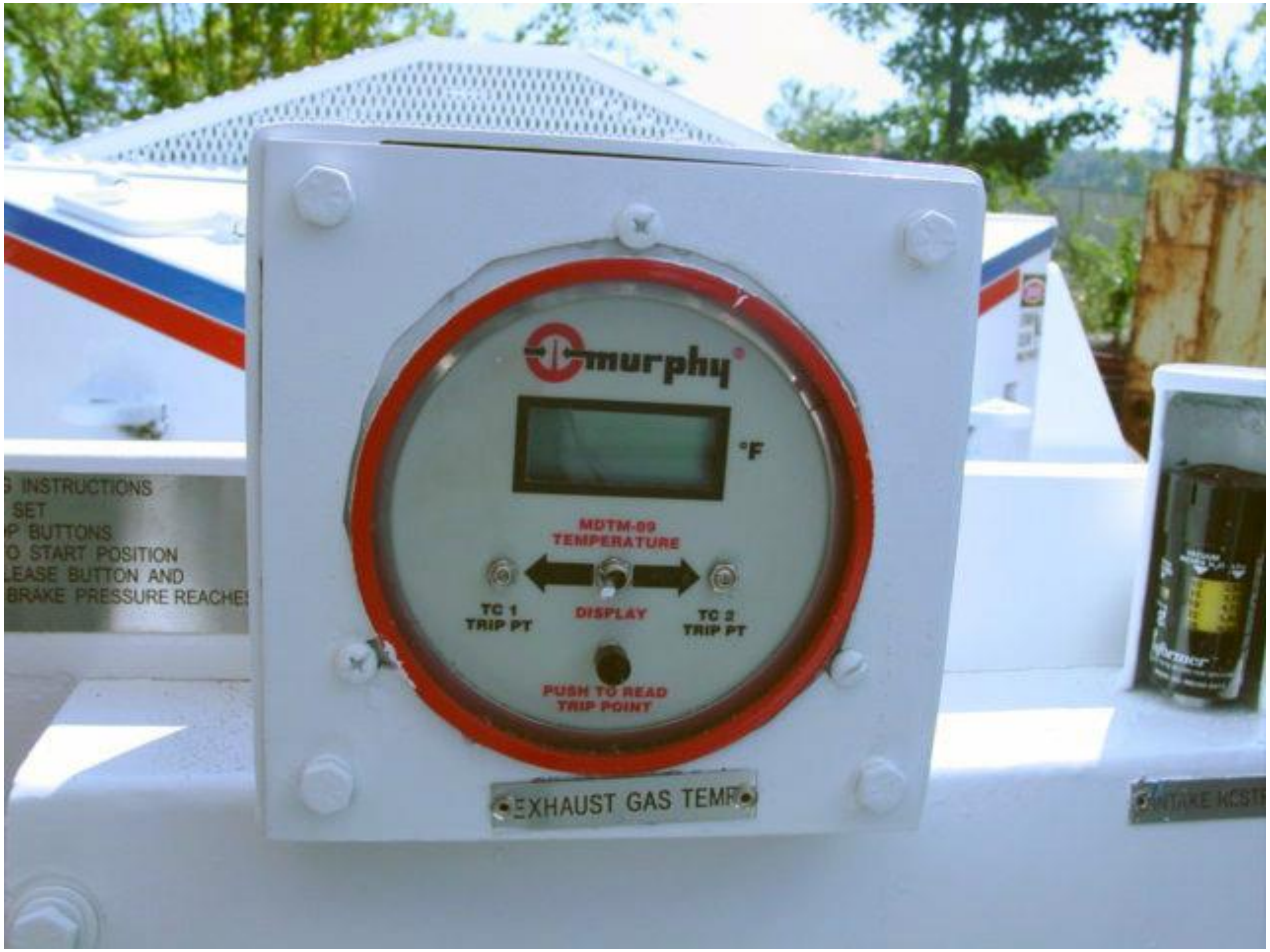
- Exhaust coolers (diffusers) operate off exhaust velocity, combining cool air with hot exhaust. Dirty DPM filters reduce the effectiveness of the cooler and can cause high exhaust temperature.

TEMPERATURE SENSORS



EXHAUST FLOW DIRECTION

EXHAUST TEMPERATURE GAUGE (302 DEGREES MAX.)



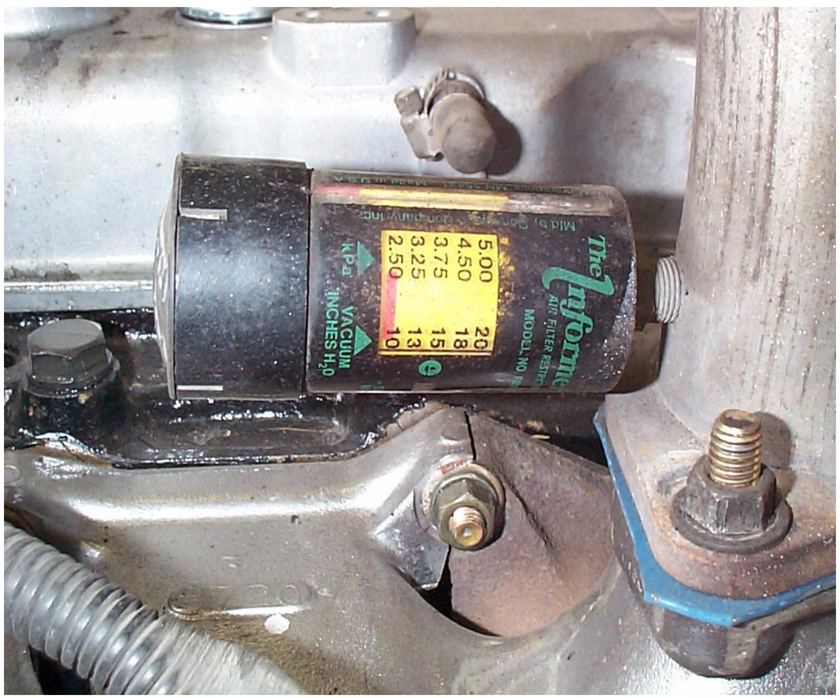
EXHAUST COATINGS

- A MILITARY COATING IS USED ON ALL OF A.L. LEE EXHAUST COMPONENTS TO KEEP THE SURFACE TEMPERATURE BELOW 302 DEGREES FAHRENHEIT.
- PAY CLOSE ATTENTION TO FLANGED AREAS AND BOLT HEADS. SINCE THESE ITEMS ARE NOT COATED HEAT ESCAPES RAPIDLY CAUSING LOOSENING OF BOLTS AND STRESS ON CONNECTIONS AND WELDED AREAS.

INTAKE RESTRICTION AND BACK PRESSURE GAUGES

(DEUTZ BF4L2011 ENGINE, 78 HP)

INTAKE RESTRICTION
20" CLEAN
26" DIRTY



BACKPRESSURE GAUGE
30" MAX.
CHANGE DPM FILTER AT 24"

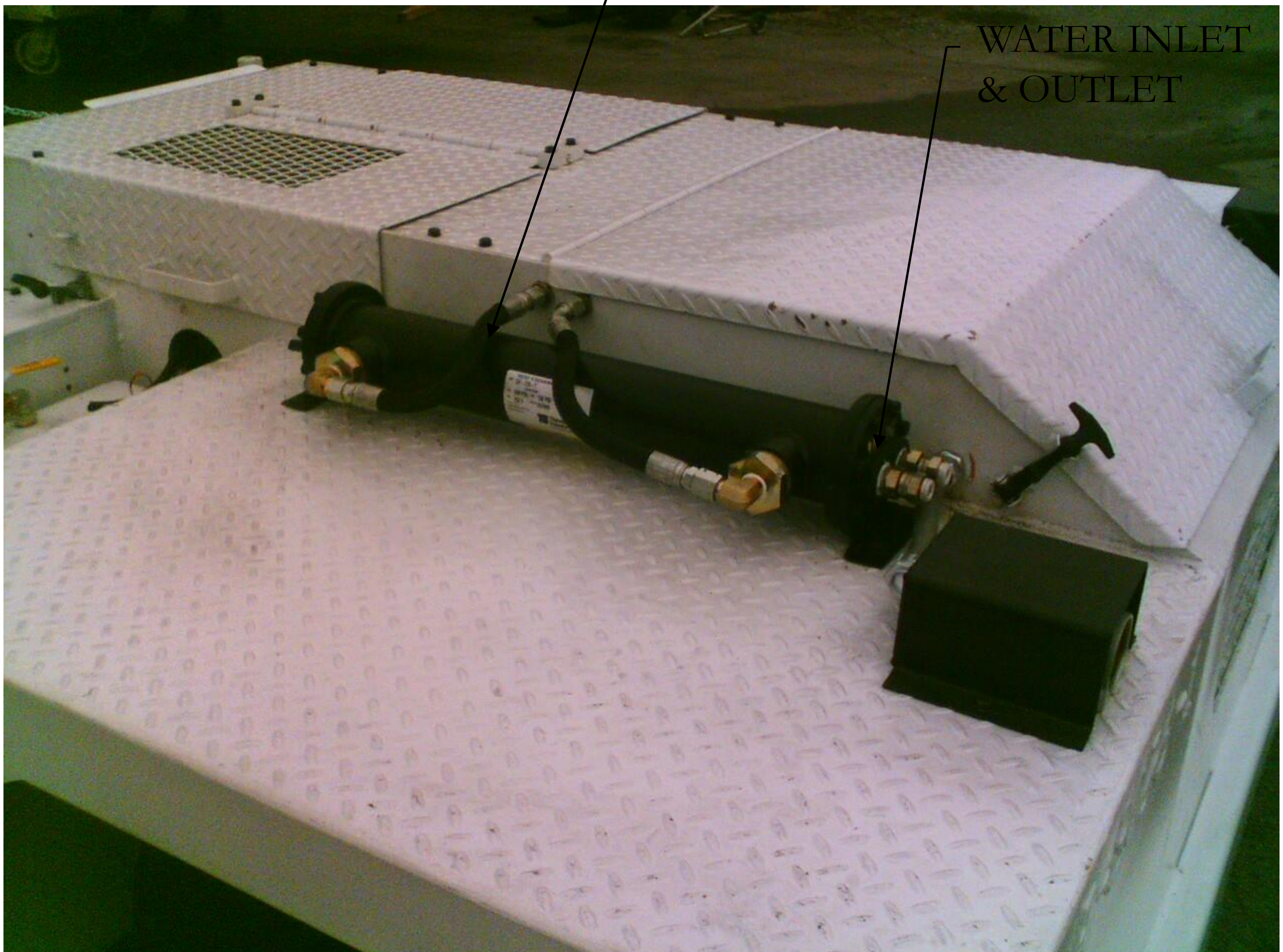
HYDROSTATIC LOAD TESTING

SOLENOID VALVE

RESISTANCE VALVE

SHELL COOLER

TORQUE CONVERTER LOAD TESTING COOLER



LOAD TEST

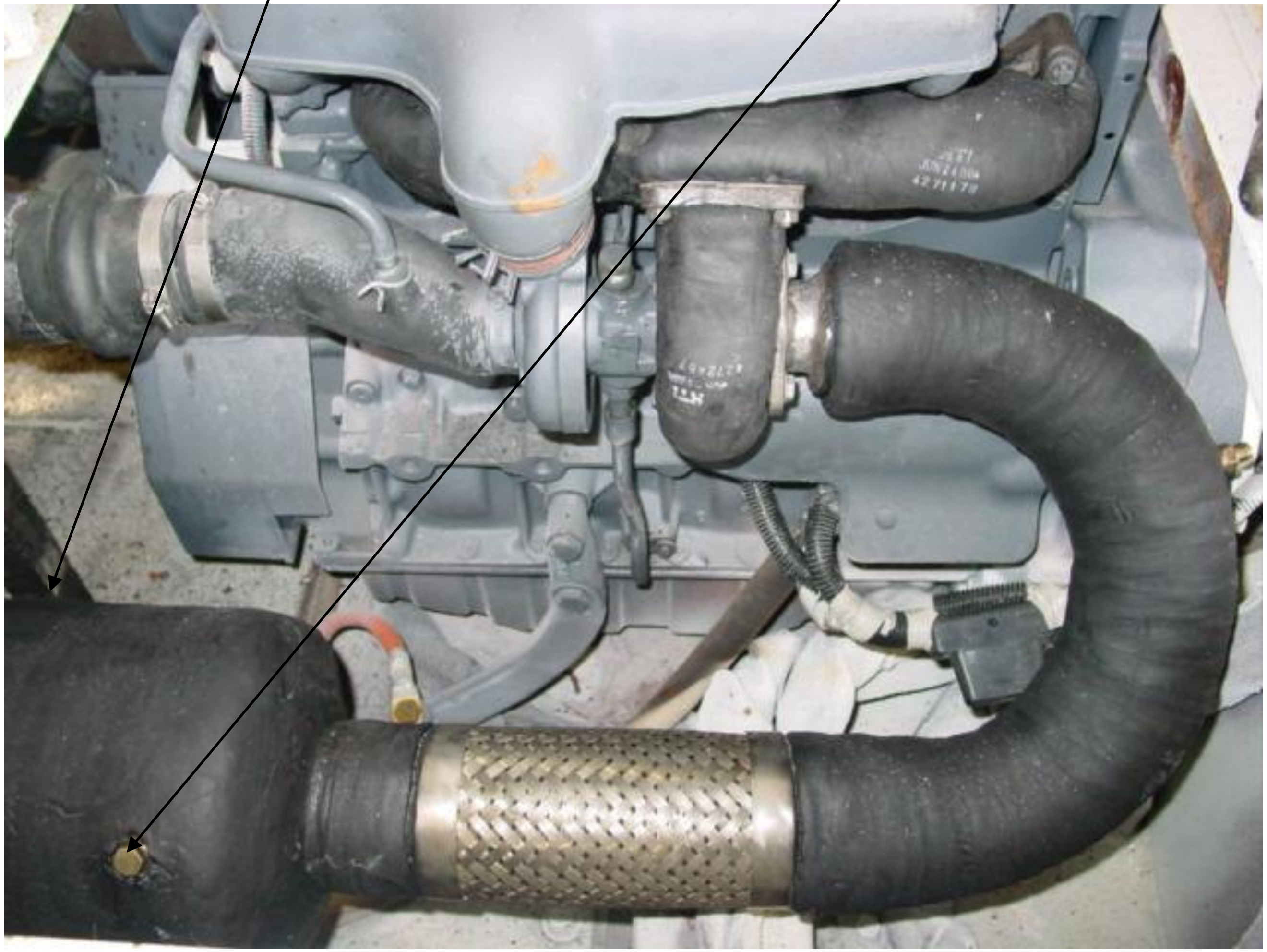
TEST PORTS IN THE OPERATOR DECK

A TREATED & UNTREATED SAMPLING PORT WITH QUICK DISCONNECTS
IS PROVIDED IN THE OPEATOR’S DECK FOR LOAD TESTING CONVENIENCE

UNTREATED PORT

OXIDATION CATALYST

UNTREATED EXHAUST PORT



TREATED EXHAUST PORT

LOCATE THE TREATED SAMPLING PORT 3 TO 4 TIMES THE DIAMETER OF THE EXHAUST PIPE FROM THE END OF THE PIPE.

TREATED SAMPLING PORT

AMBIENT EXHAUST READINGS SHOULD NOT EXCEED THE LIMITS LISTED BELOW

- Carbon Monoxide (CO TLV -- 35 ppm Action Level- 75% - 26 ppm
- Nitric Oxide (NO) TLV-- 25 ppm Action Level- 75% - 19 ppm
- Nitrogen Dioxide (NO2) TLV -- 3 ppm Action Level- 75% - 2 ppm

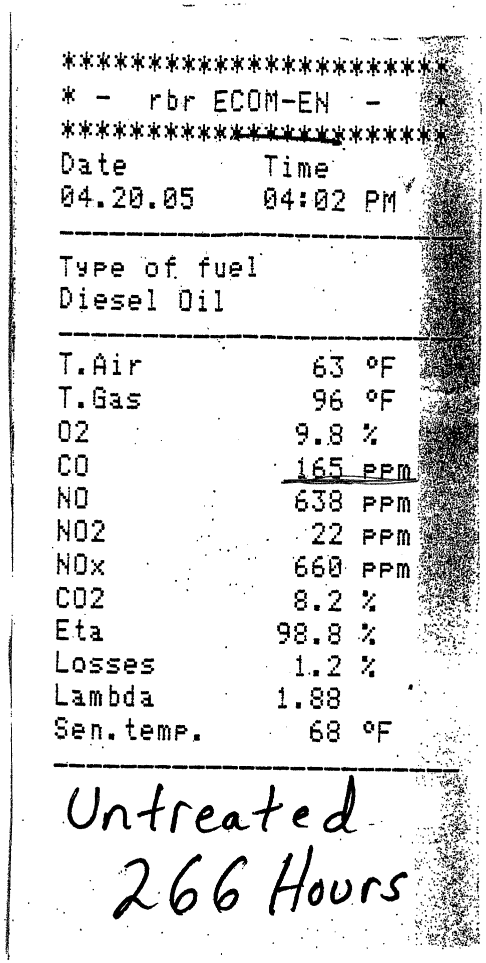
PROBLEMS EXPERIENCED IN THE FIELD

HIGH CO DURING BREAK-IN AND OIL CONSUMPTION

- Higher than normal CO levels can be expected during the first 100 hours of operation.
- Deutz engines CAN take between 500 and 700 hours before normal oil consumption is achieved.
- Normal oil consumption for Deutz engines is between .3% and .75% of the fuel consumption at part load.
- Measure the amount of oil consumed in one full tank of fuel, divide the gallons of fuel into the gallons of oil.

Example: (.25 gallon oil / 20 gallon fuel) x 100 = 1.25%

WHAT WOULD CAUSE THIS HIGH CO READING?



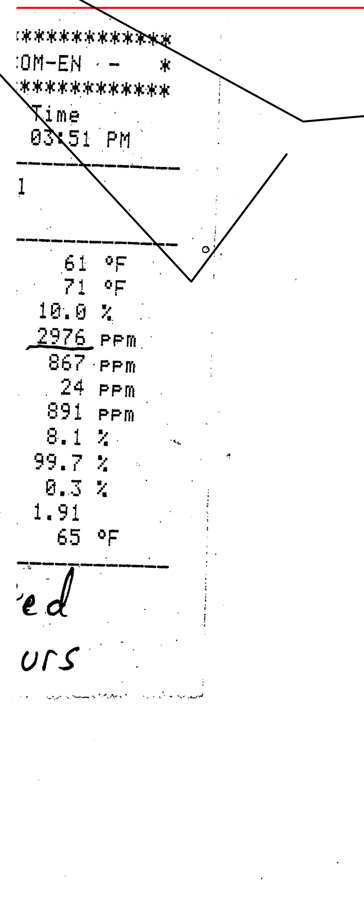
****
* - rbr ECOM-EN - *
****

Date	Time
04.20.05	04:02 PM

Type of fuel
Diesel Oil

T.Air	63 °F
T.Gas	96 °F
O2	9.8 %
CO	165 ppm
NO	638 ppm
NO2	22 ppm
NOx	660 ppm
CO2	8.2 %
Eta	98.8 %
Losses	1.2 %
Lambda	1.88
Sen.temp.	68 °F

Untreated
266 Hours



****
OM-EN - *
****
Time
03:51 PM

61 °F
71 °F
10.0 %
2976 ppm
867 ppm
24 ppm
891 ppm
8.1 %
99.7 %
0.3 %
1.91
65 °F

ed
urs

HIGH CO SHOWN ON TREATED AND UNTREATED (NOTICE TREATED CO EXCEEDS 100 PPM)

```
**********************
* -  rbr ECOM-EN  -  *
**********************
Date          Time
04.27.05      03:51 PM
------------------------
Type of fuel
Diesel Oil
------------------------
T.Air             61  °F
T.Gas             71  °F
O2              10.0  %
CO              2976  ppm
NO               867  ppm
NO2               24  ppm
NOx              891  ppm
CO2              8.1  %
Eta             99.7  %
Losses           0.3  %
Lambda          1.91
Sen.temp.         65  °F
------------------------
```

Untreated
280 Hours

```
**********************
* -  rbr ECOM-EN  -  *
**********************
Date          Time
04.28.05      03:22 PM
------------------------
Type of fuel
Diesel Oil
------------------------
T.Air             70  °F
T.Gas            782  °F
O2              10.0  %
CO               135  ppm
NO              1155  ppm
NO2               41  ppm
NOx             1196  ppm
CO2              8.1  %
Eta             74.5  %
Losses          25.5  %
Lambda          1.91
Sen.temp.         70  °F
------------------------
ECOM America Ltd.
1628 Oakbrook Drive
Gainesville
Georgia 30507
Tel. 770-532.3280
Fax: 770-532.3620
Toll-Free 877-326-6411
www.ecomusa.com
```

Treated
280 Hours

CHECK AIR FILTER

- HIGH CO INDICATED A RICH FUEL MIXTURE
- THE INTAKE AIR RESTRICTION WAS 15” (26” IS MAXIMUM) WHICH WAS FINE. AIR FILTER WAS CHECKED AND APPEARED CLEAN BUT WAS CHANGED AS A PRECAUTION.
- A 3RD TEST WAS RAN WITHOUT AIR FILTER AND THE CO CAME DOWN FROM 2,976 PPM TO APPROXIMATLEY 2,700 PPM WHICH IS NOT ACCEPTABLE

CHECK 100 HOUR SERVICE, PRE-OP AND WEEKLY SERVICE MANUALS FOR INDICATION OF A PROBLEM

- RECORDS DID NOT INDICATE EXCESSIVE OIL CONSUMPTION
- SERVICE RECORDS INDICTED A 100 HOUR SERVICE AT 200 HOURS.
- THE CO WAS WITHIN RANGE AT 200 HOURS
- ALL FLUIDS WAS CHANGED AT 200 HOURS
- THE AIR FILTER WAS CHANGED AT 200 HOURS
- **THE OIL FILTER WAS NOT CHANGED AT 200 HOURS**
- **THE FUEL FILTER WAS NOT CHANGED AT 200 HOURS**

FUEL FILTER

- A DIRTY FUEL FILTER WOULD ACTUALLY CREATE A LEAN FUEL SITUATION, CAUSING A LOWER THAN NORMAL CO LEVEL.
- THE FUEL FILTER WAS CHANGED AS A PRECAUTION. THE LOAD TEST WAS PERFORMED AGAIN WITH NO CHANGE IN THE CO.

OIL AND OIL FILTER

- THE OIL AND OIL FILTER WAS CHANGED.
- THE LOAD TEST WAS DONE ONCE AGAIN WITH THE FOLLOWING RESULTS.

THE CO CAME DOWN FROM 2,976 PPM TO 112 PPM

BEFORE OIL & FILTER WAS CHANGED

```
**********************
* -  rbr ECOM-EN  -  *
**********************
Date          Time
04.27.05      03:51 PM
```

Type of fuel
Diesel Oil

T.Air	61	°F
T.Gas	71	°F
O2	10.0	%
CO	2976	ppm
NO	867	ppm
NO2	24	ppm
NOx	891	ppm
CO2	8.1	%
Eta	99.7	%
Losses	0.3	%
Lambda	1.91	
Sen.temp.	65	°F

Untreated
280 Hours

AFTER OIL & FILTER WAS CHANGED

```
**********************
* -  rbr ECOM-EN  -  *
**********************
Date          Time
04.28.05      04:31 PM
```

Type of fuel
Diesel Oil

T.Air	68	°F
T.Gas	67	°F
O2	10.1	%
CO	112	ppm
NO	1097	ppm
NO2	42	ppm
NOx	1139	ppm
CO2	8.0	%
Sen.temp.	65	°F

Untreated
280 Hours

IT WAS DETERMINED THAT THE DIRTY OIL FILTER CAUSED THE HIGH CO LEVEL. WHY?

- AS THE OIL FILTER BECOMES DIRTY, OIL IS ALLOWED TO BYPASS AROUND THE FILTER TO PROTECT THE ENGINE.
- HYDROCARBONS FROM THE UNFILTERED OIL ESCAPES THROUGH THE RINGS ON THE PISTON AND CREATES AN EXTREMELY HIGH CO CONDITION.

REASONS FOR HIGH CO

- DIRTY AIR FILTER
- DIRTY OIL AND/OR OIL FILTER
- WRONG TYPE OF FUEL
- EXCESSIVE OIL CONSUMPTION
- DPM FILTER INSTALLED BACKWARDS
- DEFECTIVE CATALYST
- INJECTOR PROBLEMS

Who is DST®

Dry Systems Technologies®

DST® is the Leading Manufacturer of Diesel Power Packages for Underground Coal Mines.

DST® exclusively Manufactures and sells the patented "Dry System®" and Low Temperature Exhaust Filtration System.

DST® Offices and Warehouses are located in Woodridge, Illinois and DST® is represented on three Continents.

Dry Systems Technologies®

The Original – and still the Best™

Dry Systems® are designed and manufactured in the USA and available directly from the manufacturer.

More than 300 DST Dry Systems® are in operation at more than 30 mines worldwide with more than 1,000,000 hrs incident free operation.

Dry Systems® have been in continuous service since 1992 and some have accumulated more than 25,000 operating hours.

Dry Systems® are MSHA Approved for Inby and Outby use in underground Mines and Tunnels.

Dry Systems® are available for many older and new Mining Engines from 35 to 350 Hp.

What is the Dry System®

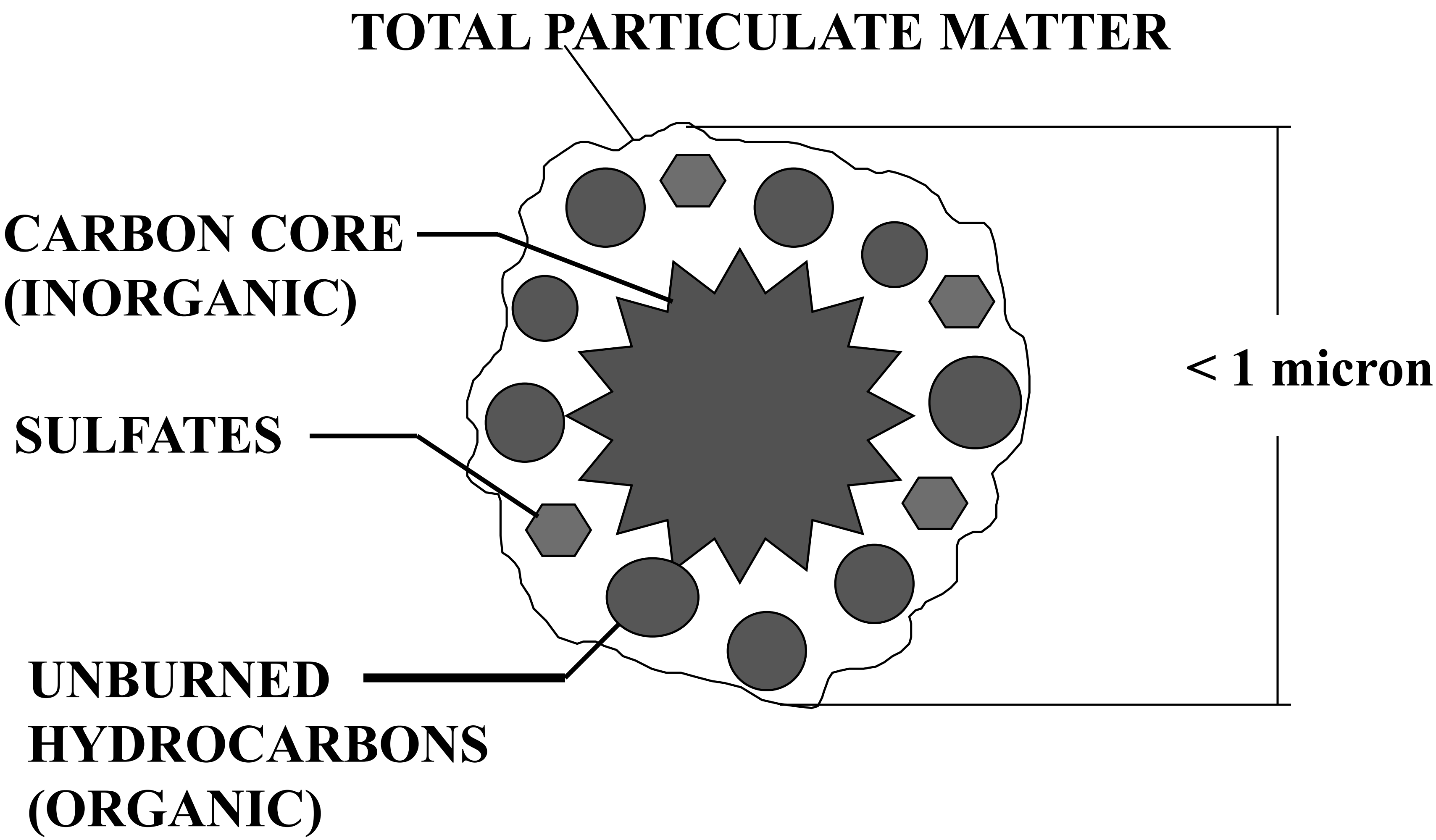
The Dry System® is the most efficient and economical Technology for Mining to reduce DPM from Diesel Engines.

The Dry System® is a safe and maintenance friendly replacement for Water Scrubbers and meets all current and proposed MSHA Regulations.

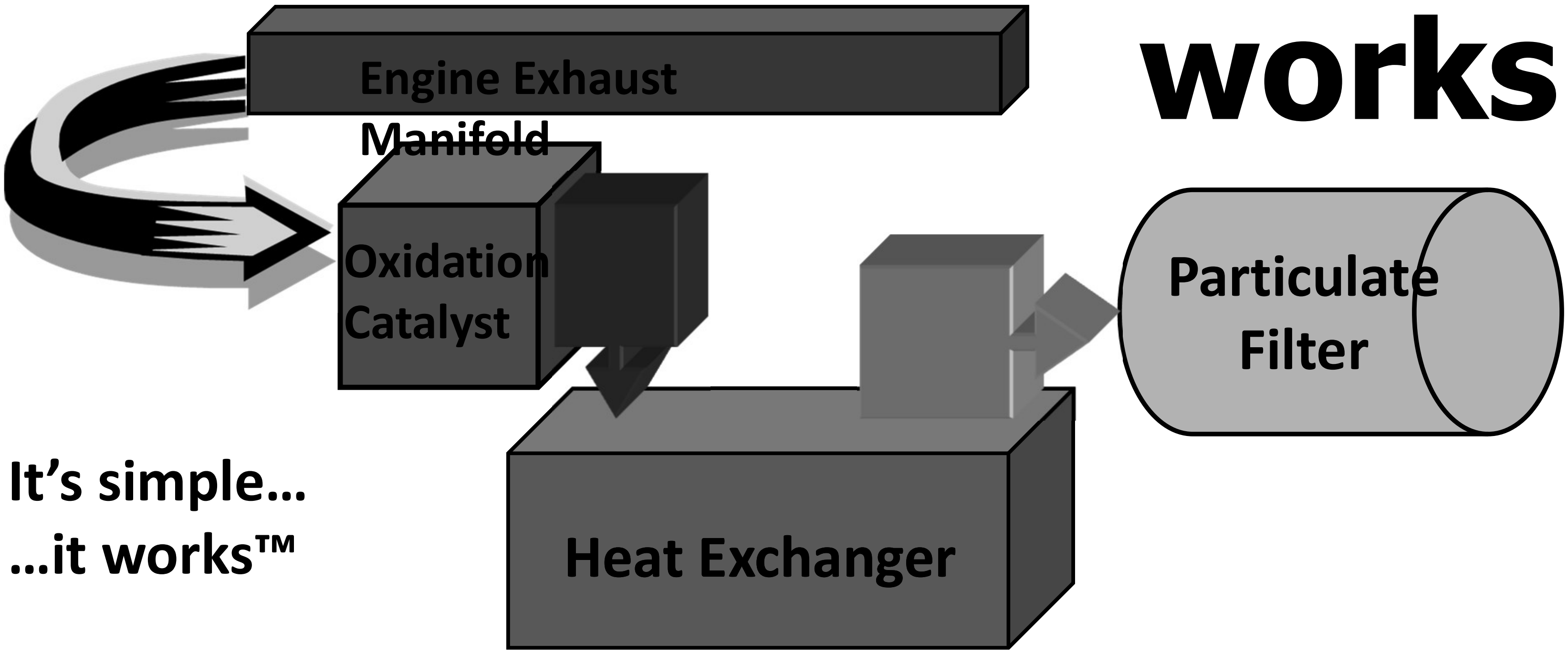
The Dry System® is an economical and proven alternative to Particulate Traps for Outby Equipment in Mining.

The Dry System® is manufactured and marketed exclusively by Dry Systems Technologies®.

DPM COMPOSITION



How the Dry System® works



It's simple…
…it works™

Unmatched Performance

- 96% DPM Removal
- 90% CO Reduction
- 97% SO2 Removal
- No Increase of NOx

APPROVED AND OPERATING ON THREE CONTINENTS

Main Components of the Inby (Part 7F) Dry System®

- **Water-cooled Oxidation Catalyst**
- **Water-cooled Heat Exchanger**
- **Mechanical Intake and Exhaust Flame Arrestor**
- **Low Temperature Particulate Filter (DPF)**
- **Integrated Cooling System**
- **Water-cooled Exhaust Manifold**
- **Complete Safety Shut-down System and Gauges**
- **CO Monitoring Port**
- **Onboard Cleaning System**

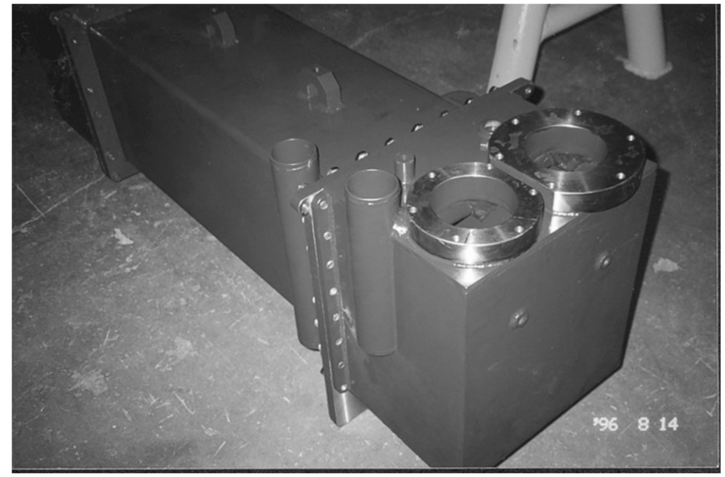
The DST® water-cooled Oxidation Catalyst

The DST water-cooled Catalyst uses a proprietary formulation and heat shielding specially developed for the needs of the Mining Industry.

The DST Catalyst reduces 90% Carbon Monoxide (CO), 80% Unburned Hydrocarbons from Fuel and Oil (HC) and removes Diesel Odors.

The DST Catalyst is formulated that it will not increase in Oxides of Nitrogen.

The DST® Heat Exchanger



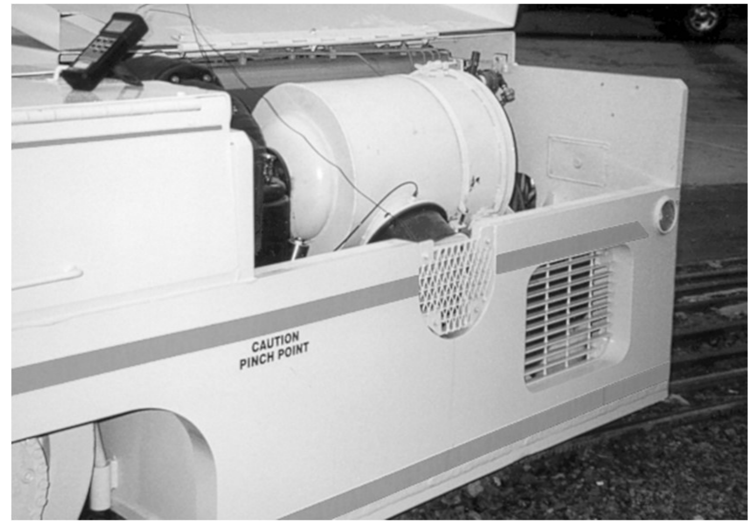
Cools the Exhaust Gas to 260°F before entering the Low Temperature Filter.

Can be sized to fit tight spaces and can be remotely mounted into existing Equipment.

Cooled through the Engine Cooling or a separate Cooling System.

Incorporates an On-Board Cleaning System to prevent fouling.

The DST® Low Temperature Diesel Particulate (DPM) Filter



- **DST® Filters are manufactured and stocked in Illinois.**
- **Three sizes match a wide range of Engines.**
- **Unique construction for superior Filter Life**
- **Filter cost to operate is very competitive**
- **Disposable without special requirements and minimizes exposure during handling.**
- **Will not generate smell from off-gasses.**

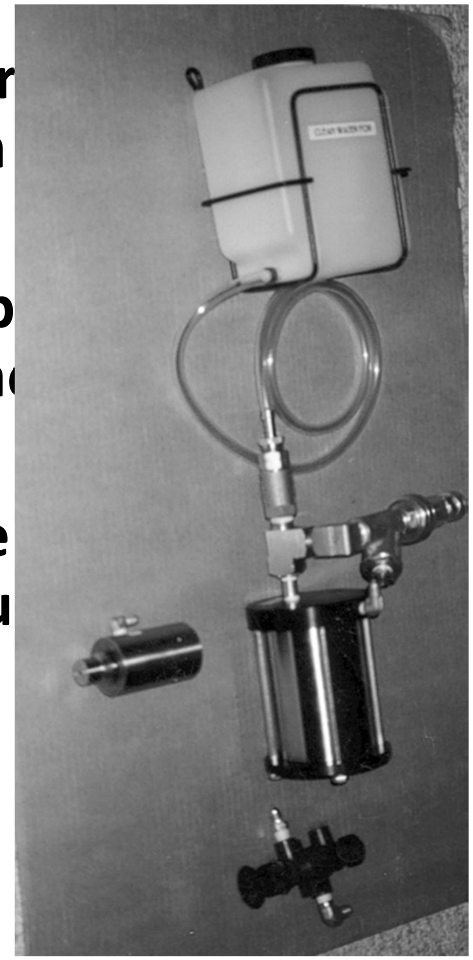
On-board Cleaning System™

The patented On-Board Cleaning System r
Soot build-up inside the Exhaust System
operation.

It is activated with a Cab mounted Knob b
Operator without having to stop the Ma
operation.

It uses compressed air, hydraulic pressure
electric power and uses less than one cu
clean water/day.

The On-Board Cleaning System generates
Emissions and can be used anytime and
anywhere in the Mine

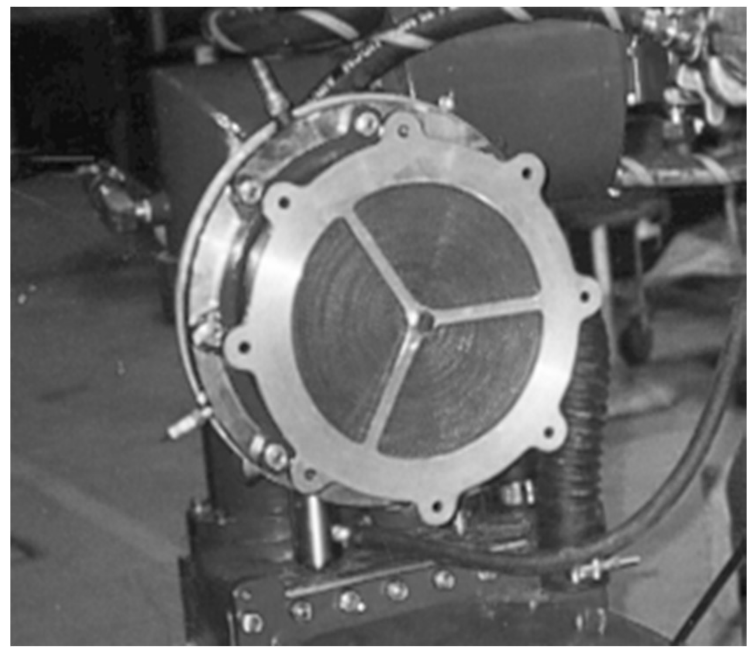


In-Cab CO Monitoring

- **Convenient Location**
- **No second Person needed for Test**
- **No Ports to remove**
- **MSHA Approved to meet Part 75.1914**
- **Uses handheld CO Monitors**

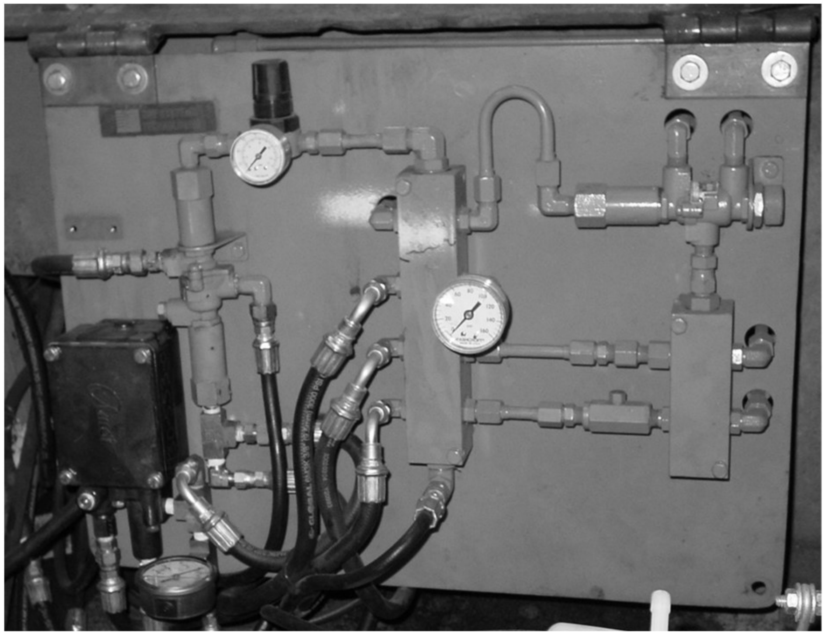
Mechanical Flame Arrestor
for Intake and Exhaust System

- **Mechanical Design with no moving Parts**
- **Large openings limit fouling**
- **MSHA tested and Approved**



The DST® Safety Shut-down System

- **Simple, reliable pneumatic and mechanical components**
- **Modular control Panel**
- **Calibration only every six months**



DST MANAGEMENT SYSTEM™

A DIESEL EMISSIONS CONTROL SYSTEM

- **THE DST MANAGEMENT SYSTEM™ IS A COMPLETE PACKAGE, NOT AN ADD-ON COMPONENT.**
- **AS A COMPLETE PACKAGE, ALL COMPONENTS ARE TUNED TO WORK TOGETHER FOR MAXIMUM REDUCTIONS OF ALL EMISSIONS.**
- **THE DST MANAGEMENT SYSTEM™ WILL PROVIDE SIGNIFICANT REDUCTION OF ALL DIESEL EMISSIONS UNDER ALL OPERATING CONDITIONS.**

DST Management System™

- **A SPECIALLY FORMULATED OXIDATION CATALYST REMOVES UP TO 90% OF THE UNBURNED HYDROCARBONS AND DRIES THE SOOT FOR BETTER FILTER PERFORMANCE. THE CATALYST ALSO REMOVES MOST OF THE DIESEL ODOR**

- **RAPID EXHAUST GAS COOLING INSIDE THE HEAT EXCHANGER ENCOURAGES AGGLOMERATION OF THE SMALL SOOT PARTICLES INTO LARGER PARTICLES THAT ARE EASIER TO CAPTURE IN THE FILTER**

- **THE DISPOSABLE PAPER FILTER CAPTURES MORE THAN 96% OF ALL PARTICULATE MATTER UNDER ALL OPERATING CONDITIONS**

- **SULFATES FROM THE FUEL SULFUR, ADHERE TO THE CARBON CORE OF THE DIESEL PARTICULATES AND ARE CAPTURED IN THE FILTER**

DST Management System™

- A SPECIALLY FORMULATED OXIDATION CATALYST PROVIDES FOR UP TO 96% REDUCTION IN CARBON MONOXIDE BEFORE DISCHARGE.

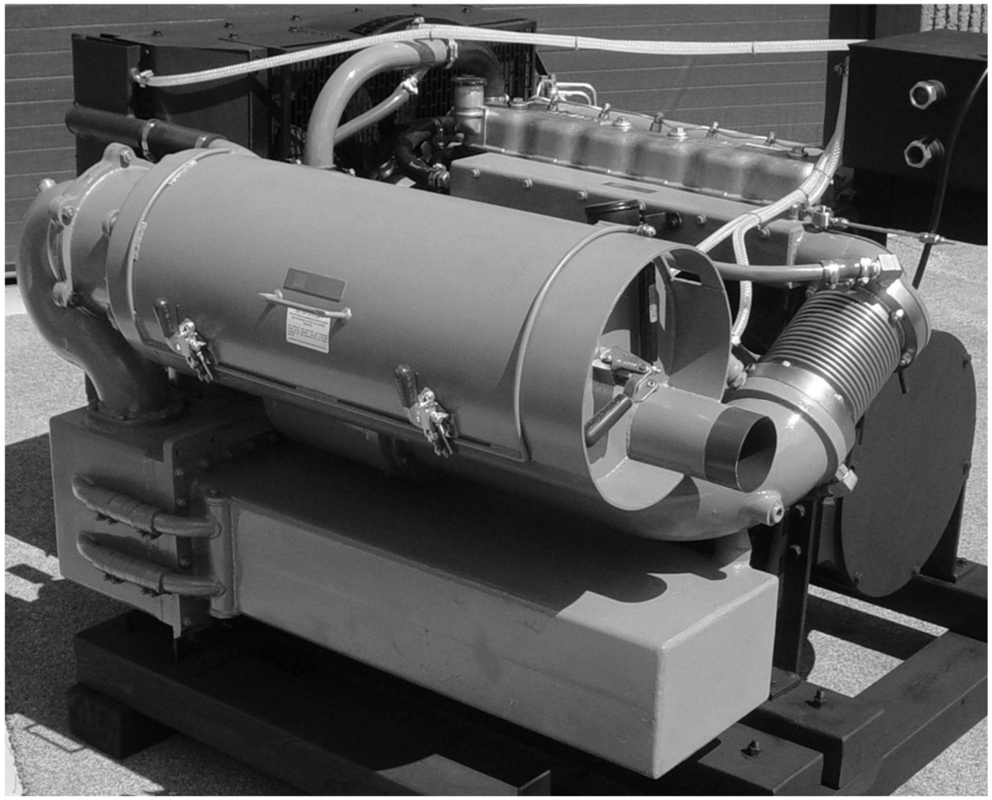
- RAPID EXHAUST GAS COOLING INSIDE THE HEAT EXCHANGER LIMITS THE FORMATION OF NITROGEN DIOXIDE.

- FINAL DILUTION WITH THE AIR FROM THE COOLING FAN AWAY FROM THE OPERATOR PROVIDES FOR LOW AMBIENT LEVELS OF OXIDES OF NITROGEN AND CO NEAR THE MACHINE AND PREVENTS ACCUMULATION OF EMISSIONS AROUND THE OPERATOR.

DST Maintenance Requirements

- **Manually activate water injection system under engine full load at least once each operating shift**
- **Observe recommended engine exhaust backpressure**
- **Observe recommended engine intake restriction**
- **Change exhaust and intake filters when indications warrant**
- **Manually flush heat exchanger as needed**
- **Weekly permissibility required**

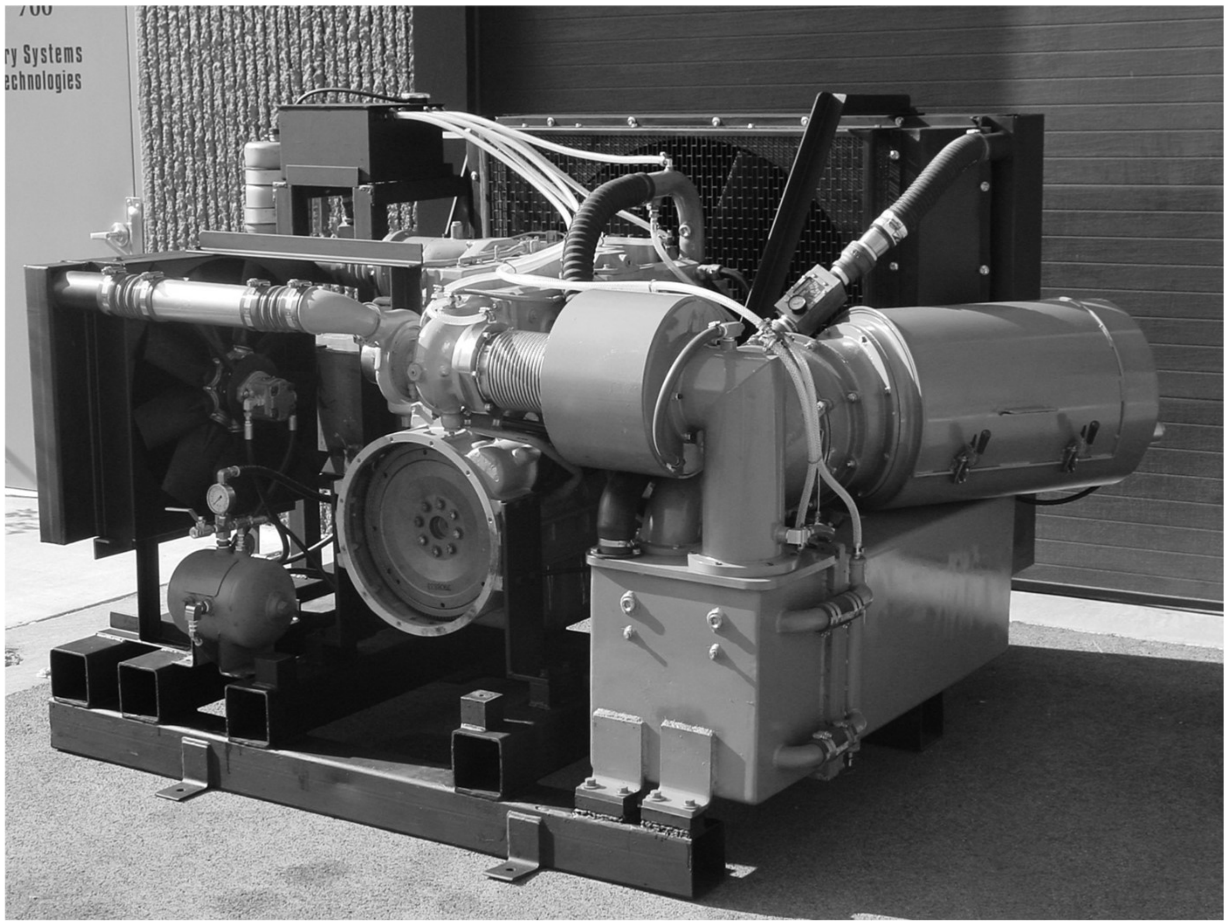
Engine: MSHA Part 7E-A006 Approved
Power Package: MSHA Part 7F -021-0 Approved



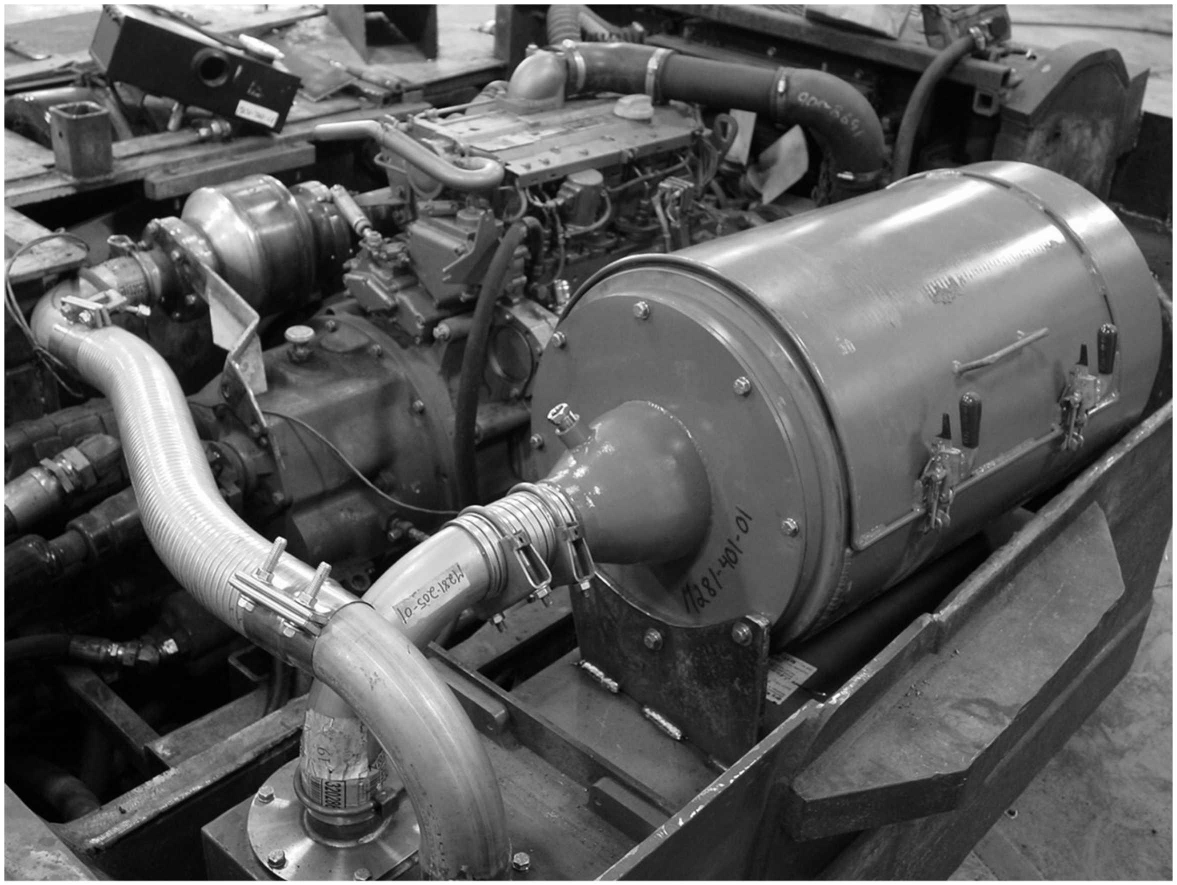
M150 DST Dry System® Diesel Power Package installed on a 116 Hp Isuzu 6BG1 Diesel Engine

Jeffrey 4110 Ramcar re-powered and rebuilt by DST®

185 Hp Cummins C8.3 Engine with Dry System® installed



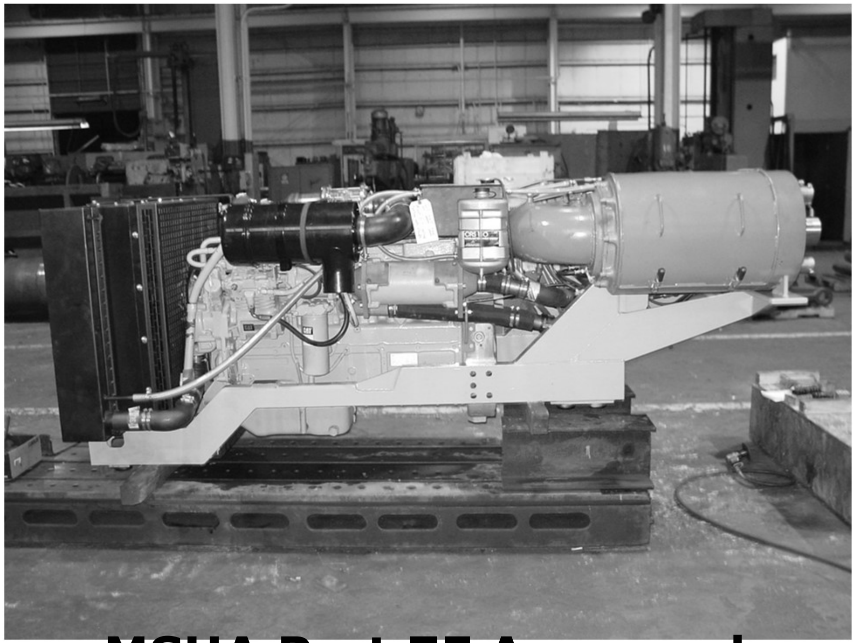
Outby Dry System® installed on a 113 Hp Deutz BF4M 1012 engine



Heavy Duty Outby System operating in Kentucky

DRY SYSTEMS TECHNOLOGIES®

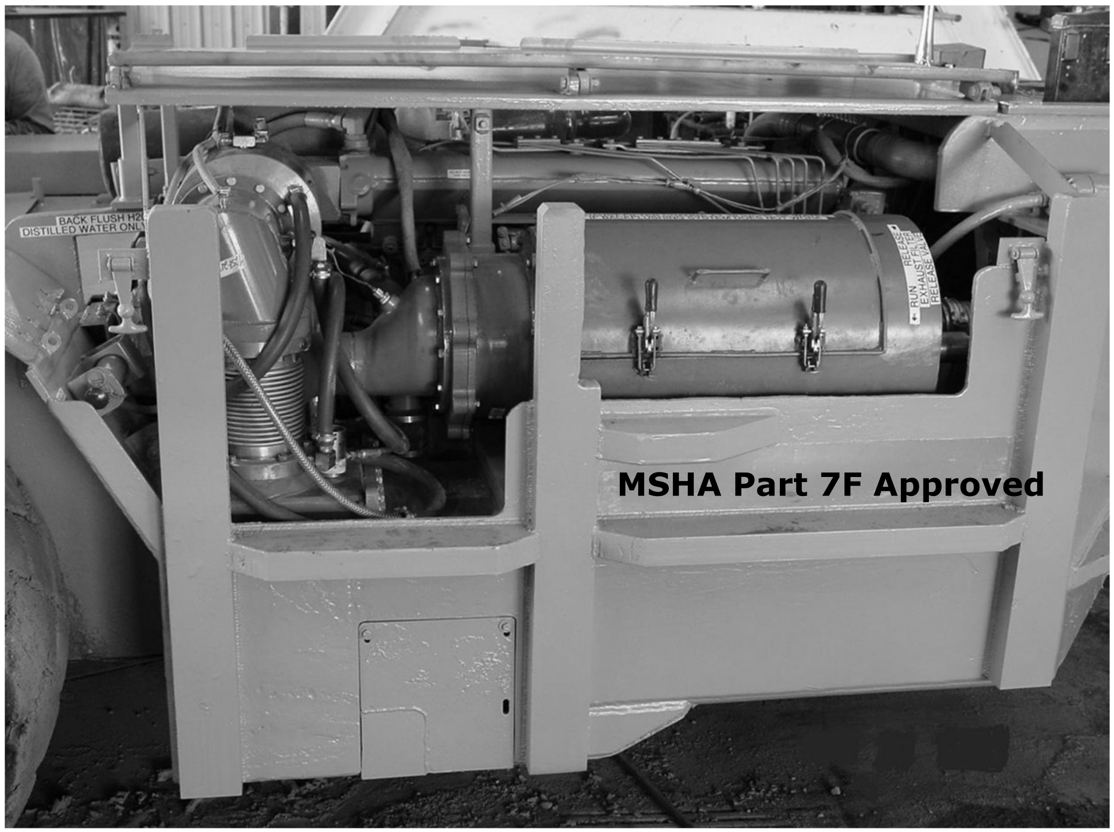
Dry System® installed on a Goodman Locomotive with a 150 Hp Caterpillar 3306 PCNA Engine



MSHA Part 7F Approved

Operating in California since 2001

Dry System® installed on a Wagner LST-5S Scoop with 150 Hp Caterpillar 3306 Engine



Operating in New Mexico, Colorado, Illinois and West Virginia since 2003

WV MINING COMPANY, INC
No.1 Mine

PERMIT NO. U-000-09

DIESEL PLANS AND APPLICATION FOR

1- Damascus Mac-10D WV Personnel Carrier

ENGINE # 1

January 12, 2009

SAMPLE PERMIT

West Virginia Diesel Commission

Application for Underground Diesel Equipment Approval

Instructions:

- **For each piece of Diesel Equipment submitted, a completed Inventory Sheet, DPM Calculation Sheet and 8-Mode Test Sheet shall accompany the submittal.**
- **A Maintenance or Training Plan need not be submitted with each request once the initial Maintenance or Training Plan is approved by the WV Diesel Commission. In cases where an approved Maintenance or Training plan(s) exist, a statement in the submittal stating that the approved plans exists for the specific mine ID and referenced initial approval date of the respective plan(s).**
- **A cover letter addressed to the WV Diesel Commission c/o the Administrator shall accompany the submittal and outline the nature of the request.**
- **A picture (if possible) of the equipment is desired with the submission**
- **The operator will submit the plans to the Administrator, for distribution to the parties responsible for reviewing the package and subsequent recommendation for approval to the WV Diesel Commission.**
- **Upon the recommendation for approval and final review, the Diesel Commission will issue an Order of Approval allowing the equipment to be placed into service.**

NOTE: To obtain Diesel Inventory, Maintenance, and Training forms go to www.wvminesafety.org click on forms (Left side of screen), then click on Diesel Forms (Middle of screen).

WV MINING COMPANY, INC
No.1 Mine
January 12, 2009

PERMIT NO. U-000-09

DIESEL PERMIT APPLICATION

Table of contents

Request Letter

WV MINING COMPANY, INC.
No.1 mine
U-000-09
P.O. Box 100
Oak Hill, WV 29076

January 12, 2009

WV Diesel Commission
Joel Watts, Administrator
1615 Washington Street East,
Charleston, WV 25311

Dear Sirs:

WV Mining Co., INC. wishes to submit a Diesel Inventory, Maintenance and Training plan enclosed in this binder to gain approval to operate one Damascus Corporation diesel powered model Mac 10D WV personnel carrier at our No.1 Mine.

The machine is identified as follows:

Engine No. 1	Mac 10 D WV	Machine Serial# 101

If additional information is required please feel free to contact me at (304) 123-4567.

Sincerely,

Jim Smith

Jim Smith
Safety Director, WV Mining Co., INC.

Diesel Inventory

West Virginia Diesel Commission

Revised 9/2006

Diesel Inventory

Date: January 12, 2009

Name of Company: WV Mining Co., INC. Permit Number: U-000-09

Name of Mine: No.1 Mine

Address: P.O. Box 100
Oak Hill, WV 29076

Person Responsible for Maintenance and Testing of Diesel Equipment at this Location: John Buck (Maintenance Supt.)

Phone Number: (304) 123-4567

I. Engine #1 Damascus Mac-10D WV Personnel Carrier S/N 101

Manufacturer	**Deutz**	**High Idle (RPM)**	**3,100 RPM**
Manufacturer Address	**3883 Steve Reynolds Blvd. Norcross GA. 30093**	**Particulate Index (PI)**	**2,500 CFM**
Engine Model No.	**BF4M2011**	**Gaseous Ventilation Rate (CFM)**	**6,000 CFM**
Engine Serial No.	**10109231**	**Raw DPM (gr/hr)**	**3.7 gr/hr**
HP/RPM	**87 HP @ 2800 RPM**	**MSHA Part 7 Approval No.**	**07-ENA040004-1**
Clean Intake Air Restriction (H^2O)	**5 to 20 inches**	**Est. Ambient Level w/ after-treatment (mg/m^3)**	**.047 mg/m3**
Max. Dirty Intake Air Restriction (H^2O)	**26 inches**	**Type of Aspiration**	**Turbocharged**
Max. Allowed Backpressure H^2O	**30 inches**	**Fuel Delivery System**	**Mechanical Pump**
Turbocharger Boost Pressure (psi)	**20.8 psi**	**Fuel Specifications**	**Meets Latest Over The Road Fuel Standards**
Low Idle (RPM)	**900 RPM**	**Untreated CO**	**142 ppm**

 (The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.)

West Virginia Diesel Commission

II. Filter System

Manufacturer	Engine Control Systems
Manufacturer Address	165 Pony Drive Newmarket, Ontario, Canada L3Y7V1
Model Number	ECS S/9 (Silicon Carbide)
Serial Number	B12345 and (spare filter B54321)
System Type	Electrically-Assisted Off Board Regeneration
System Composition	Silicon Carbide
Efficiency Rating	87%
Type of Regeneration	Electrical- 1 hour

III. Catalyst

Manufacturer	Engine Control Systems
Manufacturer Address	165 Pony Drive Newmarket, Ontario, Canada L3Y7V
System Name	AZ Purifier
Model Number	Model 7 AZ
Serial Number	B98765
Average CO Reduction	83 – 90%
Estimated CO at Tailpipe	14 to 24 ppm

 (The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan

West Virginia Diesel Commission

IV. Regeneration System

Manufacturer	Engine Control Systems
Manufacturer Address	165 Pony Drive Nemarket, Ontario, Canada L3Y7V
System Name	Combiclean
Model Number	S/9
Serial Number	B45678
System Type	Off-Board Electrical

Test data such as ISO 8178 laboratory tests or other third party test data shall be attached to this document as part of the inventory submittal.

 (The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.)

Engine Specifications

BF4M2011 Specification data

General

Cylinders	4	
Cylinder arrangement	Vertical in-line	
Bore	94 mm	3.7 in.
Stroke	112 mm	4.4 in.
Cylinder Displacement	0.777 liter	47.4 in.^{3}
Total displacement	3.108 liter	190 in.^{3}
Compression ratio	17.5:1	
Combustion system	Direct Injection	
Aspiration	Turbocharged	

Fuel system

Lift pump suction head, max	3 m	118.1 in.
Lift pump flow @max rpm	53.1 l/h	14.0 GPH
Max restriction in fuel supply line	300 mbar	120 in. H_2O
Max restriction in fuel return line	200 mbar	80 in. H_2O
Max restriction in fuel pre-filter	200 mbar	80 in. H_2O
Fuel filter type	Replaceable cartridge	
Fuel consumption @ max rating	17.7 l/h	4.7 GPH
Fuel consumption @ peak torque	11.1 l/h	2.9 GPH

Combustion air system

Combustion air flow @ max rating	370.0 m^3/h	217.7 CFM
Max allowable clean restriction	50 mbar	20 in. H_2O
Max allowable dirty restriction	65 mbar	26 in. H_2O

Exhaust system

Exhaust gas flow @ max rating	965.0 m^3/h	567.9 CFM
Exhaust temp @ max rating	550 °C	1022 °F
Max allowable back pressure	75.0 mbar	30 in. H_2O

Cooling system

Type	External oil cooling	
Coolant flow rate @ max rpm	2400.0 l/h	10.6 GPM
Coolant heat rejection % of gross power	60%	
Max coolant temp @ engine outlet	135 °C	275 °F
Max coolant operating pressure	7 bar	101.5 psi
Coolant volume in engine (std. oil sump)	13.0 liter	13.7 qt.

Lubrication system

Lubrication type	Forced-feed lubrication	
Oil flow at max rpm	40.0 l/min	10.6 GPM
Oil pump relief valve setting	7 bar	102 psi
Max oil temperature in oil sump	130 °C	266 °F
Filter volume	0.4 liter	0.423 qt.
Oil change interval	500 hours	

Electrical

Starter motor	12V, 2.3kw	24V, 4.0kw
Max battery CCA	950A	750A
Voltage drop, battery (+), max	1.0V	

Physical data

Length	718 mm	28.3 in.
Width	553 mm	21.8 in.
Height	703 mm	27.7 in.
Weight, dry	247 kg	543.4 lb.
Max bending @ housing:	900 Nm	663.3 lb-ft
Max force @ flywheel:		
Axial:	1500 N	337.8 lb.
Radial:	3700 N	833.3 lb.

Performance data

Peak torque	270 Nm	199.0 lb-ft
@ rpm	1600	
low idle speed	900 rpm	

Gross power		Genset	Variable speed		
Engine RPM		1800	2300	2500	2800
kW, intermittent	(LTP)		56.0	60.0	65.0
Hp, intermittent		0.0	76.2	81.6	88.4
kW , continuous	(COP)	46.4	53.0	57.0	62.0
Hp, continuous		63.1	72.1	77.5	84.3
Fuel consumption					
g/kWhr		204.5	210.5	219.0	230.0
lb/hphr		0.335	0.345	0.359	0.377
Combustion air					
m^3/h		220.0	270.0	300.0	370.0
CFM		129.5	158.9	176.6	217.7
Exhaust gas					
m^3/h		600.0	728.0	815.0	965.0
CFM		353.1	428.4	479.6	567.9
Coolant					
l/h		1860.0	2160.0	2280.0	2400.0
GPM		8.2	9.5	10.0	10.6
Heat rejection to coolant					
kW		29.3	33.6	36	39.0
BTU/min		1666.6	1911.2	2047.7	2218.3

Noise, dB(A)

Avg. @ 1 meter

Certifications

U.S. EPA Non Road Tier 2

European COM 1 (37 - 75 KW)

and COM 2 (18 - 37 KW)

All data refer to standard conditions of 25 °C, 1000 mbar
Data are based on max intermittent output, unless noted

DEUTZ Corporation
3883 Steve Reynolds Blvd
Norcross, GA 30093 USA

Document: 9997118
Revision: 1
Date: 01 Aug, 2002

Engine De-rate And Exhaust Cooling info.

Exhaust Cooling Information

Exhaust surface temperature is kept below 302 degrees F. by customized blanketing material that extends through the engine and transmission compartment. Exhaust surface and exhaust gas temperature continues to be cooled within an air-to-air fan driven chiller compartment. Finally, a Nett Model 20 diluter further cools the exhaust gas temperature as it reaches the outside atmosphere. This system is designed to meet the 302 degree F. surface and exhaust gas temperature standard and repeatable five-minute load-testing standard of West Virginia.

Engine De-rate Letter

BLUE RIDGE DIESEL INJECTION, INC.
1016 DELAWARE STREET
P.O. BOX 867
SALEM, VA 24153
1-540-389-7296

Fuel Injection Specialists

WATTS # 1-800-476-0456 FAX # 1-540-387-2792

ADS ASSOCIATION OF DIESEL SPECIALISTS

Walter Stuart
Damascus Corp.
26864 Watauga Rd.
Abingdon, VA. 24211

Sample

Walter Stuart, Chuck Phibbs

All diesel engines approved after promulgation of the new rule from MSHA (April 2004) need to be de-rated for elevations above 1000 ft.

The maximum operating altitude of 1000 ft. has been established by MSHA at the engine's approved HP and RPM. Operating altitudes of greater than 1000 ft. elevation require that the engine be de-rated 1% per 328 ft. of elevation above the 1000 ft. limit.

The purpose of this letter is to address the MSHA altitude de-rate required for Deutz engine model # BF4M2011, Serial # 101 MSHA Approval # 07-ENA040004 approved with 87 HP @ 2800 RPM to 1000 FT. This engine is currently rated at 82 HP which is a de-rate of 5.3% from the MSHA approved power.

5.3 % x 328 ft = 1738.4 ft over 1000 ft, i.e. engine is good up to 2738.4 ft altitude before additional de-rating is required.

Sincerely,

Sample

Willard "Mulie" Craighead
Sales Manager
Blue Ridge Diesel Injection Inc.
1016 Delaware St. Salem, VA 24153
Phone: (540) 389-7296
FAX: (540) 387-2792
e-mail: sales@blueridgediesel.com

Calculations & 8-Mode

DPM CALCULATION SHEET

Engine Model	Deutz BF4M2011 (87 HP)
MSHA Number	07-ENA040004-1
Ventilation Rate	6,000 CFM
Filter Type	Model ECS S-9 Silicon Carbide
Filter Efficiency	87%

CONVERT DPM FROM (grams/hr) to (mg/min)

(3.7 g/hr) ÷ (1hr/60 min) X (1,000mg/g) = 61.67 mg/min

CONVERT VENTILATION RATE FROM (CFM) TO (m^3/min)

(6,000 ft^3/min) X (.028315 m^3/ 1ft^3) = 169.89 m^3/min

DIVIDE DPM (mg/min) BY VENTILATION RATE (m^3/min.)

(61.67 mg/min) ÷ (169.89 m^3/min) = .363 mg/m^3

SOLVE FOR AMBIENT DPM LEVEL AT 87% FILTER EFFICIENCY

.363 mg/m^3 X (100% - 87% Filter Efficiency) = **.047 mg/m^3**

ESTIMATED TREATED CO AT TAILPIPE

Catalyst Efficiency	83% - 90%
Raw CO in PPM	142 PPM (Obtained from Mode 5 of MSHA 8 mode test)

Treated CO = (Raw CO) X (Catalyst Efficiency)

Treated CO = 142 PPM X .10 = **14 PPM CO**

(14 – 24 PPM CO)

Treated CO = 142 PPM X .17 = **24 PPM CO**

C1 - Test

Motorhersteller:	Deutz AG
Motortyp:	BF4M2011
Ausführung:	Code CE65
Motorprüfstand:	E12
Ingenieur:	Rauscher
Prüfstandsfahrer:	Schumacher
Test-Nr.:	rau..0 / rau..2

Datum:	21./26.04.04
Ort:	Köln - Porz

DEUTZ®

Certification for MSHA, calculation of ventilation rates

		Gross power					
Engine type:	BF4M2011	65,00 kW at	2800	1/min	Eng.No: 882 728	Date:	21./26.04.04
Engine Code:	Code CE65						

Fuel Data:	m.% C: 86,200		m.% H: 13,300		m.% S: 0,033	m% O:	0,000
Stoich Air Demand, kg/kg fuel:		14,4812			Densitiy, kg/dm^3 at 15 °C:		0,8428

Mode			1	2	3	4	5	6	7	8
Speed	n	1/min	2800,0	2800,0	2800,0	2800,0	1680,0	1680,0	1680,0	900,0
Torque		%	100,0	75,0	50,0	10,0	100,0	75,0	50,0	0,0
Torque calculated		Nm	221,7	166,3	110,8	22,2	270,0	202,5	135,0	0,0
Torque observed		Nm	225,0	169,9	115,5	24,2	273,4	208,4	140,4	0,5
Fuel mass flow	B	kg/h	16,8612	12,60	9,03	3,88	10,94	8,14	5,62	0,56
Water content of intake air	ha	g/kg	6,07	6,03	6,01	6,11	5,95	5,78	5,79	5,77
Air mass flow, dry	GAIRD	kg/h	422,456	382,519	339,270	274,217	222,552	200,644	184,154	88,255
Air mass flow, wet	GAIRW	kg/h	425,0	384,6	341,3	275,9	223,9	201,8	185,2	88,8
Temp air intake		°C	26,5	26,9	26,7	26,2	26,7	27,1	27,0	26,7
Lab atmospheric factor	fa		1,0024	1,0042	1,0031	1,0008	1,0031	1,0050	1,0044	1,0029
Exhaust mass flow, wet	GEXH	kg/h	441,9	397,4	350,3	279,8	234,8	209,9	190,8	89,3
Fuel to air ratio	f/a	kg/kg	0,03991	0,03294	0,02661	0,01414	0,04918	0,04058	0,03054	0,00631
Dry to wet correction factor	J		0,9160	0,9291	0,9410	0,9642	0,8989	0,9152	0,9340	0,9793
Humidity correction factor NOx	FHUM		0,936	0,924	0,915	0,901	0,950	0,933	0,917	0,881
HC, wet	HC	ppmC1	68,2	33,7	71,8	223,3	48,1	41,7	70,4	129,8
CO, dry	CO	ppm	159,0	89,3	113,2	435,9	158,0	83,7	97,2	174,5
CO2, dry	CO2	%	8,64	7,19	5,70	2,82	10,73	8,78	6,54	1,33
NOx, dry	NOx	ppm	772,6	594,6	382,6	169,0	1072,6	897,2	550,3	149,2
NO2, dry	NO2	ppm	10,6	9,6	14,6	11,0	20,6	14,2	9,3	11,2
NO, dry	NO	ppm	762,0	585,0	368,0	158,0	1052,0	883,0	541,0	138,0

NO2, corrected	NO2-K	ppm	9,1	8,2	12,6	9,6	17,6	12,1	8,0	9,7
NO, corrected	NO-k	ppm	653,6	502,4	316,8	137,2	898,0	754,2	463,2	119,0
CO, corrected	CO-k	ppm	145,6	83,0	106,5	420,3	142,0	76,6	90,8	170,9
CO2, corrected	CO2-k	Vol-%	7,91	6,68	5,36	2,72	9,64	8,04	6,11	1,30
NO2 emission	mNO2	g/h	6,4	5,2	7,0	4,2	6,6	4,0	2,4	1,4
NO emission	mNO	g/h	299,3	206,9	115,0	39,8	218,5	164,1	91,6	11,0
CO emission	mCO	g/h	62,1	31,8	36,0	113,5	32,2	15,5	16,7	14,7
CO2 emission	mCO2	g/h	53122	40328	28543	11554	34402	25626	17707	1767
Ventilation rate, NO based	cfm NO	cfm	5551	3838	2133	738	4053	3043	1699	204
Ventilation rate, NO2 based	cfm NO2	cfm	386	315	423	257	396	244	146	83
Ventilation rate, CO based	cfm CO	cfm	618	316	358	1128	320	154	166	146
Ventilation rate, CO2 based	cfm CO2	cfm	3359	2550	1805	731	2176	1621	1120	112

Ventilation rate, maximum	**cfm**	**5551**
	cfm, rounded	**6000**
	cfm/HP	**69**

CO emission in C1-Test:	**1,16 g/kWh**		
NOx emission in C1-Test:	**6,69 g/kWh**		
HC emission in C1-Test:	**0,30 g/kWh**		
Particulate emission in C1-Test:	**0,109 g/kWh**		**3,702 g/h**
Particulate index:	**2178**	**cfm**	
Particulate index, rounded:	**2500**	**cfm ,**	**29 cfm/HP**

Untertagemotoren
MSHA_C1_BF2011-CE65.xls

MSHA LUG (TORQUE) CURVE CHART for DEUTZ BF4M2011
87 HP @ 2800 RPM

TORQUE CURVE TEST - ALL TESTS AT FULL THROTTLE		
MSHA # :	07-ENA040004	
Engine:	Deutz BF4M/L 2011	
Engine Rating:	87 HP @ 2800 RPM	
Engine Speed, RPM	CO, ppm	CO2, %
1000	526	11.51
1200	322	11.06
1400	246	11.53
1600	158	11
1800	151	10.49
2000	175	10.2
2200	144	9.65
2400	139	9.34
2600	129	8.98
2800	153	8.56

Maintenance Plan

West Virginia Diesel Commission

Diesel Maintenance Plan

Date: January 12, 2009

Name of Company: WV Mining Co. INC. Permit Number: U-000-09

Name of Mine: No.1 Mine

Address: P.O. Box 100
Oak Hill, WV 29076

Person Responsible for Maintenance and Testing of Diesel Equipment at this Location: John Buck (Maintenance Supt.)

Phone Number: (304) 123-4567

Equipment: Engine #1

Manufacturer	Model Number	Serial Number
Damascus Corporation	Mac 10D WV	101

Statement of Maintenance Plan Requirements

Maintenance Plan will comply fully with all regulations pertaining to the maintenance of the diesel equipment specifically, Title 196-1-16, Maintenance subsections 16.1 thru 16.3(b), 196-1-19, Scheduled Maintenance, subsections 19.1 thru 19.1(u), Emissions Monitoring and Control, subsections 20.1 thru 20.2(o), 196-1-21, Diagnostic Testing, subsections 21.1 thru 21.1(o) and all other pertinent sections in the 196-1-1 Rules for Operating Diesel Equipment in Underground Mines in West Virginia.

The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.

Training
Plan

West Virginia Diesel Commission

Diesel Training Plan

Date: January 12, 2009

Name of Company: WV Mining Co. INC. Permit Number: U-000-09

Name of Mine: No.1 Mine

Address: P.O. Box 100
Oak Hill, WV 29076

Person Responsible for Maintenance and Testing of Diesel Equipment at this Location:
John Buck

Phone Number: (304) 123-4567

West Virginia Diesel Commission

(Attach proof of attendance and copy of WV Certification of Diesel Instructors Card for each instructor listed.)

Instructors

List instructors used in conducting diesel training

Name	Address	Affiliation
Larry A. Wine Cert. No. QDI-287-08	P.O. Box 100 Oak Hill, WV 29076	WV Mining Co. INC.
Marvin L. Given Cert. No. QDI-289-08	P.O. Box 610 Abingdon, VA. 24212	Damascus Corporation
Edward O. Blake Cert. No. QDI-288-08	P.O. Box 007 Welch, WV 22675	Blake Safety Company

The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.

I. Diesel Mechanic - §196-1-24 – 16 Hours

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/OR SUPV. OPER.	METHOD OF EVALUATION
24.5.a. Federal and State requirements	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.b. Company policies and rules	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
24.5.c. Emissions control system	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.5 Hours	Questions
24.5.d. On-board engine performance and maintenance diagnostics	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.5 Hours	Questions
24.5.e. Service and maintenance procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	2.0 Hours	Questions
24.5.f. Emissions testing procedures and evaluation	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	2.0 Hours	Questions
24.5.g. Troubleshooting procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.h. Fire protection systems test and maintenance	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions

I. Diesel Mechanic - §196-1-24 – (continued)

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/OR SUPV. OPER.	METHOD OF EVALUATION
24.5.i. Fire and ignition sources	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
24.5.j. Fuel system maintenance and safe fueling procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.5 Hours	Questions
24.5.k. Intake air system design	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.l. Engine shutdown device tests and maintenance	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.m. Special instructions regarding components	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.n. Instruction on recordkeeping	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions

II. Diesel Operator - §196-1-22 – 8 Hours

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/OR SUPV. OPER.	METHOD OF EVALUATION
22.6.a. Engine fundamentals	Qualified Diesel Instructor	Hand outs; Power Point, Lecture	0.5 Hours	Questions
22.6.b. Diesel regulations	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.c. Diesel emissions	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
22.6.d. Factors that affect diesel emissions	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.e. Emissions control devices	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.f. Diagnostic techniques	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
22.6.g. The preoperational inspection	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
22.6.h. Ventilation	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.25 Hours	Questions
22.6.i. Fire suppression system	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.25 Hours	Questions
22.6.j. Operating rules	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.k. Emergency procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.75 Hours	Questions

22.6.i Recordkeeping and reporting procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
23.1.e Driving Practice	Qualified Diesel Instructor assisted by Experienced Operator	Underground Driving	0.25 Hours	Observation

Part III. Diesel Mechanic Annual Refresher Plan- §196-1-24.4 (8 Hours)

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/ OR SUPV. OPER.	METHOD OF EVALUATION
24.5.a. Federal and State requirements	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 120 Min.	Oral and/or Written Question & Answer
24.5.b. Company policies and rules	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
24.5.c. Emissions control system & component technical training	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.d. On-board engine performance and maintenance diagnostics	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.e. Service and maintenance procedures	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.f. Emissions testing procedures and evaluation & evaluation of test results	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.g. Troubleshooting procedures	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer

West Virginia Diesel Commission

Part III. **Diesel Mechanic Annual Refresher Plan- §196-1-24.4 (8 Hours - Continued)**				
24.5.h. Fire protection systems test and maintenance	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.i. Fire and ignition sources, control & elimination	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min.	Oral and/or Written Question & Answer
24.5.j. Fuel system maintenance and safe fueling procedures	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
24.5.k. Intake air system design & maintenance procedure	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min.	Oral and/or Written Question & Answer
24.5.l. Engine shutdown device tests and maintenance	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min.	Oral and/or Written Question & Answer
24.5.m. Special instructions regarding components	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
24.5.n. Instruction on record keeping	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
New Procedures & New Diesel Technologies (As Necessary)	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min. (If applicable)	Oral and/or Written Question & Answer

The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.

QDI Certification Cards

QUALIFIED DIESEL INSTRUCTOR CERTIFICATION CARDS

STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY & TRAINING
CLASS 28 QUALIFIED DIESEL INSTRUCTOR
NAME LARRY A. WINE
ENTERED

DATE OF ISSUE	DATE OF EXPIRATION
06/18/2008	
QDI-287-08	XXX-XX
CERTIFICATE NUMBER	SOCIAL SECURITY NUMBER

0714021304
CERTIFYING OFFICIAL VERIFYING OFFICIAL

STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY & TRAINING
CLASS 28 QUALIFIED DIESEL INSTRUCTOR
NAME MARVIN L. GIVEN
ENTERED

DATE OF ISSUE	DATE OF EXPIRATION
06/18/2008	N/A
QDI-289-08	XXX-XX
CERTIFICATE NUMBER	SOCIAL SECURITY NUMBER

0714021306
CERTIFYING OFFICIAL VERIFYING OFFICIAL

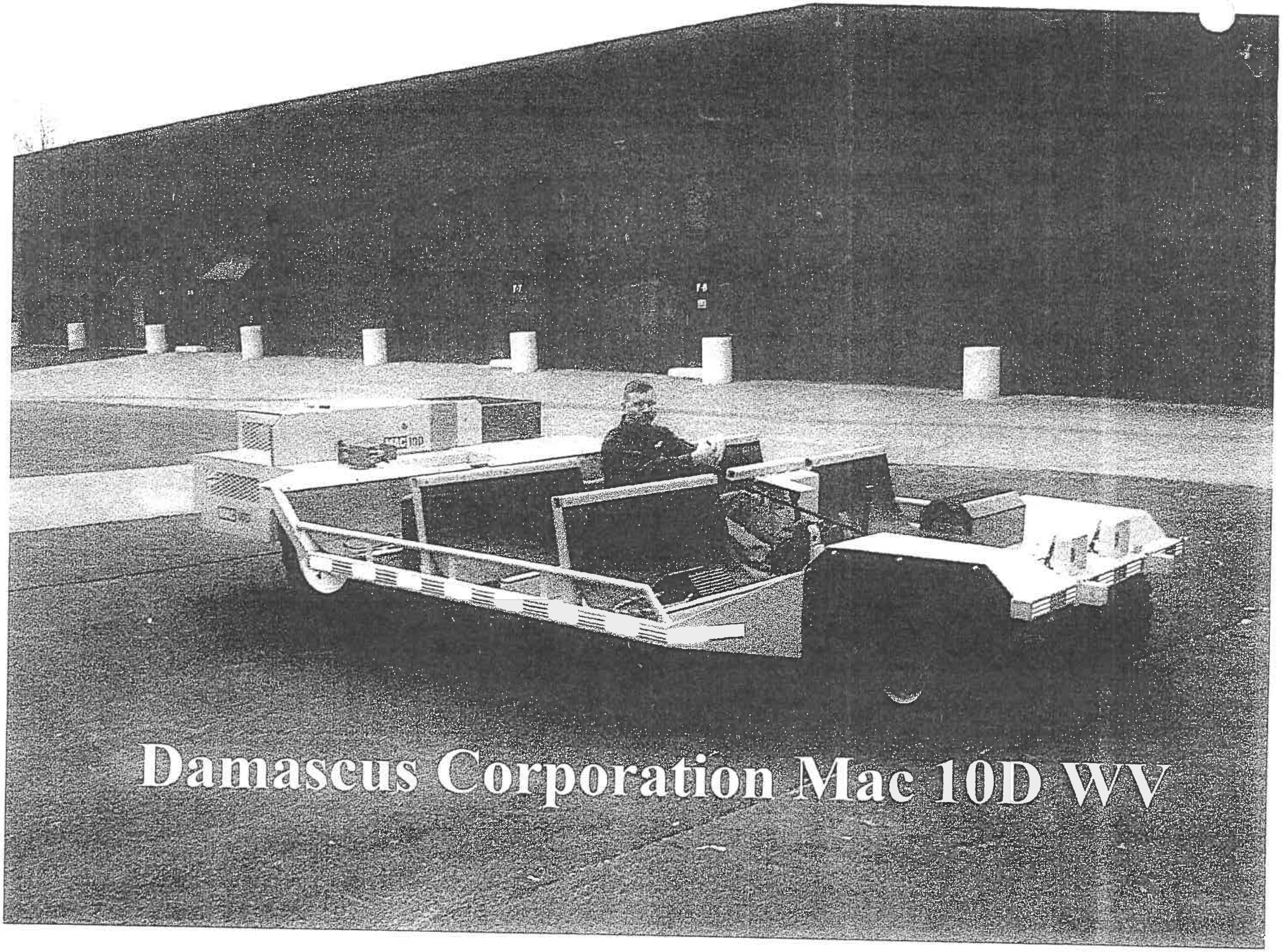
STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY & TRAINING
CLASS 28 QUALIFIED DIESEL INSTRUCTOR
NAME EDWARD O. BLAKE
ENTERED

DATE OF ISSUE	DATE OF EXPIRATION
06/18/2008	N/A
QDI-288-08	XXX-XX
CERTIFICATE NUMBER	SOCIAL SECURITY NUMBER

0714021307
CERTIFYING OFFICIAL VERIFYING OFFICIAL

SAMPLE

Photos/ Drawings


Damascus Corporation Mac 10D WV

OUTBY MACHINE CHECKLIST

§ 75.1909 Nonpermissible diesel-powered equipment; design and performance requirements.

§ 75.1910 Nonpermissible diesel-powered equipment; electrical system design and performance requirements.

Machine: ______________________________

Model No.: ____________________________

Serial No. ____________________________

Owner: ________________________________

Condition: ____________________________

Date of Inspection: ___________________

Location: _____________________________

Investigators: ________________________

Section	Rule	Comments	Changes Minor	Major
1909	Nonpermissible diesel-powered equipment; design and performance requirements.			
(a)	Nonpermissible diesel-powered equipment, except for the special category of equipment under Sec. 75.1908(d), must be equipped with the following features:			
(a)(1)	An engine approved under subpart E of part 7 of this title	Approval No.______		
(a)(1) cont.	equipped with an air filter sized in accordance with the engine manufacturer's recommendations,	Air filter model no.:____________ CFM rating:____________________		
(a)(1) cont.	an air filter service indicator set in accordance with the engine manufacturer's recommendations;	_____"Hg		
(a)(2)	At least one portable multipurpose dry chemical type (ABC) fire extinguisher listed or approved by a nationally recognized independent testing laboratory with a 10A:60B:C or higher rating.	Date of last inspection- UL, FM tag-		
(a)(2) cont.	The fire extinguisher must be located within easy reach of the equipment operator and protected from damage;			

Section	Rule	Comments	Changes Minor	Major
(a)(3)	A fuel system specifically designed for diesel fuel meeting the following requirements:	OEM or aftermarket?		
(a)(3) (i)	A fuel tank and fuel lines that do not leak;			
(a)(3) (ii)	A fuel tank that is substantially constructed and protected against damage by collision;	UL 395 OEM? metal? min-1/16", typ. 1/8" within machine frame, skid plate		
(a)(3) (iii)	A vent opening that maintains atmospheric pressure in the fuel tank, and that is designed to prevent fuel from splashing out of the vent opening;	OEM or aftermarket?		
(a)(3) (iv)	A self-closing filler cap on the fuel tank;	Flap in filler nozzle?		
(a)(3) (v)	The fuel tank, filler and vent must be located so that leaks or spillage during refueling will not contact hot surfaces;			
(a)(3) (vi)	Fuel line piping must be either steel-wire reinforced; synthetic elastomer-covered hose suitable for use with diesel fuel that has been tested	SAE 1527 Type A, SAE 1942 UL 1114 Type A1 type N		

Section	Rule	Comments	Changes Minor	Changes Major
	and has been determined to be fire-resistant by the manufacturer; or metal;			
(a)(3) (vii)	Fuel line piping must be clamped;			
(a)(3) (viii)	Primary fuel lines must be located so that fuel line leaks do not contact hot surfaces;			
(a)(3) (ix)	The fuel lines must be separated from electrical wiring and protected from damage in ordinary use;			
(a)(3) (x)	A manual shutoff valve must be installed in the fuel system as close as practicable to the tank;			
(a)(3) (xi)	A water separator and fuel filter(s) must be provided.			
(a)(4)	A sensor to monitor the temperature and provide a visual warning of an overheated cylinder head on air-cooled engines;			
(a)(5)	Guarding to protect fuel, hydraulic, and electric lines when such lines pass near rotating parts or in the event of shaft failure;			

Section	Rule	Comments	Changes Minor	Major
(a)(6)	Hydraulic tanks, fillers, vents, and lines located to prevent spillage or leaks from contacting hot surfaces;			
(a)(7)	Reflectors or warning lights mounted on the equipment which can be readily seen in all directions;			
(a)(8)	A means to direct exhaust gas away from the equipment operator, persons on board the machine, and combustible machine components;			
(a)(9)	A means to prevent unintentional free and uncontrolled descent of personnel-elevating work platforms;			
(a)(10)	A means to prevent the spray from ruptured hydraulic or lubricating oil lines from being ignited by contact with engine exhaust system component surfaces.			
(b)	Self-propelled nonpermissible diesel-powered equipment must have the following features in addition to those in paragraph (a):			
(b)(1)	A means to ensure that no stored hydraulic energy that will cause machine articulation is available after the engine is shut down;			

Section	Rule	Comments	Changes Minor	Major
(b)(2)	A neutral start feature which ensures that engine cranking torque will not be transmitted through the powertrain and cause machine movement on vehicles utilizing fluid power transmissions;			
(b)(3)	For machines with steering wheels, brake pedals, and accelerator pedals, controls which are of automobile orientation;			
(b)(4)	An audible warning device conveniently located near the equipment operator;			
(b)(5)	Lights provided and maintained on both ends of the equipment.			
(b)(5) cont.	Equipment normally operated in both directions must be equipped with headlights for both directions;			
(b)(6)	Service brakes that act on each wheel of the vehicle and that are designed such that failure of any single component, except the brake actuation pedal or other similar actuation device, must not result in a complete loss of service braking capability;			
(b)(7)	Service brakes that safely bring the fully loaded vehicle to a complete stop on the maximum grade on which it is	Vehicle grade rating-		

Section	Rule	Comments	Changes Minor	Major
	operated;			
(b)(8)	No device that traps a column of fluid to hold the brake in the applied position shall be installed in any brake system, unless the trapped column of fluid is released when the equipment operator is no longer in contact with the brake activation device.			
(c)	Self-propelled nonpermissible heavy-duty diesel-powered equipment under Sec. 75.1908(a), except rail-mounted equipment, shall be provided with a supplemental braking system that:			
(c)(1)	Engages automatically within 5 seconds of the shutdown of the engine;			
(c)(2)	Safely brings the equipment when fully loaded to a complete stop on the maximum grade on which it is operated;	Vehicle grade rating-		
(c)(3)	Holds the equipment stationary, despite any contraction of brake parts, exhaustion of any nonmechanical source of energy, or leakage;			
(c)(4)	Releases only by a manual control that does not operate any other equipment function;			

Section	Rule	Comments	Changes Minor	Changes Major
(c)(5)	Has a means in the equipment operator's compartment to apply the brakes manually without shutting down the engine, and a means to release and reengage the brakes without the engine operating;			
(c)(6)	Has a means to ensure that the supplemental braking system is released before the equipment can be trammed, and is designed to ensure the brake is fully released at all times while the equipment is trammed.			
(d)	Self-propelled nonpermissible light-duty diesel-powered equipment under Sec. 75.1908(b), except rail-mounted equipment, must be provided with a parking brake that holds the fully loaded equipment stationary on the maximum grade on which it is operated despite any contraction of the brake parts, exhaustion of any nonmechanical source of energy, or leakage.			
(e)	The supplemental and park brake systems required by paragraphs (c) and (d) must be applied when the equipment operator is not at the controls of the equipment, except during movement of			

Section	Rule	Comments	Changes Minor	Changes Major
	disabled equipment.			
(f)	Self-propelled personnel-elevating work platforms must be provided with a means to ensure that the parking braking system is released before the equipment can be trammed, and must be designed to ensure the brake is fully released at all times while the equipment is trammed.			
(g)	Any nonpermissible equipment that discharges its exhaust directly into a return air course must be provided with a power package approved under subpart F of part 7 of this title.			
(h)	Self-propelled nonpermissible heavy-duty diesel-powered equipment meeting the requirements of Sec. 75.1908(a) must be provided with an automatic fire suppression system meeting the requirements of Sec. 75.1911.	See attached §75.1911 Checklist		
(i)	Self-propelled nonpermissible light-duty diesel-powered equipment meeting the requirements of Sec. 75.1908(b) must be provided with an automatic or manual fire suppression system meeting the requirements of Sec. 75.1911.	See attached §75.1911 Checklist		

Section	Rule	Comments	Changes Minor	Major
(j)	Nonpermissible equipment that is not self-propelled must have the following features in addition to those listed in paragraph (a):			
(j)(1)	A means to prevent inadvertent movement of the equipment when parked;			
(j)(2)	Safety chains or other suitable secondary connections on equipment thatis being towed;			
(j)(3)	An automatic fire suppression system meeting the requirements of Sec. 75.1911.	See attached §75.1911 Checklist		
1910	Nonpermissible diesel-powered equipment; electrical system design and performance requirements.			
1910 cont.	Electrical circuits and components associated with or connected to electrical systems on nonpermissible diesel-powered equipment utilizing storage batteries and integral charging systems, except for the special category of equipment under Sec. 75.1908(d), must conform to the following requirements:			
(a)	Overload and short circuit protection must be provided for electric circuits	Attach wiring schematics-		

Section	Rule	Comments	Changes Minor	Major
	and components in accordance with Secs. 75.518 and 75.518-1 of this part;			
(b)	Each electric conductor from the battery to the starting motor must be protected against short circuit by fuses or other circuit-interrupting devices placed as near as practicable to the battery terminals;	Fuse rating:__________ Starter motor\kW:__________		
(c)	Each branch circuit conductor connected to the main circuit between the battery and charging generator must be protected against short circuit by fuses or other automatic circuit-interrupting devices;	Attach wiring schematics-		
(d)	The electrical system shall be equipped with a circuit-interrupting device by means of which all power conductors can be deenergized.			
(d) cont.	The device must be located as close as practicable to the battery terminals and be designed to operate within its electrical rating without damage.	Distance from battery:__________ Switch rating:__________		
(d) cont.	The device shall not automatically reset after being actuated.			
(d) cont.	All magnetic circuit-interrupting devices must be mounted in a manner to			

Section	Rule	Comments	Changes Minor	Major
	preclude their closing by force of gravity;			
(e)	Each motor and charging generator must be protected by an automatic overcurrent device. One protective device will be acceptable when two motors of the same rating operate simultaneously and perform virtually the same duty;	Attach wiring schematics-		
(f)	Each ungrounded conductor must have insulation compatible with the impressed voltage.	Wire designation:__________		
(f) cont.	Insulation materials must be resistant to deterioration from engine heat and oil.	Wire designation:__________		
(f) cont.	Electric conductors must meet the applicable requirements of Secs. 75.513 and 75.513-1, except electric conductors for starting motors, which must only meet the requirements of Sec. 75.513;	Wire designation:__________ NEC, ICEA, or SAE standard: ____________________		
(g)	All wiring must have adequate mechanical protection to prevent damage to the cable that might result in short circuits;			
(h)	Sharp edges and corners must be removed			

Section	Rule	Comments	Changes Minor	Major
	at all points where there is a possibility of damaging wires, cables, or conduits by cutting or abrasion.			
(h) cont.	The insulation of the cables within a battery box must be protected against abrasion;			
(i)	When insulated wires other than cables pass through metal frames, the holes must be substantially bushed with insulated bushings.			
(i) cont.	Cables must enter metal frames of motors, splice boxes, and electric components only through proper fittings.			
(i) cont.	All electrical connections and splices must be mechanically and electrically efficient, and suitable connectors shall be used.			
(i) cont.	All electrical connectors or splices in insulated wire must be reinsulated at least to the same degree of protection as the remainder of the wire;			
(j)	The battery must be secured to prevent movement, and must be protected from external damage by position.			
(j)	Batteries that are not protected from			

Section	Rule	Comments	Changes Minor	Changes Major
cont.	external damage by position must be enclosed in a battery box.			
(j) cont.	Flame-resistant insulation treated to resist chemical reaction to electrolyte must be provided on battery connections to prevent battery terminals from contacting conducting surfaces;	Mfg's spec.:________		
(k)	A battery box, including the cover, must be constructed of steel with a minimum thickness of \1/8\ inch, or of a material other than steel that provides equivalent strength;			
(l)	Battery-box covers must be lined with a flame-resistant insulating material permanently attached to the underside of the cover, unless equivalent protection is provided.	Mfg.'s spec.________		
(l) cont.	Battery-box covers must be provided with a means for securing them in closed position. At least \1/2\ inch of air space must be provided between the underside of the cover and the top of the battery, including terminals;			
(m)	Battery boxes must be provided with ventilation openings to prevent the accumulation of flammable or toxic gases or vapors within the battery box.			

Section	Rule	Comments	Changes Minor	Major
(m) cont.	The size and locations of openings for ventilation must prevent direct access to battery terminals;			
(n)	The battery must be insulated from the battery-box walls and supported on insulating materials.			
(n) cont.	Insulating materials that may be subject to chemical reaction with electrolyte must be treated to resist such action;	Mfg.'s spec.________		
(o)	Drainage holes must be provided in the bottom of each battery box.			

Outby Machine Checklist

§ 75.1911 Fire suppression systems for diesel-powered equipment and fuel transportation units.

Machine: ____________________

Model No.: ____________________

Serial No. ____________________

Owner: ____________________

Condition: ____________________

Date of Inspection: ____________________

Location: ____________________

Investigators: ____________________

Warning: Determine *"....the hazards inherent to the operation* *of the fire suppression systems and, where appropriate, the safeguards available for each system."*

Section	Rule	Comments	Changes Minor	Major
1911	Fire suppression systems for diesel-powered equipment and fuel transportation units.			
(a)	The fire suppression system required by Secs. 75.1907 and 75.1909 shall be a multipurpose dry chemical type (ABC) fire suppression system listed or approved by a nationally recognized independent testing laboratory and appropriate for installation on diesel-powered equipment and fuel transportation units.	UL-______ FM-______		
(a)(1)	The system shall be installed in accordance with the manufacturer's specifications and the limitations of the listing or approval.	No. of tanks\qty.:____________ No. of nozzles:____________ Drawing No.:____________		
(a)(2)	The system shall be installed in a protected location or guarded to minimize physical damage from routine vehicle operations.			
(a)(3)	Suppressant agent distribution tubing or piping shall be secured and protected against damage, including			

Section	Rule	Comments	Changes Minor	Major
	pinching, crimping, stretching, abrasion, and corrosion.			
(a)(4)	Discharge nozzles shall be positioned and aimed for maximum fire suppression effectiveness.			
(a)(4) cont.	Nozzles shall also be protected against the entrance of foreign materials such as mud, coal dust, or rock dust.			
(b)	The fire suppression system shall provide fire suppression and, if automatic, fire detection for the engine................................ including the starter,................. transmission,........................ hydraulic pumps and tanks,............. fuel tanks,........................... exposed brake units,.................. air compressors....................... and battery areas..................... on diesel-powered equipment and electric panels or controls........... used on fuel transportation units and other areas as necessary..............			

Section	Rule	Comments	Changes Minor	Changes Major
(c)	If automatic, the fire suppression system shall include audible and visual alarms to warn of fires or system faults.			
(d)	The fire suppression system shall provide for automatic engine shutdown. If the fire suppression system is automatic, engine shutdown and discharge of suppressant agent may be delayed for a maximum of 15 seconds after the fire is detected by the system.	Delay time:________		
(e)	The fire suppression-system shall be operable by at least two manual actuators. One actuator shall be located on each side of the equipment. If the equipment is provided with an operator's compartment, one of the manual actuators shall be located in the compartment within reach of the operator.			
(f)	The fire suppression system shall remain operative in the event of engine shutdown, equipment electrical system failure, or failure of any other equipment system.			

Section	Rule	Comments	Changes Minor	Major
(g)	The electrical components of each fire suppression system installed on equipment used where permissible electric equipment is required shall be permissible or intrinsically safe and such components shall be maintained in permissible or intrinsically safe condition.	IS-_____		
(h)	Electrically operated detection and actuation circuits shall be monitored and provided with status indicators showing power and circuit continuity.			
(h) cont.	If the system is not electrically operated, a means shall be provided to indicate the functional readiness status of the detection system.			
(i)	Each fire suppression system shall be tested and maintained in accordance with the manufacturer's recommended inspection and maintenance program and as required by the nationally recognized independent testing laboratory listing or approval, and be visually inspected at least once each week by a person trained to make such inspections.	NRITL\Mfg's test\maintenance scedule-		
(j)	*Recordkeeping* Persons performing inspections and tests of fire	Note defects\repairs-		

Section	Rule	Comments	Changes Minor	Changes Major
	suppression systems under paragraph (i) shall record when a fire suppression system does not meet the installation or maintenance requirements of this section.			
(j)(1)	The record shall include the equipment on which the fire suppression system did not meet the installation or maintenance requirements of this section, the defect found, and the corrective action taken.			
(j)(2)	Records are to be kept manually in a secure manner not susceptible to alteration or recorded electronically in a secured computer system that is not susceptible to alteration.			
(j)(3)	Records shall be maintained at a surface location at the mine for one year and made available for inspection by an authorized representative of the Secretary and miners' representatives.			
(k)	All miners normally assigned to the active workings of the mine shall be instructed about the hazards inherent to the operation of the fire suppression systems and, where appropriate, the safeguards available for each system.			

Section	Rule	Comments	Changes Minor	Major
(l)	For purposes of Sec. 75.380(f), a fire suppression system installed on diesel-powered equipment and meeting the requirements of this section is equivalent to a fire suppression system meeting the requirements of Secs. 75.1107-3 through 75.1107-16.			

WEST VIRGINIA STATE MINE INSPECTOR'S DIESEL INSPECTION CHECKLIST

Date___________________ **Company**____
Mine _________________________ **Equipment Type**___________________________
WV Approval #(*see Approval Letter)*______________ **Machine serial#**_______________

RECORDS REQUIRED

56-23-22.3	1. Diesel operator training records. (MSHA 5000-23 FORMS)
56-23-24.3	2. Diesel mechanic training records. (MSHA 5000-23 FORMS)
56-23-4.3	3. Diesel inventory on file at mine.
56-23-16.2	4. Diesel maintenance plan on file at mine.
56-23-22.1	5. Diesel training plan on file at mine.
56-23-8.2	6. Latest fuel delivery receipt (*ultra-low sulfur fuel* **ONLY !**)
56-23-17.1	7. Preoperational check records.
56-23-17.1	8. Weekly ambient emissions records.
56-23-17.1	9. 200 hour service records.(*note:* can not be more than 200 hr from last service). *Last 200hr service done at*___________*Hours.*
56-23-11.2	10. Semi-annual fire suppression check records. *Last check*__________

MACHINE INSPECTION

56-23-5.5	11. Check all gauges and controls (properly labeled)
56-23-16.1	12. Sounding device (*must be* ***horn***).
56-23-16.1	13. A means to prevent the spray from ruptured hoses from coming in Contact with a hot surface
56-23-10.4.2	14. Filler caps provided for fuel tanks must be "self closing caps".
56-23-10.4.5	15. Manual fuel shut off valve provided for tank.(*should be labeled).*
56-23-14.2	16. Check machine for fuel leaks.
56-23-16.1	17. Fuel system must be provided with a water separator and fuel filter(s).
56-23-16.1	18. Fuel lines must be fire resistant or metal.
56-23-16.1	19. Fuel line piping must be clamped.
56-23-16.1	20. Guarding to protect fuel, hydraulic, and electrical lines when such lines pass near rotating parts.
56-23-14.2.	21. Accumulations of diesel fuel and other combustible materials on machine.
56-23-16.1	22. Reflectors or warning lights mounted on the machine that can be readily seen in all directions.
56-23-16.1	23. Neutral start feature. *(machine must not start if transmission is in gear).*
56-23-16.1	24. Check headlights on each end of machine.
56-23-25.8.	25. Check service brake and park brake.
56-23-19.1.15	26. Check portable fire extinguisher. *(must be near operator and be10A:60B. Or higher rating.*
56-23-7.5.3	27. Proper installation and maintenance of intake air filters.

56-23-16.1 28. Battery must be secured and maintained properly.

56-23-16.1 29. Battery dis-connecting device installed as close to battery as practicable.

56-23-16.1 30. Battery boxes lined with insulating material and drainage holes (unclogged) provided.

56-23-16.1 31. Sharp edges and corners must be removed at all points where there is a possibility of damaging wires, cables, or conduits by cutting or abrasion.

56-23-16.1 32. Battery boxes must be provided ventilation openings.

56-23-5.4.3. 33. Check surface temperature of engine and exhaust components. (note: surface temperature can be no more than **302 degrees**). **Surface Temperature is**__________________

56-23-5.4.5. 34. Automatic engine shutdown that will shut the engine down before exhaust gas temperature reaches **302 degrees**. Also, must give operator warning before engine shutdown.

FIRE SUPPRESSION SYSTEM

56-23-11.2. 35. Fire suppression system must be able to be automatically activated in the event of a fire on the machine.

56-23-11.2.1. 36. Fire suppression system must be installed according to manufacturer's specifications.

56-23-11.2.2. 37. System must be installed in a protected location or guarded to minimize physical damage from routine operations.

56-23-11.2.3. 38. Hoses provided for the system must be secured and protected against damage, including pinching, crimping, stretching, abrasion and corrosion.

56-23-11.2.4. 39. Discharge (spray) nozzles shall be aimed for maximum effectiveness. Also, check all nozzles to make sure the end of the nozzle is not clogged with mud or coal dust. (NOTE: The nozzles must be provided with a protective cap to prevent the entrance of foreign material).

56-23-11.3.1. 40. The following areas must be covered by the fire suppression system – **1.** engine , **2.** transmission , **3.** hydraulic pumps and tanks, **4.** fuel tanks, **5.** exposed (open) brake units, **6.** air compressors, **7.** battery areas. (b.) Fuel containers and elect. Controls on fuel cars.

56-23-11.4. 41. System must be provided with a fire detection unit (unit will be located in the operator cab) to warn the operator of a fire or system malfunction. (Note: To check this operator warning un-plug the squib from the unit).

56-23-11.5. 42. When system is activated the engine must automatically shutdown within 15 seconds after the fire alarm alerts the operator. (Note: To check this system manually flip the shutdown switch).

56-23-11.6. 43. Must be provided with at least 2 manual actuators. 1 actuator near the operator and 1 on the other end and opposite side of machine.

EMISSIONS CHECK

56-23-5.4.2.

44. **Catalyst Inspection-** 1) Visually inspect catalyst (make sure catalyst is not damaged). 2) TAILPIPE TEST- Under all conditions of operation at **normal engine operating temperature *(at least 170 degrees)*** the carbon monoxide exiting the tailpipe can be no More than **100 ppm**. (NOTE: To perform this test use the iTx detector with the pump and probe. Insert the probe into the tailpipe of the machine). If CO is greater than 100ppm the machine must be taken out of service. ***THE FILTERED CO IS_________***

56-23-5.4.1.

45. **DPM Filter Inspection-** 1) Visually inspect filter (make sure filter is not damaged and is installed correctly). 2) SMOKE DOT TEST- Filter must capable of at least **75%** reduction of diesel particulate matter (DPM). Smoke dot shall be a **#3** or less. (NOTE: To perform this test use the Bacharach Smoke Dot Tester. Insert tester into tailpipe pull 10 pumps *(take 4 seconds to pull each pump)* remove test paper from tester and compare to the scale provided). If the smoke dot number is greater than 3 the machine must be taken out of service. ***THE SMOKE DOT # IS_______________________***

56-23-18.1.1.

46. **Exhaust Leak Test-** Check the exhaust system from the manifold to the DPM filter for exhaust leaks. (NOTE: To perform this test use the iTx detector with the pump and probe. Follow the exhaust with the probe. Any exhaust leaks will be detected with the iTx.

56-23-7.1,2,3,4.

LOCATION OF AMBIENT TEST IS

____

____

____

47. **Ambient Emissions Test-** Have machine moved underground and placed in proper airflow *(find minimum amount of airflow on MSHA approval tag provided on engine)* (NOTE: To perform this test take air reading then measure 8 feet downwind of the **exhaust pipe**. Using the iTx detector travel from rib to rib in the exhaust flow. Also, measure the emissions at the operator's cab. ***CFM MEASURED FOR THIS TEST IS__________________***

TEST AT 8 FEET DOWNWIND OF EXHAUST -

CO________ppm **NO**________ppm **NO2**________ppm

TEST AT OPERATOR'S CAB-

CO________ppm **NO**________ppm **NO2**________ppm

VIOLATION
CO – 26 to 35 ppm
NO – 19 to 25 ppm
NO2- 2 to 3 ppm

OTHER REGULATIONS TO CONSIDER

56-23-10.14.	48. Safety cans shall be used for emergency fueling only. Safety cans may not be used to do regular fueling of equipment.
56-23-10.15.	49. Safety cans shall be clearly marked, have a maximum capacity of five gallons, and be constructed of metal, and equipped with a nozzle.
56-23-6.3.	50. Ventilation not adequate to operate the diesel machine.
56-23-25.4.	51. Roadways not maintained properly.
22A-2-37(z)	52. E-stop switch **rail equipment only.**
36-18-5.2	53. Pre-operational checklist provided on machine.
22A-2-37t(5)	54. Track equipment provided with two-way communications Or handheld Operator Radio (*personal communication*)
22A-2-37(o)	55. Provided with lifting jack and bar.
22A-2-49(b)	56. Fenders provided for machine.
22A-2-49(e)	57. Sanders on Rail Equipment.
56-23-16.1	58. Manual park brake release.(*A means to release the park brake With the Engine of the Machine Off*).
56-23-25.8.	***(Catch All)*** – ALL DIESEL POWERED EQUIPMENT **SHALL** BE MAINTAINED IN A SAFE AND HEALTHFUL OPERATING CONDITION. EQUIPMENT IN AN UNSAFE OR UNHEALTHFUL CONDITION OR NOT MAINTAINED IN ACCORDANCE WITH THE ENGINE OR EMISSIONS CONTROL OPERATING SPECIFICATIONS SHALL BE ROMOVED FROM SERVICE IMMEDIATELY AND SHALL NOT BE RETURNED TO SERVICE UNTIL ALL NECESSARY CORRECTIVE ACTIONS HAVE BEEN TAKEN.

INSPECTOR'S NOTES

REVISED 2/2021

DO NOT WRITE IN THIS SPACE

Registration No: ______________________

Date Issued: ______________________

Approved by: ______________________

Date of Class: ______________________

Location of Class: ______________________

STATE OF WEST VIRGINIA

OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

#7 Players Club Drive – Suite 2

Charleston, West Virginia 25311-1626

https://minesafety.wv.gov

Qualified Diesel Instructor Application

(Print:

Name ____

Last First Middle

Address ____

Street or Box City State Zip

Telephone No.: ______________________ Date of Birth: ________ / ________ / ________

Social Security No. (Last 4 Digits) ______________ West Virginia Certificate No. ______________

Currently Employed by:

____

Coal Company

____

Mine Name

______________________ ______________________

Signature of Applicant **Date**

22A-1-21(d) Whoever knowingly makes any false statement, representation, or certification in any application, record, report, plan or other document filed or required to be maintained pursuant to this law or any order or decision issued under this law shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined not more than $5,000.00 or imprisoned in the county jail not more than six months, or both fined and imprisoned.

CONTENTS & AGENDA

WV QUALIFIED DIESEL INSTRUCTOR TRAINING CONTACTS

History and Progress of Diesels in West Virginia

Diesels in West Virginia

- Prohibited from use in WV until 2004
- Waited until improvements in engine exhaust conditioning equipment developed
- WV Rule requires use of oxidizing catalyst
- Strictly limits diesel emissions
- WV regulates both NO2 and NO
- 2017 The WV Diesel Regs were changed from Title 196 Series 1 to Title 56 Series 23.

- 2017 Changed to allow the Operator to replace a DPM filter or Catalyst of the same make and model without contacting the WVOMHST.
- 2017 Changed to allow that a ASE certified mechanic can make repairs and adjustments to fuel injection systems or engine timing. (Before July 2017 the mechanic had to be certified by the Engine Manufacture).

- 2017 – Changed to allow the 100 hour service to now be done at 200 hours.
- 2017 – Stall test changed from five 1 minute tests to three 30 second tests (untreated and treated)
- 2017 – Annual 8 hour Diesel equipment operator training no longer required.
- 2018 - Regulations changed to allow the use of Underground Diesel Generator.

MSHA’s Current Diesel Emission Limits

- Carbon Monoxide (CO) ceiling is 50 ppm
- Nitrogen Dioxide (NO2) ceiling is 5 ppm
- Nitrogen Monoxide (NO) not regulated
- Diesel Particulate Matter (DPM) is 2.5 g/hr
- Action taken at 50% of ceiling

WV's Current Diesel Emission Limits

- Carbon Monoxide (CO) ceiling is 35 ppm
- Nitrogen Dioxide (NO2) ceiling is 3 ppm
- Nitrogen Monoxide (NO) ceiling is 25 ppm
- Diesel Particulate Matter (DPM) is .12 mg/m3 per minute
- Action taken at 75% of ceiling

Summary

More Than 900 Diesel Machines Are Approved in WV And New Machines Arrive Weekly. West Virginia Is Fast Becoming the Nation's Leader in Underground Use of Diesel Equipment Even With High Emission Standards.

DIESEL ENGINE FUNDAMENTALS VIDEOS

1. CUMMINGS DIESEL VIDEO
2. DIESEL POWERED VEHICLES (MSHA) VIDEO

Diesel Exhaust

What Is Diesel Exhaust?

- Highly Complex Mixture
- Organic and Inorganic Compounds
- Gas and Particulate Phases
- Gases - Irritate and Toxic
- Particulates - Thousands of Chemicals Absorbed, Suspected Carcinogens, Mutagens and Teratogens

Main Constituents

- Carbon Monoxide
- Nitrogen Dioxide
- NOx
- Particulate
- Carbon Dioxide
- Hydrocarbons
- Sulfur Oxides

Carbon Monoxide

- CO - Colorless, Odorless, Tasteless Gas
- Silent Killer - No Warning Properties
- Targets the Blood
- Hemoglobin - 200-300 Times the Affinity
- Chemical Asphyxiation

Carbon Monoxide - Early Signs

- Headache
- Dizziness
- Weakness
- Vision Problems
- Confusion

Carbon Monoxide - Symptoms

- Nausea
- Vomiting
- Reddened Skin
- Ears Ringing
- Difficulty Breathing

Carbon Monoxide - Continued

- 200 PPM - 1 hour
- 400 PPM - 1/2 hour
- 600 PPM - 15 minutes
- 600 PPM - 2 to 3 Hours - Fatal
- Blood Saturation & Concentration - Increases Effects

Nitrogen Dioxide

- Red - Brown Gas
- Irritating Odor
- Nitrogen Tetroxide - N_2 O_4
- Reacts to Form Nitrous and Nitric Acid
- Irritates Mucous Membrane
- Pulmonary Edema

Nitrogen Dioxide - 60 - 150 PPM

- Delayed Symptoms - 6 to 24 hours
- Tightness and Burning - Chest
- Shortness of Breath
- Sleeplessness
- Restlessness
- Dyspnea (labored breathing)
- Cyanosis (bluish skin from lack of blood O2)

Nitrogen Dioxide - Continued

- 100 - 150 PPM ... 30 - 60 minutes
- 200 PPM and above .... Very Short Periods
- Pulmonary Edema ... Permanent Disability
- Respiratory Track irritation
- Cough
- Headache
- Loss of Appetite

Continued

- Dyspepsia - Indigestion
- Corrosion of the Teeth
- Loss of Strength

Diesel Particulate -Acute effects

- Eye Irritant
- Mucus membrane
- Cough
- Respiratory Irritation (Including Allergic Responses)

Diesel Particulate- Chronic Effects

- Premature Death from Cardiovascular, Cardiopulmonary, and Respiratory Causes
- Lung Cancer?

Hydrocarbons - Aldehydes

- Nasal and Eye Irritation
- Strong Sensitizer
- Headaches
- Skin Rash
- Respiratory problems

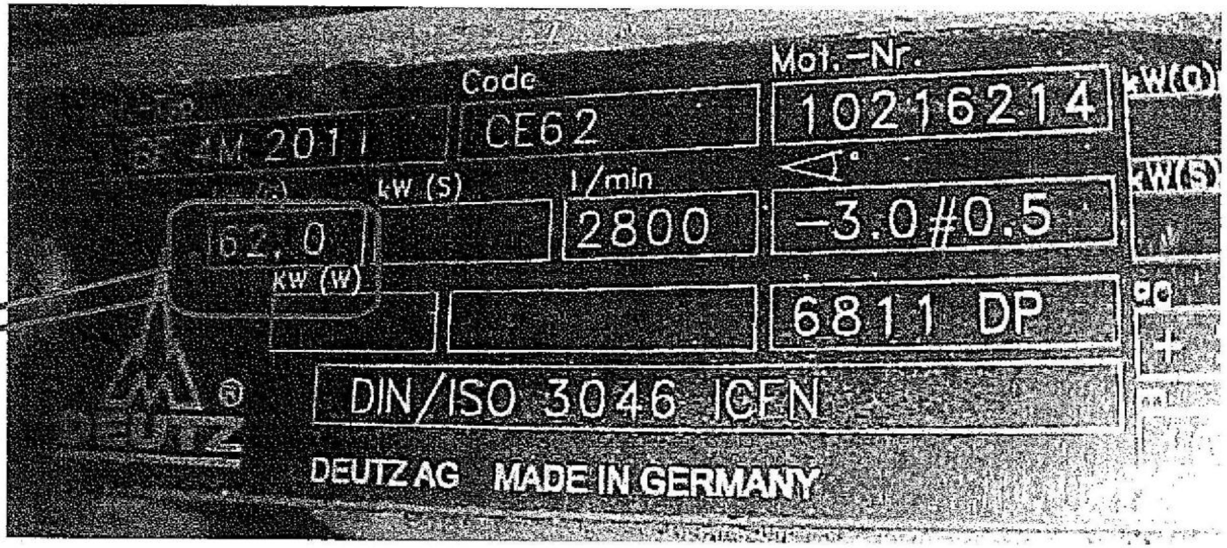
Hydrocarbons - Phenols

- Colorless Solids
- Strong Corrosive Action on the Body
- Burns
- Dermatitis

MSHA Exposure Limits

- Carbon Monoxide - 50 PPM (35 PPM for WV)
- Nitrogen Dioxide - 5 PPM Ceiling (3 PPM for WV)
- Carbon Dioxide - .5% (same for WV)
- Nitric Oxide is regulated by WV (25 PPM)

Wolf Run Mining
Engine #1
S/N 10216214

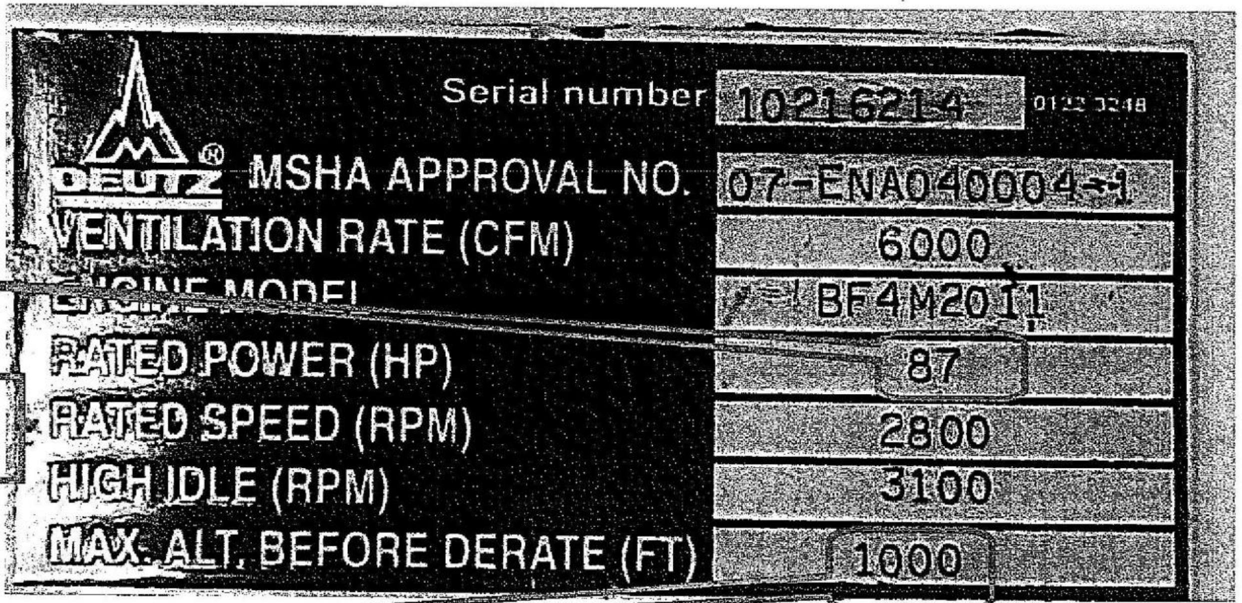


62 X 1.34 =83.08HP,

a de-rate of 4.6%

[100% minus (83 divided by 87 HP)]

4.6% X 328'=1508 feet



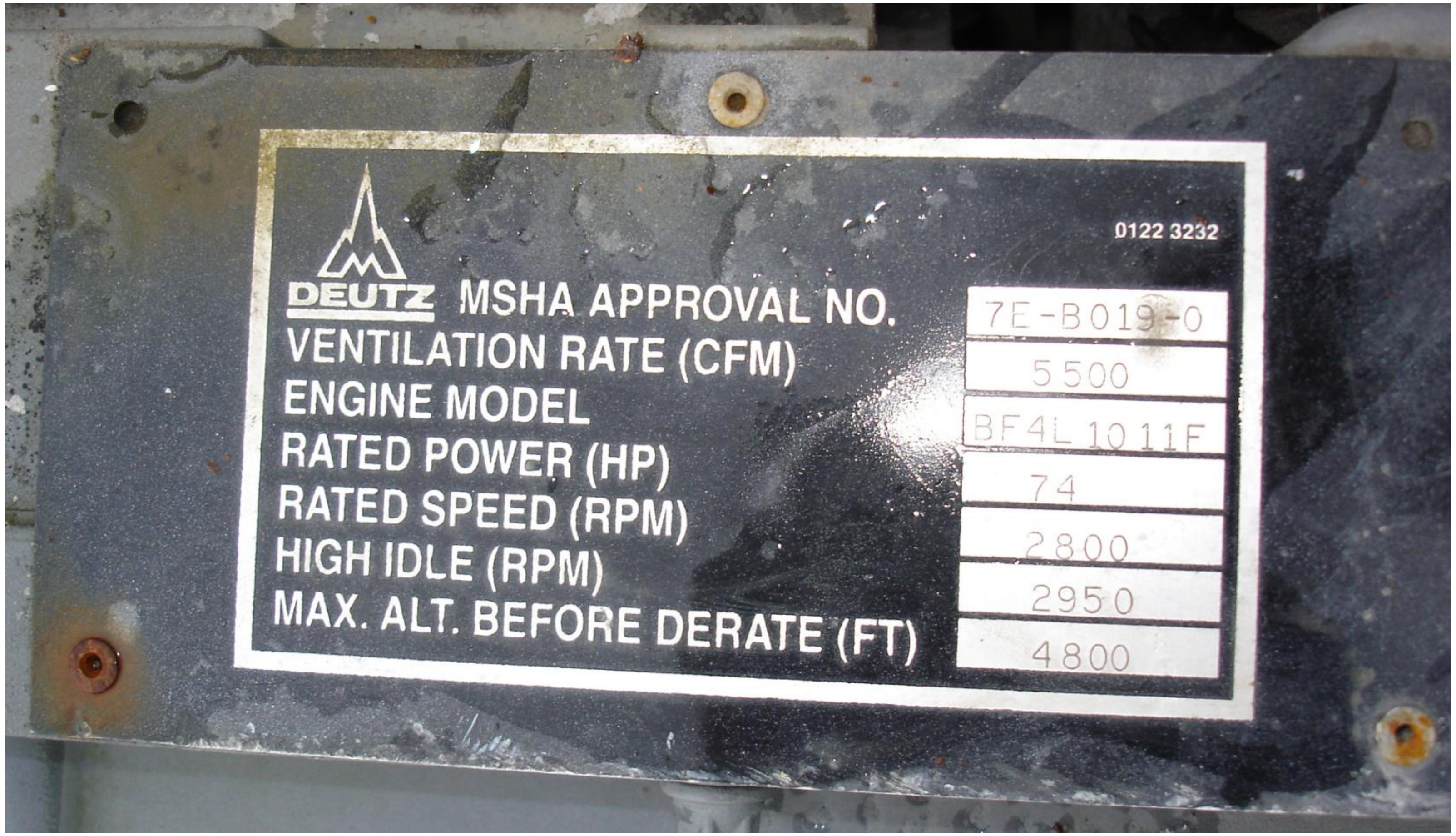
1508' plus 1000' = <u>2508</u> feet max. alt.
before another de-rate needed

WHAT COMPONENTS MAKE UP THE EXHAUST TREATMENT SYSTEM

- OXIDATION CATALYST
  - REMOVES CO BY 83% MINIMUM
    - AMBIENT CO CANNOT EXCEED 35 PPM CEILING, ACTION MUST BE TAKEN AT 26 PPM
- DPM FILTER
  - CAPABLE OF REDUCING DPM BELOW .12 MG/M^3
- EXHAUST COOLER
  - REDUCES EXHAUST EXIT TEMPERATURE BELOW 302 DEGREES FAHRENHEIT

West Virginia Approval Tag

MSHA Approval Tag



Factors That Affect Diesel Emissions

Intake Air System Restriction

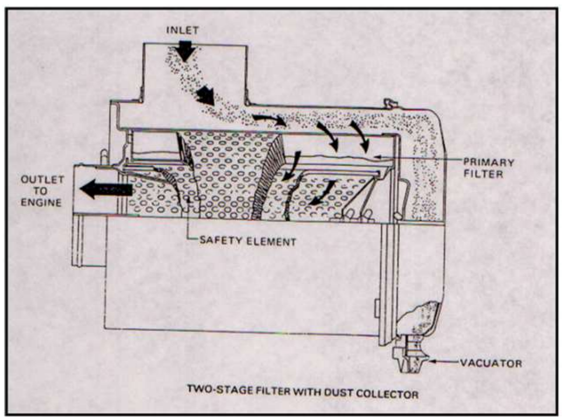
- Intake restriction -- <u>most common</u> cause for over-fueling and increased emissions

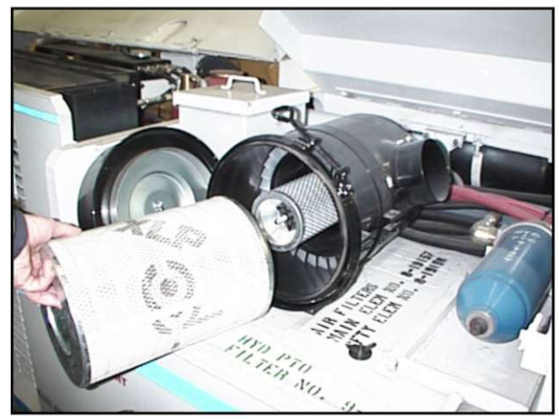
Air Intake System Restriction and Fuel Flow

- The engine is designed to have unrestricted airflow into the engine
- Fuel flow is adjusted according to the available air
- Any significant additional restriction on the intake system upsets this balance causing over fueling and excessive harmful emissions

Over Fueling

- **Excessive intake restriction causes significant increase in carbon monoxide and soot emissions -- restriction (>50” WG)**
- **When increased carbon monoxide and black smoke are detected, the intake air cleaner may need replaced**
- **A <u>mostly blocked</u> intake system can lead to carbon monoxide increases of 50-250% and increases in smoke by up to 500% !**





Leaking Intake System

- Dust and coal particles may be ingested into the intake system

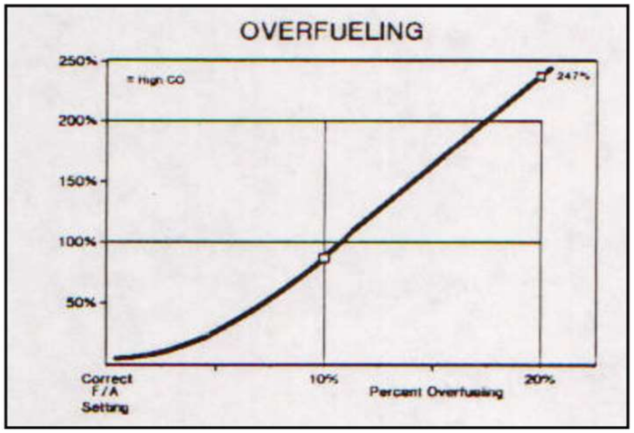
- This is referred to as "dusting"
- The engine may be destroyed in as little as a single shift

- The impact on emissions is due to the damage of components, which in turn cause excessive blow-by of oil and low engine compression

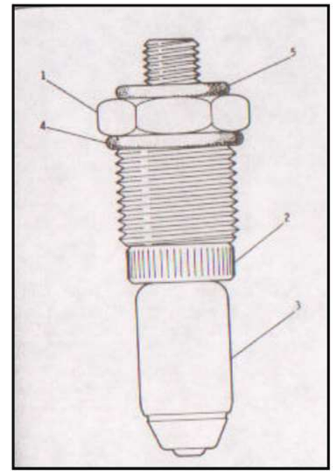
Fuel Injection Pump Setting

- Over fueling also occurs when the maximum fuel injection rate is too high because the fuel rack is improperly set
- Most likely found right after engine repair work was performed
- This over fueling is not normally observed after the machine has been in service for a while

- Any increase of the amount of fuel injected by 10% can double carbon monoxide and diesel particulate



Fuel Injector Failure



- **Fuel injectors are sealed and do not require much attention. However, they do fail at times, due to water in the fuel or other contamination**
  - Causes increased hydrocarbons and carbon monoxide due to poor combustion, noticeable by increased smell
  - Noticeable loss of power, especially when more than one injector is defective

Engine Temperature

- A cold engine produces higher carbon monoxide, unburned hydrocarbon and particulate matter emissions
- Start-up of a cold engine, blue smoke, associated with a strong odor may be observed
- This is unburned fuel and will quickly go away as the engine warms up
- Most engines operate more efficiently and cleaner at higher operating temperature

Coolant Temperature

- A thermostat limits the amount of cooling below a certain coolant temperature, usually around 175°F
- If the thermostat is removed, the engine will cool down too far at light load and run dirtier
- Diesel engines are normally expected to operate at temperatures of up to 210°F

Refueling

- The Fuel Buffalo enables the fuel to remain clean during transition to fuel tank

- Keep the tank topped off to minimize the moisture buildup in the tank

Catalyst Failure

- **The catalyst is designed to last the duration of the engine and contains no wear parts**

- **Likely failure would be caused by:**
  - excessive idling of the vehicle
  - contaminated fuel or
  - unauthorized aftermarket fuel additives

- **Since the catalyst performance is checked at least weekly, any failure would be detected promptly**

Exhaust Particulate Filter Failure

- **Some causes of exhaust particulate filter failure:**
  - Improper installation of the particulate filter element
  - Missing particulate filter element
  - Filter element damaged during shipping or handling

- **In either case, the harmful hydrocarbon emissions and the diesel particulate emissions would significantly increase**
- **The first indication of a leaking or otherwise damaged exhaust particulate filter is soot deposit downstream of the filter**

Summary

- Many factors can adversely affect diesel emissions
- Intake restriction is the most common
- Strictly maintain engine and exhaust conditioning equipment
- Regularly monitor the mine atmosphere
- Remember, excessive diesel emissions are harmful

TITLE 56, SERIES 23
WEST VIRGINIA OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

RULES FOR OPERATING DIESEL EQUIPMENT IN UNDERGROUND MINES IN WEST VIRGINIA

NOTE: This rule was filed as an emergency rule and a legislative rule. The effective date of the emergency rule is July 10, 2018. The legislative rule will go before the Legislature during the 2019 Session.

The change to this rule permits the use of diesel generators in underground mines so long as the generator is vented directly to the return and at least one person is present within sight and sound of the generator. A section has also been added addressing electrical safety rules applicable to diesel generators that are similar to MSHA's regulations governing diesel generators.

§56-23-1. General.

1.1. Scope. -- This legislative rule establishes the standards, procedural and interpretative guidelines under which diesel powered equipment may be used in an underground coal mine in the state of West Virginia.

1.2. Authority. -- W. Va. Code §§22A-2A-1001 and 22A-2A-308(a).

1.3. Filing Date - ___________________.

1.4. Effective Date -- __________________.

1.5. Sunset Provision. -- This rule shall terminate and have no further force or effect upon the expiration of 5 years from its effective date.

§56-23-2. Definitions.

2.1. Unless the context in which a word or phrase appears clearly requires a different meaning, all terms used in this rule that are not defined herein shall have the meanings set forth in W. Va. Code §22A-1-2.

2.2. "ASE certified diesel mechanic" means a diesel mechanic certified by the National Institute for Automotive Service Excellence.

2.3. "Board" means the board of coal mine health and safety continued by W. Va. Code §22A-6-3.

2.4. "Certificate of approval" means a formal document issued by MSHA stating that a complete assembly has met the requirements of part 36, title thirty of the code of federal regulations, 30 CFR §36.1, *et seq*., for mobile diesel-powered transportation equipment and authorizing the use and attachment of an official approval plate so indicating.

2.5. "Diesel fuel tank" means a closed metal vessel specifically designed for the storage or transport of diesel fuel.

2.6. "Diesel fuel transportation unit" means a self-propelled or portable wheeled vehicle used to transport a diesel fuel tank.

2.7. "Diesel engine" means any compression ignition internal combustion engine using the basic diesel cycle where combustion results from the spraying of fuel into air heated by compression.

2.8. "Diesel power package" means a diesel engine with an intake system, exhaust system, and a safety shutdown system installed that meets the specific requirements for MSHA approval of diesel power packages intended for use in approved equipment in areas of underground coal mines where electric equipment is required to be permissible.

2.9. "Director" means the director of the office of miners' health, safety and training or his or her authorized representative.

2.10. "Exhaust emission" means any substance emitted to the atmosphere from the exhaust port of the combustion chamber of a diesel engine.

2.11. "Exhaust emissions control and conditioning system" means a device or combination of devices that will collect and treat diesel exhaust emissions at the exhaust port of the engine, and will reduce the volume of, or eliminate emissions of, diesel particulate matter, carbon monoxide and oxides of nitrogen in accordance with the requirements and standards of the commission established in accordance with the provisions of W. Va. Code §22A-2A-403.

2.12. "ISO 8178-1" means an international standard set by the International Organization for Standardization that specifies the standard reference temperature for geometrical product specification and verification.

2.13. "MSHA" means the mine safety and health administration of the United States Department of Labor.

2.14. "Office of miners' health, safety and training" means the West Virginia office of miners' health, safety and training continued by W. Va. Code §22A-1-1.

2.15. "Permanent underground diesel fuel storage facility" means a facility designed and constructed to remain at one location for the storage or dispensing of diesel fuel, which does not move as mining progresses.

2.16. "Safety can" means a metal container intended for storage, transport or dispensing of diesel fuel, with a nominal capacity of five gallons, listed or approved by a nationally recognized independent testing laboratory.

2.17. "Temporary underground diesel fuel storage area" means an area of a mine provided for the short-term storage of diesel fuel in a fuel transportation unit, which moves as mining progresses.

2.18. "Underground diesel generator" means any machine powered with an approved diesel power package and electrical components used as an alternative electrical power source.

§56-23-3. Underground Use.

3.1. Underground use of inby and outby diesel-powered equipment, including mobile equipment, stationary equipment and equipment of all horsepower ratings, may only be approved, operated and maintained as provided in this rule, except for emergency fire-fighting equipment to be used specifically for that purpose.

3.2. All diesel-powered equipment shall be attended while in operation with the engine running in underground mines. For purposes of this rule, "attended" shall mean a diesel equipment operator is within sight or sound of the diesel-powered equipment.

3.3. Inby and outby diesel-powered equipment may be used in underground mines if the inby or outby diesel-powered equipment uses an engine approved or certified by MSHA, as applicable, for inby or outby use that, when tested at the maximum fuel-air ratio, does not require an MSHA Part 7 approval plate ventilation rate exceeding 75 c.f.m. per rated horsepower. Should MSHA promulgate new regulations that change the MSHA part 7 approval plate ventilation rate, the cfm requirement per rated horsepower will be revised either up or down on a direct ratio basis upon the recommendation of the director.

§56-23-4. Diesel-Powered Equipment Package.

4.1. All diesel-powered equipment shall be approved by the director as a complete diesel-powered equipment package, which shall be subject to all of the requirements, standards and procedures set forth in this rule.

4.2. Diesel engines shall be certified or approved, as applicable, by MSHA and maintained in accordance with MSHA certification or approval and the director's approval.

4.3. All approved diesel powered equipment packages shall be listed on an inventory sheet submitted to the director with a copy maintained at the mine. The following information shall be provided on the inventory list:

4.3.1. Name, address and permit number of the mine.

4.3.2. The telephone number and name of the contact person responsible for maintenance and testing of the diesel equipment.

4.3.3. The following specific information for each engine:

4.3.3.a. Manufacturer, serial number and model of the equipment using the power-package.

4.3.3.b. Manufacturer, model number and serial number of the engine.

4.3.3.c. MSHA 7E approval number.

4.3.3.d. Rated HP and RPM.

4.3.3.e. DPM gr/hr rating and mg over m to the third power.

4.3.3.f. Ventilation rate.

4.3.4. The following specific information for each filter system:

4.3.4.a. Manufacturer and model of the filter system.

4.3.4.b. MSHA Efficiency Rating of the specific filter system(s) or an accepted third party rating.

4.3.4.c. System type and composition (i.e., Passively Regenerated Cordierite, etc.).

4.3.4.d. The manufacturer/model of regeneration system (if applicable).

4.4. The mine operator shall be permitted to replace a filter or catalyst of the same make and model without contacting the office of miners' health, safety and training. A record must be maintained of all of the pertinent data and available for inspection.

§56-23-5. Exhaust Emissions Control.

5.1. Underground diesel-powered equipment shall include an exhaust emissions control and conditioning system that has been laboratory tested with the diesel engine, except as provided in section 5.3., using the ISO 8178-1 test and has resulted in diesel particulate matter emissions that do not exceed an average concentration of 0.12 mg over m to the third power when diluted by one hundred percent of the MSHA Part 7 approval plate ventilation rate for that diesel engine. Should MSHA promulgate new regulations that change the MSHA Part 7 approval plate ventilation rate, the dilution percentage relative to the approval plate ventilation rate will be adjusted either up or down on a direct ratio basis upon recommendation of the director.

5.2. The exhaust emissions control and conditioning system shall be required to successfully complete a single series of laboratory tests conducted at a laboratory accepted by the director for each diesel engine, except as provided in section 5.3.

5.3. An exhaust emissions control and conditioning system may be approved for multiple diesel engine applications through a single series of laboratory tests, known as the ISO 8178-1 test, only if data is provided to the director that reliably verifies that the exhaust emissions control and conditioning system will meet, for each diesel engine, the in-laboratory diesel particulate matter standard established by this section. Data provided to satisfy this provision shall include diesel particulate matter production rates for the specified engine as measured during the ISO 8178-1 test, if available. If ISO 8178-1 test data for diesel particulate matter production is not available for a specified engine, comparable data may be provided to the director that reliably verifies that the exhaust emissions control and conditioning system will meet, for the specified diesel engine, the in-laboratory diesel particulate matter standard established by this section. This standard shall only be used for in-laboratory testing for approval of diesel-powered equipment for use underground.

5.4. The exhaust emissions control and conditioning system shall include the following:

5.4.1. A diesel particulate matter (DPM) filter that has proven capable of at least a seventy-five percent reduction of diesel particulate matter,

5.4.2. An oxidation catalyst or other gaseous emissions control device capable of reducing undiluted carbon monoxide emissions to 100 ppm or less under all conditions of operation at normal engine operating temperature range.

5.4.3. An engine surface temperature control capable of maintaining significant external surface temperatures below three hundred two degrees Fahrenheit.

5.4.4. A system capable of reducing the exhaust gas temperature below three hundred two degrees Fahrenheit.

5.4.5. An automatic engine shutdown system that will shut off the engine before the exhaust gas temperature reaches three hundred two degrees Fahrenheit and, if waterjacketed components are used, before the engine coolant temperature reaches two hundred twelve degrees Fahrenheit. A warning shall be provided to alert the equipment operator prior to engine shutdown.

5.4.6. A spark arrestor system.

5.4.7. A flame arrestor system.

5.4.8. A sampling port for measurement of undiluted and untreated exhaust gases as they leave the engine.

5.4.9. A sampling port for measurement of treated undiluted exhaust gases before they enter the mine atmosphere.

5.4.10. For inby diesel equipment, any additional requirements of MSHA regulations at 30 CFR Part 36 (relating to mobile diesel-powered transportation equipment for gassy noncoal mines and tunnels).

5.5. On-board engine performance and maintenance diagnostics systems shall be capable of continuously monitoring and giving readouts for subsections 5.5.1. thru 5.5.8. of this section. The diagnostics system shall identify levels that exceed the engine and/or component manufacturer's recommendation or the applicable MSHA or director's requirements as to the following:

5.5.1. Engine speed;

5.5.2. Operating hour meter;

5.5.3. Total intake restriction;

5.5.4. Total exhaust backpressure;
5.5.5. Cooled exhaust gas temperature;
5.5.6. Coolant temperature;
5.5.7. Engine oil pressure;
5.5.8. Engine oil temperature.

§56-23-6. Ventilation.

6.1. Minimum quantities of air where diesel-powered equipment is operated shall be maintained pursuant to this section.

6.2. Each specific model of diesel-powered equipment shall be approved by the director before it is taken underground. The director shall require an approval plate that must be attached to each piece of the diesel-powered equipment. The approval plate shall specify the minimum ventilating air quantity for the specific piece of diesel-powered equipment. The minimum ventilating air quantity shall be determined by the director based on the amount of air necessary at all times to maintain the exhaust emissions at levels not exceeding the exposure limits established in section 7 of this rule.

6.3. The minimum quantities of air in any split where any individual unit of diesel-powered equipment is being operated shall be at least that specified on the approval plate for that equipment. Air quantity measurements to determine compliance with this requirement shall be made at the individual unit of diesel-powered equipment.

6.4. Where multiple units are operated, the minimum quantity shall be at least one hundred percent of MSHA's Part 7 approval plate quantities for each unit operating in that split. Air quantity measurements to determine compliance with this requirement shall be made at the most downwind unit of diesel-powered equipment that is being operated in that air split. Should MSHA promulgate new regulations that change the MSHA Part 7 approval plate ventilation rate, the minimum quantity where multiple units are operated shall be revised on a direct ratio basis upon recommendation of the director.

6.5. The minimum quantities of air on any split where any diesel-powered equipment is operated shall be in accordance with the minimum air quantities required in sections 6.1 and 6.2 and shall be specified in the mine diesel ventilation plan.

§56-23-7. Exhaust Gas Monitoring and Control.

7.1. In monitoring and controlling exhaust gases, the ambient concentration of exhaust gases in the mine atmosphere shall not exceed 35 ppm ceiling for carbon monoxide (CO), 25 ppm ceiling for nitric oxide (NO) and 3 ppm ceiling for nitrogen dioxide (NO2). The concentration of these exhaust gases shall be measured at the equipment operator's or equipment attendant's position and inby the last piece of diesel-powered equipment operating in the same split of air. Measurements shall be made weekly or more often if necessary by a qualified person and shall be conducted pursuant to the requirements of this section.

7.2. Measurement of exhaust gases shall be made with a sampling instrument no less precise than detector tubes.

7.3. If the concentration of any of the gases listed in section 7.1 is seventy-five percent or more of its exposure limit, changes to the use of the diesel equipment, the mine ventilation or other modifications to the mining process shall be made.

7.4. If the concentration of any of the gases listed in section 7.1 exceeds the exposure limit, the diesel equipment operating in that split shall be removed from service immediately and corrective action taken. After corrective action has been taken by the mine operator, the diesel equipment may be returned to service in its regular operating mode for emissions testing purposes only, and emissions testing shall be conducted immediately to assure that the concentration does not exceed seventy-five per cent of the exposure limit. Corrective action must be taken until the concentration does not exceed seventy-five percent of the exposure limit before the diesel equipment can be returned to full operation.

7.5. In addition to the other maintenance requirements set forth in this rule, the mine operator shall comply with the following requirements:

7.5.1. Repair or adjustment of the fuel injection system, engine timing or exhaust omissions control and conditioning systems shall only be performed by qualified mechanics authorized by the engine manufacturer or ASE certified diesel mechanics.

7.5.2. Complete testing of the emissions system in accordance with section 20 of this rule shall be conducted prior to any piece of diesel-powered equipment being put into service, after any repair or adjustment to the fuel delivery system, engine timing or exhaust emissions control and conditioning system.

7.5.3. Service and maintenance of the intake air filter exhaust particulate filter and the exhaust system shall be performed at specific time intervals based on the component manufacturer's recommendation, compliance with the engine or emissions control operation specifications and, as needed, based on the on-board diagnostics and/or emissions test results. Accurate records shall be maintained of all such service and maintenance.

§56-23-8. Fuel Storage Facilities.

8.1. An underground diesel fuel storage facility shall be any facility designed and constructed to provide for the storage of any mobile diesel fuel transportation unit(s) or the dispensing of diesel fuel.

8.2. Diesel-powered equipment shall be used underground only with fuel that meets the standards of the most recently approved EPA guidelines for over-the-road-fuel. Additionally, the fuel shall also meet the ASTM D975 fuel standards with a flash point of one hundred degrees Fahrenheit or greater at standard temperature and pressure. The operator shall maintain a copy of the most recent delivery receipt from the supplier that will prove that the fuel used underground meets the standard listed above.

8.3. Underground diesel fuel storage facilities shall meet the following general requirements:

8.3.1. Fixed underground diesel fuel storage tanks are prohibited.

8.3.2. No more than five hundred gallons of diesel fuel shall be stored in each underground diesel fuel storage facility.

8.4. Underground diesel fuel storage facilities shall be located as follows:

8.4.1. At least one hundred feet from shafts, slopes, shops and explosives magazines;

8.4.2. At least twenty-five feet from trolley wires, haulage ways, power cables and electric equipment not necessary for the operation of the storage facilities; and

8.4.3. In an area that is as dry as practicable.

8.5. Underground diesel fuel storage facilities shall meet the construction requirements and safety precautions enumerated in this section.

8.5.1. Underground diesel fuel storage facilities shall meet all of the following:

8.5.1.a. Be constructed of noncombustible materials and provided with either self-closing or automatic closing doors.

8.5.1.b. Be ventilated directly into the return air course using noncombustible materials.

8.5.1.c. Be equipped with an automatic fire suppression system complying with section 12 of this rule. The director may approve an alternate method of complying with section 12 of this rule on a mine by mine basis.

8.5.1.d. Be equipped with at least two portable twenty-pound multipurpose dry-chemical type fire extinguishers.

8.5.1.e. Be marked with conspicuous signs designating combustible liquid storage.

8.5.1.f. Be included in the pre-shift examination.

8.5.2. Welding or cutting other than that performed in accordance with subdivisions 8.5.2.a. and 8.5.2.b. below shall not be done within fifty (50) feet of a diesel fuel storage facility. When it is necessary to weld, cut or solder pipelines, cylinders, tanks or containers that may have contained diesel fuel, the following requirements shall apply:

8.5.2.a. Cutting or welding shall not be performed on or within containers or tanks that have contained combustible or flammable materials until such containers or tanks have been thoroughly purged and cleaned or inerted and a vent or opening is provided to allow for sufficient release of any buildup pressure before heat is applied.

8.5.2.b. Diesel fuel shall not be allowed to enter pipelines or containers that have been welded, soldered, brazed or cut until the metal has cooled to ambient temperature.

§56-23-9. Transfer of Diesel Fuel.

9.1. Diesel fuel shall be transferred as provided in this section.

9.2. When diesel fuel is transferred by means of a pump and a hose equipped with a nozzle containing a self-closing valve, a powered pump may be used only if:

9.2.1. The hose is equipped with a nozzle containing a self-closing valve without a latch-open device; and

9.2.2. The pump is equipped with an accessible emergency shutoff switch.

9.3. Diesel fuel shall not be transferred using compressed gas.

9.4. Diesel fuel shall not be transferred to the fuel tank of diesel-powered equipment while the equipment's engine is running.

9.5. Diesel fuel piping systems shall be designed and operated as dry systems.

9.6. All piping, valves and fittings shall meet the following:

9.6.1. Be capable of withstanding working pressures and stresses.

9.6.2. Be capable of withstanding four times the static pressures.

9.6.3. Be compatible with diesel fuel.

9.6.4. Be maintained in a manner that prevents leakage.

9.7. Vertical pipelines shall have manual shutoff valves installed at the surface filling point and at the underground discharge point.

9.8. Unburied diesel fuel pipelines shall not exceed three hundred feet in length and shall have shutoff valves located at each end of the unburied pipeline.

9.9. Horizontal pipelines shall not be used to distribute fuel throughout the mine.

9.10. Diesel fuel piping systems shall be used only to transport fuel from the surface directly to a single underground diesel fuel transfer point.

9.11. When boreholes are used, the diesel fuel piping system shall not be located in a borehole with electric power cables.

9.12. Diesel fuel pipelines located in any shaft shall be included as part of the required examination of the shaft.

9.13. Diesel fuel piping systems located in entries shall not be located on the same side of the entry as electric cables or power lines.

9.14. Diesel fuel pipelines shall not be located in any trolley-haulage entry, except that they may cross the entry perpendicular if buried or otherwise protected in steel conduit or an equivalent from damage and sealed.

9.15. Diesel fuel piping systems shall be protected to prevent physical damage.

§56-23-10. Containers.

10.1. Containers for the transport of diesel fuel shall meet the requirements of this section.

10.2. Diesel fuel shall be transported only in containers specifically designed for the transport of diesel fuel.

10.3. No more than one safety can, conspicuously marked, shall be transported on a vehicle at any time.

10.4. Containers other than safety cans used to transport diesel fuel shall be provided with the following:

10.4.1. Devices for venting.

10.4.2. Self-closing caps.

10.4.3. Vent pipes at least as large as the fill or withdrawal connection, whichever is larger, but not less than one and one-fourth inch nominal inside diameter.

10.4.4. Liquid-tight connections for all container openings that are identified by conspicuous markings and closed when not in use.

10.4.5. Shutoff valves located within one inch of the tank shell on each connection through which liquid can normally flow.

10.5. When tanks are provided with openings for manual gauging, liquid-tight caps or covers shall be provided and shall be kept closed when not open for gauging.

10.6. Containers used for the transport of diesel fuel shall not exceed a capacity of five hundred gallons.

10.7. Containers, other than safety cans, used for the transport of diesel fuel shall be permanently fixed to the transportation unit; provided, however, that the director may develop criteria on a mine by mine basis that allows for approved diesel fuel transportation units to be transported on (or by) a secondary transportation unit to their respective work areas.

10.8. Diesel fuel transportation units shall be transported individually and not with any other cars, except that two diesel fuel transportation units up to a maximum of five hundred gallons each may be transported together.

10.9. Diesel fuel shall not be transported on conveyor belts.

10.10. When transporting diesel fuel in containers other than safety cans, a fire extinguisher shall be provided on each end of the transportation unit. The fire extinguishers shall be multipurpose type dry-chemical fire extinguishers containing a nominal weight of twenty pounds.

10.11. Diesel fuel transportation units shall have a fire suppression system that meets the requirements of section 11 of this rule.

10.12. In mines where trolley wire is used, diesel fuel transportation units shall be provided with insulating material to protect the units from energized trolley wire, and the distance between the diesel fuel transportation unit and the trolley wire shall not be less than twelve inches, or the trolley wire shall be de-energized when diesel fuel transportation units are transported through the area.

10.13. Unattended diesel fuel transportation units shall be parked only in underground diesel fuel storage facilities.

10.14. Safety cans shall be used for emergency fueling only.

10.15. Safety cans shall be clearly marked, have a maximum capacity of five gallons and be constructed of metal and equipped with a nozzle and self-closing valves.

§56-23-11. Fire Suppression for Equipment and Transportation.

11.1. Fire suppression systems for diesel-powered equipment and fuel transportation units shall meet the requirements of this section.

11.2. The system must be an automatic multipurpose dry-powder type fire suppression system suitable for the intended application and listed or approved by a nationally recognized independent testing laboratory. Installation requirements are as follows:

11.2.1. The system shall be installed in accordance with the manufacturer's specifications and the limitations of the listing or approval.

11.2.2. The system shall be installed in a protected location or guarded to minimize physical damage from routine operations.

11.2.3. Suppressant agent distribution tubing or piping of the system shall be secured and protected against damage, including pinching, crimping, stretching, abrasion and corrosion.

11.2.4. Discharge nozzles of the system shall be positioned and aimed for maximum fire suppression effectiveness in the protected areas. Nozzles shall also be protected against the entrance of foreign materials such as mud, coal dust or rock dust that could prevent proper discharge of suppressant agent.

11.3. The fire suppression system shall provide automatic fire detection and suppression for all of the following:

11.3.1. The engine, transmission, hydraulic pumps and tanks, fuel tanks, exposed brake units, air compressors and battery areas, as applicable, on all diesel-powered equipment.

11.3.2. Fuel containers and electric panels or controls used during fuel transfer operations on fuel transportation units.

11.4. The fire suppression system shall include a system fault and fire alarm annunciator that can be seen and heard by the equipment operator.

11.5. The fire suppression system shall provide for automatic engine shutdown. Engine shutdown and discharge of suppressant agent may be delayed for a maximum of fifteen (15) seconds after the fire alarm annunciator alerts the operator.

11.6. At least two manual actuators shall be provided with at least one manual actuator at each end of the equipment. If the equipment is provided with an operator's compartment, one of the mechanical actuators shall be located in the compartment within easy reach of the operator. For stationary equipment, the two manual actuators shall be located with at least one actuator on the stationary equipment and at least one actuator a safe distance away from the equipment and in intake air.

§56-23-12. Fire Suppression for Storage Areas.

12.1. Fire suppression systems for diesel fuel storage areas shall meet the requirements of this section.

12.2. The system shall be an automatic multipurpose dry-powder type fire suppression system or other system of equal capability, suitable for the intended application and listed or approved by a nationally recognized independent testing laboratory. The system shall meet the following installation requirements:

12.2.1. The system shall be installed in accordance with the manufacturer's specifications and the limitations of the listing or approval.

12.2.2. The system shall be installed in a protected location or guarded to minimize physical damage from routine operation.

12.2.3. Suppressant agent distribution tubing or piping of the system shall be secured and protected against damage, including pinching, crimping, stretching, abrasion and corrosion.

12.2.4. Discharge nozzles of the system shall be positioned and aimed for maximum fire suppression effectiveness in the protected areas. Nozzles must also be protected against the entrance of foreign materials such as mud, coal dust and rock dust that could prevent proper discharge of suppressant agent.

12.3. The fire suppressant system shall provide automatic fire detection and suppression for the fuel storage tanks, containers, safety cans, pumps, electrical panels and control equipment in fuel storage areas.

12.4. Audible and visual alarms to warn of fire or system faults shall be provided at the protected area and at a surface location that is always staffed when persons are underground. A means shall also be provided for warning all endangered persons in the event of fire.

12.5. Fire suppression systems shall include two manual actuators with at least one located within the fuel storage facility and at least one located a safe distance away from the storage facility and in intake air.

12.6. The fire suppression system shall remain operative in the event of electrical system failure.

12.7. If electrically operated, the detection and actuation circuits shall be monitored and provided with status indicators showing power and circuit continuity. If not electrically operated, a means shall be provided to indicate the functional readiness status of the system.

12.8. Fire suppression devices shall be visually inspected at least once each week by a person qualified to make such inspections.

12.9. Each fire suppression device shall be tested and maintained.

12.10. A record shall be maintained of the inspection required by this section. The record of the weekly inspections shall be maintained at an appropriate location for each fire suppression device.

12.11. All miners normally assigned to the active workings of a mine shall be instructed about any hazards inherent to the operation of all fire suppression devices installed and, where appropriate, the safeguards available for each device.

§56-23-13. **Use of Certain Starting Aids Prohibited.**

13.1. The use of volatile or chemical starting aids is prohibited.

§56-23-14. **Fueling.**

14.1. Fueling of diesel-powered equipment shall not be conducted in the intake escapeway unless the mine design and entry configuration make it necessary. In those cases where fueling in the intake escapeway is necessary, the mine operator shall submit a plan for approval to the director outlining the special safety precautions that will be taken to insure the protection of miners. Such plan shall specify a location, (such as end of the tail track or adjacent to the load out point), where fueling will be conducted in the intake escapeway and all other safety precautions that will be taken, which shall include an examination of the area for spillage or fire by a qualified person.

14.2. Diesel fuel and other combustible materials shall be cleaned up and not be permitted to accumulate anywhere in an underground mine or on diesel-powered or electric equipment located therein.

14.3. At least one person specially trained in the cleanup and disposal of diesel fuel spills shall be on duty at the mine when diesel-powered equipment or mobile fuel transportation equipment is being used or when any fueling of diesel-powered equipment is being conducted.

§56-23-15. Fire and Safety Training.

15.1. All underground employees at the mine shall receive special instruction related to fighting fires involving diesel fuel. This training may be included in annual refresher training under MSHA regulations at 30 CFR Part 48 (relating to training and retraining of miners) or included in the fire drills required under MSHA regulations at 30 CFR 75.1101-23 (relating to program of instruction; location and use of fire fighting equipment; location of escapeways, exits and routes of travel; evacuation procedures; fire drills.)

15.2. All miners shall be trained in precautions for safe and healthful handling and disposal of diesel-powered equipment filters. All used intake air filters, exhaust diesel particulate matter filters and engine oil filters shall be placed in their original containers or other suitable enclosed containers and removed from the underground mine to the surface no less than once in a twenty-four (24) hour period. Arrangements will be made for safe handling and disposal of these filters within a timely manner after they have reached the surface.

§56-23-16. Maintenance.

16.1. Diesel-powered equipment shall be maintained in an approved and safe condition as described in this rule or shall be removed from service.

16.2. An operator choosing to use diesel equipment in an underground coal mine must develop a maintenance plan and submit his or her plan to the director for approval. Failure of the mine operator to comply with the maintenance requirements of this section may result in the revocation of the director's approval of the complete diesel-powered equipment package, provided appropriate notification has been given to the mine operator and the procedures of this section have been taken. Upon receiving such notice, the mine operator shall have thirty days to submit a plan to achieve and maintain compliance. Such plan shall be evaluated by the director, and, upon approval, the mine operator shall implement the plan. The director shall monitor the mine operator's compliance. At any time the director determines that the mine operator is unable or unwilling to comply, the director shall revoke the mine operator's approval, which would in turn prohibit use of all diesel equipment at that mine.

16.3. To acquire and maintain approval of a complete diesel-powered equipment package, the mine operator shall comply with the following requirements:

16.3.1. All service, maintenance and repairs of approved complete diesel-powered equipment packages shall be performed by mechanics that are trained and qualified in accordance with section 24 of this rule.

16.3.2. Service and maintenance of approved complete diesel-powered equipment packages shall be performed according to:

16.3.2.a. The specified routine maintenance schedule;

16.3.2.b. On-board performance and maintenance diagnostics readings;

16.3.2.c. Emissions test results; and

16.3.2.d. Component manufacturer's recommendations.

§56-23-17. Records.

17.1. A record shall be made of all emissions tests, preoperational examinations and maintenance and repairs of complete diesel-powered equipment packages. The records made pursuant to this section shall meet the requirements of this section.

17.2. The person performing the emissions test, examination, maintenance or repair shall certify by date, time, engine hour reading and signature that the emissions test, examination, maintenance or repair was made.

17.3. Records of emissions tests and examinations shall include the specific results of such tests and examination.

17.4. Records of maintenance and repairs shall include the work that was performed, any fluids or oil added, parts replaced or adjustments made and the results of any subsequently required emissions testing.

17.5. Records of preoperational examinations shall be retained for the previous one hundred-hour maintenance cycle.

17.6. Records of emissions tests, two hundred (200) hour maintenance tests and repairs shall be countersigned once each week by the certified mine electrician or mine foreman.

17.7. All records required by this section shall be retained for at least one year at a surface location at the mine and made available for inspection by the director, district mine inspector and by miners and their representatives.

§56-23-18. Duties of Operator.

18.1. Prior to using a piece of diesel-powered equipment during a shift, an equipment operator shall conduct an examination as follows:

18.1.1. Check the exhaust emissions control and conditioning system components to determine that the components are in place and not damaged or leaking.

18.1.2. Assure that the equipment is clean and free of accumulations of combustibles.

18.1.3. Assure that the machine is loaded safely.

18.1.4. Check for external physical damage.

18.1.5. Check for loose or missing connections.

18.1.6. Check engine oil level.

18.1.7. Check transmission oil level.
18.1.8. Check other fluid levels, if applicable.
18.1.9. Check for hydraulic, coolant and oil leaks.
18.1.10. Check fan, water pump and other belts.
18.1.11. Check the fan for damage.
18.1.12. Check guards.
18.1.13. Check the fuel level.
18.1.14. Check for fuel leaks.
18.1.15. Comply with record keeping requirements pursuant to section 17 of this rule.

18.2. After the engine is started and warmed up, the equipment operator shall conduct an examination as follows:

18.2.1. Check all on-board engine performance and maintenance diagnostics system gauges for proper operation and in-range readings. The equipment operator shall immediately shut down the engine and notify the operator if the on-board readings indicate any of the following:

18.2.1.a. Intake restriction at full engine speed is greater than the manufacturer's recommendation.

18.2.1.b. Exhaust restriction at full engine speed is greater than the manufacturer's recommendation.

18.2.1.c. Coolant temperature is at or near two hundred twelve degrees Fahrenheit.
18.2.1.d. Low engine oil pressure.
18.2.1.e. High engine oil temperature.

18.2.2. Check safety features, including, but not limited to, the throttle, brakes, steering, lights and horn.

18.2.3. Comply with record keeping requirements pursuant to section 17 of this rule.

§56-23-19. Scheduled Maintenance.

19.1. At intervals not exceeding two hundred (200) hours of engine operation, a qualified mechanic shall perform the following maintenance and make all necessary adjustments or repairs or remove the equipment from service:

19.1.1. Wash or steam-clean the equipment.

19.1.2. Check for and remove any accumulations of coal, coal dust or other combustible materials.

19.1.3. Check the equipment for damaged or missing components or other visible defects.
19.1.4. Conduct electrical and safety component inspections.

19.1.5. Replace engine oil and filter. An independent analysis shall be conducted of the engine oil.

19.1.6. Check the transmission oil level and add oil, if necessary.
19.1.7. Check hydraulic oil level and add oil, if necessary.
19.1.8. Check the engine coolant level and add coolant, if necessary.
19.1.9. Check all other fluid levels and add fluid, if necessary.
19.1.10. Check for oil, coolant and other fluid leaks.

19.1.11. Inspect the cooling fan, radiator and shroud. Remove any obstructions and make necessary repairs.

19.1.12. Check all belts. Tighten or replace, if necessary.
19.1.13. Check the battery and service as necessary.
19.1.14. Check the automatic fire suppression system.
19.1.15. Check the portable fire extinguisher.
19.1.16. Check the lights.
19.1.17. Check the warning devices.
19.1.18. With the engine operating, check and replace or repair the following:

19.1.18.a. Oil pressure.
19.1.18.b. Intake air restriction at full engine speed.
19.1.18.c. Exhaust gas restriction at full engine speed.
19.1.18.d. Exhaust flame arrestor.
19.1.18.e. All gauges and controls.

19.1.19. Conduct repeatable loaded engine-operating test in accordance with section 20 of this rule.

19.1.20. Evaluate and interpret the results of all of the above tests and examinations and make all necessary repairs or remove equipment from service.

19.1.21. Comply with recordkeeping requirements pursuant to section 17 of this rule.

§56-23-20. Emissions Monitoring and Control.

20.1. Emissions for diesel-powered equipment shall be monitored and controlled as provided in this section.

20.2. When any diesel-powered machine first enters service at a mine, baseline emission values shall be determined by a qualified mechanic. Unless the director approves an alternate procedure, the qualified mechanic shall:

20.2.1. Verify that the seal on the engine fuel injector pump is in place and that the proper fuel pump is on the equipment.

20.2.2. Install a new clean intake air cleaner, measure and record the intake restriction pressure.

20.2.3. Check the level of engine oil.

20.2.4. Change the engine lubrication oil if not fresh.

20.2.5. Check the level of the transmission fluid.

20.2.6. Flush the exhaust system, if needed. Measure and record the exhaust back pressure. If exhaust gas backpressure is above that recommended by the manufacturer, then steps must be taken to bring the exhaust gas back pressure within the manufacturer's recommended limit prior to beginning the test described in this section.

20.2.7. Test the brakes.

20.2.8. Place the equipment into an intake entry.

20.2.9. Set the brakes and chock the wheels.

20.2.10. Start the engine and allow it to warm up to operating temperature.

20.2.11. For mobile equipment, shift into the highest gear and put the engine at full throttle, or for stationary equipment, induce a load and put the engine at full throttle.

20.2.12. Start the CO sampler and measure and record CO levels every thirty seconds for ninety seconds.

20.2.13. Comply with recordkeeping requirements pursuant to section 17 of this rule.

20.2.14. An alternative to the testing provided in the aforementioned subsections may be developed by the director.

Note: CO baseline emissions must be representative of MSHA's approval data.

§56-23-21. Diagnostic Testing.

21.1. At intervals not exceeding once every two hundred (200) hours of engine operation, a qualified mechanic shall perform equipment maintenance diagnostic testing of each piece of diesel-powered equipment in the mine. The qualified mechanic shall:

21.1.1. Verify the identification numbers on the equipment;

21.1.2. Check the level of the engine lubricating oil;

21.1.3. Check the level of the transmission fluid;

21.1.4. Set the brakes and chock the wheels;

21.1.5. Install the portable CO sampling device into the untreated exhaust port coupling;

21.1.6. Start the engine and allow it to warm up to operating temperature;

21.1.7. Check the intake restriction and the exhaust back pressure at high idle speed;

21.1.8. If the intake restriction is more than the manufacturer's maximum recommended intake restriction, replace the intake filter with a clean one;

21.1.9. If exhaust gas backpressure is above that recommended by the manufacturer, then steps must be taken to bring the exhaust gas back pressure within the manufacturer's recommended limit prior to beginning the test described in this section;

21.1.10. For mobile equipment, shift into the highest gear and put the engine at full throttle, or for stationary equipment, induce a load and put the engine at full throttle.

21.1.11. Start the CO sampler and record CO levels every thirty (30) seconds for ninety (90) seconds;

21.1.12. Install the portable CO sampling device into the treated exhaust port coupling and repeat steps 21.1.l and 21.1.k;

21.1.13. If the average CO reading for treated exhaust gas is greater than 100 ppm, the equipment has failed and must be serviced and retested before it is returned to regular service; and

21.1.14. Comply with recordkeeping requirements pursuant to section 17 of this rule.

21.1.15. An alternative to the testing provided in subsections 21.1.1 thru 21.1.15. may be developed and/or approved by the director.

§56-23-22. Training and General Requirements.

22.1. To use diesel equipment in an underground mine the mine operator shall submit a training plan to the director for approval.

22.2. All training course instructors and all training plans required by this section and sections 23 and 24 of this rule shall be approved by the director. Operator training and qualification shall meet the requirements of this section.

22.3. Training shall be conducted in the basics of the operation of a diesel engine, federal and state regulations governing their use, company rules for safe operations, specific features of each piece of equipment and the ability to recognize problems and shall be provided to each equipment operator and the mine health and safety committee if one exists. This training shall be designed to bring every operator to a level of good understanding of diesel equipment operation. Each operator will be qualified by attending a minimum eight-hour course, including classroom training on diesel fundamentals and equipment-specific hands-on training on the job.

22.4. Upon successful completion of both training sessions, the operator shall be issued a Certificate of Qualification (MSHA 5000-23) that qualifies him or her to operate a specific type of diesel-powered equipment. An operator may be qualified to operate more than one type of equipment by completing additional equipment-specific training covering differences specific to each additional type of equipment.

22.5. The mine operator shall furnish all required training. The employees will suffer no loss of pay for attending training.

22.6. The minimum eight-hour training required by section 22.3 shall include instruction in the following classroom subjects:

22.6.1. Engine fundamentals, which shall include an introduction to the function of a diesel engine and recognition of all major components and their functions.

22.6.2. Diesel regulations, which shall include an introduction to federal and state regulations governing the use of diesel equipment.

22.6.3. Diesel emissions, which shall include an introduction to diesel emissions and their adverse health effects.

22.6.4. Factors that affect diesel emissions, which shall include a detailed presentation of engine faults and diesel fuel quality and their effect on emissions and the preventive actions that can be taken to minimize emissions levels.

22.6.5. Emissions control devices, which shall include a detailed presentation of the different emissions control devices employed to reduce emissions and details about actions the operator must take to keep the devices in working order.

22.6.6. Diagnostic techniques, which shall include a presentation of techniques that can be employed by the operator to assure the equipment is in safe operating condition and instruction about how to recognize and diagnose certain engine faults that may cause increases in emissions.

22.6.7. The preoperational inspection, which shall include a presentation of the purpose, benefits and requirements of the preoperational inspection.

22.6.8. Ventilation, which shall include an introduction to special ventilation requirements for areas where diesel-powered equipment will operate.

22.6.9. Fire suppression system, which shall include an introduction to the fire suppression system and its function and when and how to activate the fire suppression manually.

22.6.10. Operating rules, which shall include a detailed presentation of the driving rules, safe driving speeds, traffic control devices and equipment limitations.

22.6.11. Emergency procedures, which shall include discussion of emergency situations, such as fire, diesel fuel spills, component failure, loss of ventilation air and emergency escape procedures and discussion of the potential use of the diesel-powered vehicle as an emergency escape vehicle in case of a mine emergency situation.

22.6.12. Record keeping and reporting procedures, which shall include a presentation on required record keeping and reporting procedures for problems or unsafe conditions, high emissions levels and preoperational inspections made by the equipment operator.

§56-23-23. **Equipment-Specific Training.**

23.1. Equipment-specific hands-on orientation training shall be given in an area of the mine where the equipment will be operated. This orientation shall be specific to the type and make of the diesel machine and shall be presented in small groups. The following subjects shall be included in the training:

23.1.1. Equipment layout, which shall include familiarization with the layout of the equipment, the operator's compartments and the controls.

23.1.2. Pre-operation inspection, which shall include familiarization with the pre-operation inspection procedure and review of specific details of the inspection and location of the components to be inspected.

23.1.3. Equipment limitations, which shall include instruction relating to equipment performance, speeds, capacities and blind areas.

23.1.4. Operating areas, which shall include instruction relating to areas in which the equipment may be operated.

23.1.5. Operation, which shall include familiarization with the controls, gauges and warning devices and safe operating limits of all indicating gauges.

23.1.6. Refueling procedure, which shall include familiarization with fuel handling, permissible refueling areas, spill prevention, cleanup and potential hazards from diesel fuel.

23.1.7. Emergency devices, which shall include instruction relating to the location and use of the fire extinguisher and fire suppression devices.

23.1.8. Driving practice, which shall include supervised operation of the equipment.

§56-23-24. **Diesel Mechanic Training.**

24.1. Diesel mechanic training and qualification shall meet the requirements of this section.

24.2. Diesel mechanics shall be trained and qualified to perform maintenance, repairs and testing of the features of diesel equipment certified by MSHA and the director.

24.3. To be qualified, a diesel mechanic must successfully complete a minimum of sixteen hours of a training program approved by the director regarding the general function, operation, maintenance and testing of emissions control and conditioning components. The diesel mechanic must be qualified to perform these tasks on the specific machines used at the mine or mines where they are employed. Additional engine-specific training shall be provided to diesel mechanics in accordance with a plan approved by the director.

24.4. Annual retraining programs of eight (8) hours for diesel mechanics shall be required and approved by the director. The annual retraining shall include refresher training as well as new procedure and new technology training as necessary. Such training shall be separate from refresher training pursuant to MSHA regulations at 30 CFR Part 48 (relating to training and retraining of miners) and electrical training required by MSHA. The mine operator shall furnish all required training and refresher training. The employees will suffer no loss of pay for attending training and refresher training.

24.5. The minimum sixteen-hour diesel mechanic training programs shall be submitted for approval to the director and shall include training in the following minimum subject requirements:

24.5.1. Federal and state requirements regulating the use of diesel equipment.

24.5.2. Company policies and rules related to the use of diesel equipment.

24.5.3. Emissions control system design and component technical training.

24.5.4. On-board engine performance and maintenance diagnostics system design and component technical training.

24.5.5. Service and maintenance procedures and requirements for the emissions control systems.

24.5.6. Emissions testing procedures and evaluation and interpretation of test results.

24.5.7. Troubleshooting procedures for the emissions control systems.

24.5.8. Fire protection systems test and maintenance.

24.5.9. Fire and ignition sources and their control and elimination.

24.5.10. Fuel system maintenance and safe fueling procedures.

24.5.11. Intake air system design and components technical training and maintenance procedures.

24.5.12. Engine shutdown device tests and maintenance.

24.5.13. Special instructions regarding components, such as the fuel injection system, that shall only be repaired and adjusted by a qualified mechanic who has received special training and is authorized to make such repairs or adjustments by the component manufacturer or ASE certified diesel mechanic.

24.5.14. Instruction on record keeping requirements for maintenance procedures and emissions testing.

24.5.15. Other subjects determined by the director to be necessary to address specific health and safety needs.

24.6. Individuals successfully completing the approved sixteen (16) hour diesel mechanic training will be considered to be a trained operator providing he or she has received the necessary task training on the specific piece of diesel equipment.

§56-23-25. Operation of Diesel-Powered Equipment.

25.1. In addition to other requirements of this rule, diesel-powered equipment shall be operated pursuant to the standards set forth in this rule.

25.2. All diesel-powered equipment shall be attended while in operation with the engine running in underground mines.

25.3. Unnecessary idling of diesel-powered equipment shall be prohibited.

25.4. All roadways where diesel-powered equipment is operated shall be maintained as free as practicable from bottom irregularities, debris and wet or muddy conditions that will affect control of the equipment.

25.5. Operating speeds shall be consistent with conditions of roadways, grades, clearances, visibility and traffic and type of equipment used.

25.6. Equipment operators shall have full control of the mobile equipment while it is in motion.

25.7. Traffic rules, including speed, signals and warning signs, shall be standardized at each mine and posted.

25.8. All diesel-powered equipment shall be maintained in a safe and healthful operating condition. Equipment in an unsafe or unhealthful condition or not maintained in accordance with the engine or emissions control operating specifications shall be removed from service immediately and shall not be returned to service until all necessary corrective actions have been taken.

§56-23-26. Diesel Inspectors; Employment; Training.

26.1. The office of miners' health, safety and training shall assign a diesel inspector in each region of the state's four regional offices.

26.2. The diesel inspector may be assigned other duties as prescribed by the director.

26.3. The office of miners' health, safety and training shall provide the diesel inspectors with specific training on this rule; also they shall train and equip the diesel inspectors with the proper equipment so that the inspectors may effectively test for diesel emissions and properly enforce this rule as prescribed by the director.

26.4. The diesel inspectors shall be trained in accordance with criteria as established and approved by the director.

26.5. After the implementation of this rule, the office of miners' health, safety and training shall employ additional diesel inspectors as needed.

§56-23-27. Diesel Inspector -- Training Course.

27.1. Training for diesel inspectors shall include, but is not limited to, the following:

27.1.1. Engine Fundamentals – Components and Operation of a Diesel Engine.

27.1.2. Fuel Standards – Fuel Requirements and Effect of Various Fuels on DPM Emissions.

27.1.3. Diesel Regulations – State and Federal.

27.1.4. DPM – Health Effects.

27.1.5. Factors that increase/decrease DPM emissions.

27.1.6. Emission Control Techniques – Operation, Maintenance and Testing.

27.1.7. Diagnostics – Instruments, Testing and Evaluation.

27.1.8. Inspection Techniques – Enforcement.
27.1.9. Ventilation.
27.1.10. Fire Suppression Systems – Operation, Testing and Maintenance.
27.1.11. Emergency Procedures – Firefighting, Spills/Containment.
27.1.12. Fuel Handling/Storage.
27.1.13. Manufacturer Training.
27.1.14. Training Requirements – Plans, Record Keeping.

§56-23-28. Operation of Underground Diesel Powered Electric Generators.

28.1. While being operated, the diesel generator shall be vented directly to the return air course.

28.2. At least one person shall be present within sight and sound while the generator is in operation (engine running) and he/she shall have a multi-gas detector capable of detecting nitric oxide (NO), nitrogen dioxide (NO_2) and carbon monoxide (CO).

28.3. All current state rules and statutes relating to the use of diesel-powered equipment and electricity remain in force.

28.4. Prior to the initial operation of the diesel generator underground, the operator shall give the director or his/her authorized representative ten (10) days' written notice. In case of an emergency, the operator shall notify the director or his/her authorized representative as soon as possible prior to its initial use.

§56-23-29. Electrical Provisions for Diesel-Powered Electrical Generators.

29.1. Electrical provisions for diesel-powered electrical generators used as an alternative to power centers for moving equipment in, out, and around the mine and to perform work in areas where permissible equipment is not required, must comply with the following:

29.1.1. A grounding resistor rated for the phase-to-phase voltage of the system must be provided to limit the ground-fault current to not more than 0.5 amperes.

29.1.1.a. The grounding resistor(s) must be located:

29.1.1.a.1. Between the wye-connected generator neutral and the generator frame or

29.1.1.a.2. Between the wye-connected generator neutral and the generator frame and between the wye-connected transformer secondary and the transformer frame when an isolation transformer(s) is used and the generator is supplying power to the other equipment or

29.1.1.a.3. Between the wye-connected generator neutral and the generator frame when an auto-transformer is used.

29.2. Each three-phase output circuit of the generator must be equipped with a sensitive ground fault relay. The protective relay must be set to cause the circuit interrupting device that supplies power to the primary windings of each transformer to trip and shut down the diesel engine when a phase-to-frame fault of not more than 90 milliamperes occurs.

29.3. The neutral grounding resistor shall be provided with backup ground fault protection that will shut down the diesel engine if a ground fault occurs with the neutral grounding resistor open.

29.4. Each three-phase output circuit that supplies power to equipment must be equipped with an instantaneous sensitive ground-fault relay that will cause its respective circuit interrupting device(s) to trip and cause shutdown of the diesel engine when a phase-to-frame fault occurs. The grounded-phase protection must be set at not more than 90 milliamps. Current transformers used for the ground-fault protection must be single window-type and must be installed to encircle all three phase conductors. Equipment safety grounding conductors must not pass through or be connected in series with ground-fault current transformers.

29.5. Each three-phase circuit interrupting device must be provided with a means to provide short-circuit, overcurrent, grounded-phase, under-voltage, and ground wire monitoring protection. The instantaneous only trip unit for the circuit interrupting device(s) in use must be adjusted to trip at not more than seventy-five percent (75%) of the minimum available short circuit current at the point where the portable cable enters the equipment, specified in Table 56-23A found at the end of this rule.

29.6. The equipment portable cable length(s) must not exceed the length(s) specified in Table 56-23B found at the end of this rule.

29.7. Permanent label(s) listing the maximum circuit interrupting device setting(s) and maximum portable cable length(s) must be installed on each instantaneous trip unit or be maintained near each three-phase circuit interrupting device. The permanent label(s) must be maintained legibly.

29.8. The circuit interrupting device that supplies three-phase power circuit(s) to the equipment being powered must be limited to the use of only one circuit interrupting device at a time when equipment is being moved in, out, and around the mine.

29.9. The grounding system must include an MSHA-accepted ground wire monitor system to assure that grounding conductor is connected to the frames of all equipment and to the frame of the generator. Double grounding will not be accepted in lieu of ground monitoring.

29.10. All trailing cables extending from the generator to equipment must comply with the design of trailing cables for medium-voltage circuits.

29.11. Trailing cables for medium-voltage circuits shall include grounding conductors, a ground check conductor, and grounded metallic shields around each power conductor or a ground metallic shield over the assembly, except that on equipment employing cable reels, cables without shields may be used if the insulation is rated 2,000 volts or more.

29.12. A strain relief device must be provided on each end of the trailing cables that extends between the generator and the piece of equipment being powered.

29.13. Prior to moving each piece of equipment or performing work, a functional test of each ground fault and ground wire monitor system must be performed by a qualified electrician. The ground-fault circuit must be tested without subjecting the circuit to an actual grounded phase condition. A record of each test must be maintained and made available to authorized representatives of the director and to the miners in such mine.

29.14. The diesel generator must be provided with power quality monitoring. This shall include volt meter(s), ammeters and a frequency meter to determine the power quality of all three phases.

Table 56-23A

Conductor Size AWG or MGM	Maximum Allowable Circuit Breaker Instantaneous Setting (Ampheres)
14	50
12	75
10	150
8	200
6	300
4	500
3	600
2	800
1	1,000
1/0	1,250
2/0	1,500
3/0	2,000
4/0	2,500
250	2,500
300	2,500
350	2,500
400	2,500
450	2,500
500	2,500

TABLE 56-23B
SPECIFICATIONS FOR PORTABLE CABLES LONGER THAN 500 FEET

Conductor Size -- AWG or MCM	Max. Allowable Length (Feet)	Normal Ampacity at 60° C. Copper Temperature (40° C. Ambient)	Resistance at 60° C. Copper Temperature (Ohms)
6	550	50	0.512
4	600	70	.353
3	650	80	.302
2	700	95	.258
1	750	110	.220
1/0	800	130	.185
2/0	850	150	.157
3/0	900	175	.130
4/0	1,000	200	.116
250	1,000	220	.098
300	1,000	240	.082
350	1,000	260	.070
400	1,000	280	.061
450	1,000	300	.054
500	1,000	320	.050

Pre-Operational Inspection Locomotive

Plan for Safety

Pre-Operational Inspection

- Assure park brake is set
- Assure machine is clean and free of accumulations of combustibles
- Check for unsecured equipment and materials on locomotive
- Check for physical external damage
- Look for loose or missing connections

Pre-Operational Inspection

- Check for leaks - hydraulic, coolant, fuel and oil leaks
- Check guards
- Check sanders
- Check jack, bar, fire extinguisher, reflectors, manual un-coupler bar, and safety chain

Pre-Operational Inspection

- Check exhaust emissions control and conditioning system components to determine that they are in place and operational
- Check fan, water pump and other belts
- Check coolant level

Start Engine

- Check oil pressure
- Check all gauges for safe operating ranges
- Allow engine to warm-up
- Put engine into high idle
- Check intake restriction
- Check exhaust gas back pressure
- Check coolant temperature

Pre-op Checks After Start-Up

- Check two-way communications
- Notify a mechanic if the intake restriction, exhaust gas backpressure, coolant temperature, oil pressure or oil temperature are not in the normal range as indicated on gauge

Continue Warm Engine Checks

- Set parking brake
- Make sure the equipment is positioned correctly
- Secure machine against movement
- Put machine into high gear and check service brake and park brake
- Do not operate unsafe equipment

Record and Sign

- Complete pre-operational checklist
- Record Engine hours:__________hrs.
- Next 200-hour check due:______hrs.
- Operator:____________________________
- Date:_________________________________
- Time:________________________AM/PM

MINE:___________________________________

DIESEL EQUIPMENT
PRE-OPERATION CHECKLIST

MACHINE:_______________________________

	Beginning	Ending
DATE	_______________	_______________
HOUR METER	___________	____________

Next 200-hour Service Due
at __________________hour meter reading.

Do not operate this diesel equipment if hour meter exceeds this number. Report to immediate supervisor for maintenance / servicing.

PRE-OPERATION CHECKLIST

_______ **Assure the park brake is set**
_______ Assure that the equipment is clean and free of accumulations of combustibles
_______ Check for loose, unsecured materials stored or hauled on equipment
_______ Check for external physical damage and reflectors on all sides
_______ Check for loose, leaking or missing filter on exhaust conditioning system
_______ Check fire suppression system status panel (power light should blink)
_______ Check engine oil level
_______ Check other fluid levels if applicable
_______ Check for hydraulic, coolant, fuel or oil leaks
_______ Fluids added ____
_______ Check fan, water pump belt and other belts
_______ Check guards
_______ Check lifting jack & bar, (and lug wrench)
_______ Check fire extinguisher
_______ Check lights and horn
_______ Check self-closing fuel filler cap and cap vent
_______ Check fuel level and indicate amount 1/4 1/2 3/4 Full
_______ **Start the engine and avoid low idle**
_______ Check engine oil pressure as engine warms
_______ Check all on-board gauges for proper operation and in-range readings
_______ Immediately shut down the engine and notify the supervisor if the on-board readings fail
_______ Check Intake Restriction at full engine speed and record ___inches. Normal is 6 to22 inches
_______ Check Exhaust Restriction at full engine speed and record ___ inches. Normal is 6 to26 inches
_______ Check Coolant Temperature
_______ Check for High Engine Oil Temperature
_______ Check transmission oil level
_______ Check the brakes
_______ Check the steering
_______ **Record engine hours___________**
_______ **Next 200-hour service due at_______________hours**
_______ Be sure passengers are safely loaded

Date_______________ Time___________a.m. / p.m.

Operator's signature:

____

COMPANY RULES
FOR NORMAL DIESEL OPERATION
AND USE DURING EMERGENCIES

(Topics for discussion and inclusion into customized operator training programs)

DRIVING RULES

What speed, engine RPM's, and transmission gear should be used?

Drive on right (or left) side?

Method to keep equipment out of low or close clearance areas:

When and where will idling be considered unnecessary?

Maximum number of vehicles inside air-locked areas (based upon ventilation volume and equipment requirements):

Maximum number of vehicles on each split of ventilation current?

TRAFFIC CONTROL

What signs, barriers or methods prevent entering low areas?

Will regular-shaped traffic control signs, stop, yield, do-not-enter, etc. be utilized?

Method of communications with dispatcher if traveling on track:

Method of controlling roadway dust:

Schedule for maintaining roadways:

FAN OUTAGES

Procedure to follow:

COMPANY RULES
FOR NORMAL DIESEL OPERATION
AND DURING EMERGENCIES

(Topics for discussion and inclusion into customized operator training programs)

EMERGENCY ESCAPE VEHICLE

A readily available vehicle must be maintained for persons inby the dumping point on working sections.

Your plan or method to assure a readily available vehicle is provided:

FIGHTING FIRES OR FLOODS

Procedure to use and ventilate equipment required for fire fighting (i.e. bulk rockduster trailer or water car pulled to fire scene with diesel tow tractor):

Procedure to use and ventilate diesel pumps or emergency power sources brought to flood scenes:

DIESEL SPILLS

Who are the trained person(s) responsible to clean up diesel spills?

Day shift:
Evening shift:
Midnight shift:

Storage location of diesel clean-up materials:

What protective clothing and spill clean-up materials are provided?

SECTION L – <u>DIESEL FUEL AND FUELING</u>

1. **<u>Diesel Fuel Requirements</u>** *EPA GUIDELINES* **(Review WV Requirements and Regulations).** *POWER POINT*
2. **<u>Fuel Storage / Transport of Fuel –</u> (Review WV Requirements and Regulations).** *POWER POINT*

SECTION M – DIESEL TESTING INSTRUMENT HANDS ON TRAINING

1. ECOM ANALYZER TRAINING.
2. 5 GAS DETECTOR TRAINING.
3. EXHAUST LEAKS.
4. SURFACE AND EXHAUST TEMP.
5. BACHARACH SMOKE DOT TESTER.

SECTION N – 90 SECOND LOAD TEST TRAINING

1. Test Simulation
2. Logging Test Data

MINE:_______________________________

DIESEL EQUIPMENT
200-HOUR
MAINTENANCE RECORD

MACHINE:___________________________

	Beginning	Ending
DATE	_______________	_______________
HOUR METER	___________	___________

200-HOUR MAINTENANCE CHECKLIST-

Engine Serial Number _____________

______**Set the park brake** and wash or steam clean the equipment

______Check for and remove any accumulated coal or fluids

______Inspect brakes, safety chains, reflectors

______Repair damaged or missing intake or exhaust components, heat shields or shutdown controls

______Check electrical equipment, E-stop, breakers, fuses, battery switch and repair as necessary

______Change engine oil and filter

______Check transmission fluid and add if necessary

______Check hydraulic fluid and add if necessary

______Check all other fluid levels and add if necessary

______Check for and repair oil, coolant or other fluid leaks

______Check the cooling fan, radiator, and fan shroud for obstructions or bent blades and repair

Tighten or replace all belts as necessary

______Check battery and service as needed

______Check automatic fire suppression system and recharge or repair if defective

______Check portable fire extinguisher(s) and replace if missing or defective

______Check front and rear headlights, horn, dash instruments and replace or repair if defective

Keep brake set, secure the machine against movement and start the engine

______Check the oil pressure

______Check intake restriction at full engine speed and replace intake filter(s) if necessary. Normal intake restriction is __________ inches.

______Check engine back pressure at full engine speed and replace or clean the soot filter if necessary. Normal back pressure is ________ inches.

______Test engine shutdown controls and repair or replace if defective

______Conduct 90 SECOND untreated and treated load tests and record readings

______Evaluate emission test data, make necessary repairs or remove the equipment from service

______Measure smoke in the treated exhaust to check soot filter performance. Be sure smoke number is less than 3. Current smoke number is______.

______Be sure surface **<u>and</u>** exhaust gas temperatures are less than 302 degrees F.

______Perform all additional service as required by the manufacturer's service instructions

______Fill out this <u>200-Hour Record</u>, the <u>CO Emissions Form</u>, and the <u>Repair & Maintenance Form</u>

Engine hours at time of service ________ Date ______________Time __________ a.m. / p.m.

Signature of qualified diesel mechanic___________________________________**Date**__________

Countersigned

by___________________________________Mine Foreman__or Mine Electrician__ Date_________

Attach emissions printout here or emissions chart if available

200-Hour Carbon Monoxide Emissions Form

For Diesel Powered Equipment

Engine # ________________________

Form must be filled out by a qualified diesel mechanic as part of the CO emissions record. Engine must be at operating temperature before test. Emissions readings should be taken for 90 seconds at 30 second intervals once oxygen drops to 10% or when CO 2 is between 8 to 10% (10 to 12% for engine without turbo).

At start of test:

Engine Speed ...._____RPM
Engine Temperature ...._____ F
Transmission Temperature ...._____ F
Maximum Intake Restriction (at high Idle) ...._____“ wg
Maximum Exhaust Back Pressure (at high idle).........................._____“ wg
Maximum Exhaust Temperature ...._____ F

	CO2/CO2	Untreated CO	Treated CO
1st 30 seconds	___/___	_____	_____
2nd 30 seconds	___/___	_____	_____
3rd 30 seconds	___/___	_____	_____

Average Untreated CO _______ Treated CO _______

Engine hour reading ________ Date _____________ Time ________ a.m. / p.m.
Person performing
emissions test ____

Countersigned
by ____Mine Foreman __ or Mine Electrician

Date_______________

Diesel Powered Equipment Repair and Maintenance Form

MACHINE:________________________________

Note: Diesel Mechanics should use this form to list all repairs or maintenance performed during each 200-hour scheduled service, or any additional maintenance or repair required between service intervals.

Description of maintenance or repair

1.____

____

2.____

____

3.____

____

4.____

____

5.____

____

6.____

____

7.____

____

8.____

____

9.____

____

10.____

Engine Hour Reading ____________ Date____________ Time________a.m.__p.m.__

Person performing
maintenance or repair)s ____Date_________

Countersigned
by____________________________Mine foreman__ or Mine electrician__Date__________

MINE:________________________________

DIESEL EQUIPMENT
WEEKLY EMISSIONS RECORD

MACHINE:________________________________

	Beginning	Ending
DATE	____________________	____________________
HOUR METER	______________	______________

WEEKLY EMISSIONS REPORT FOR DIESEL EQUIPMENT

West Virginia Rule §56-23-7. Exhaust Gas Monitoring and Control.

7.1. In monitoring and controlling exhaust gases, the ambient concentration of exhaust gases in the mine atmosphere shall not exceed 35 ppm ceiling for carbon monoxide (CO), 25 ppm ceiling for nitric oxide (NO) and 3 ppm ceiling for nitrogen dioxide (NO2). The concentration of these exhaust gases shall be measured at the equipment operator's or equipment attendant's position and inby the last piece of diesel-powered equipment operating in the same split of air. Measurements shall be made weekly or more often if necessary by a qualified person and shall be conducted pursuant to the requirements of this section.

Ambient Diesel Emissions

MACHINE:____

Measurements at operator's station (ppm)..........................____ CO......____ NO......___ NO2....____O2
Measurements 6 to 10 feet downwind and in same split (ppm)..____ CO......____ NO......___ NO2…____O2
Tailpipe filtered CO reading ______ppm

Automatic Fire Suppression System *(MSHA REGULATION)*
OK________
Defective________
List system defects found and corrections made ________________________________

____

Comments____

Engine hour reading ________ Date ________ Time ________ a.m. / p.m.

Person performing emissions test
and fire suppression check____

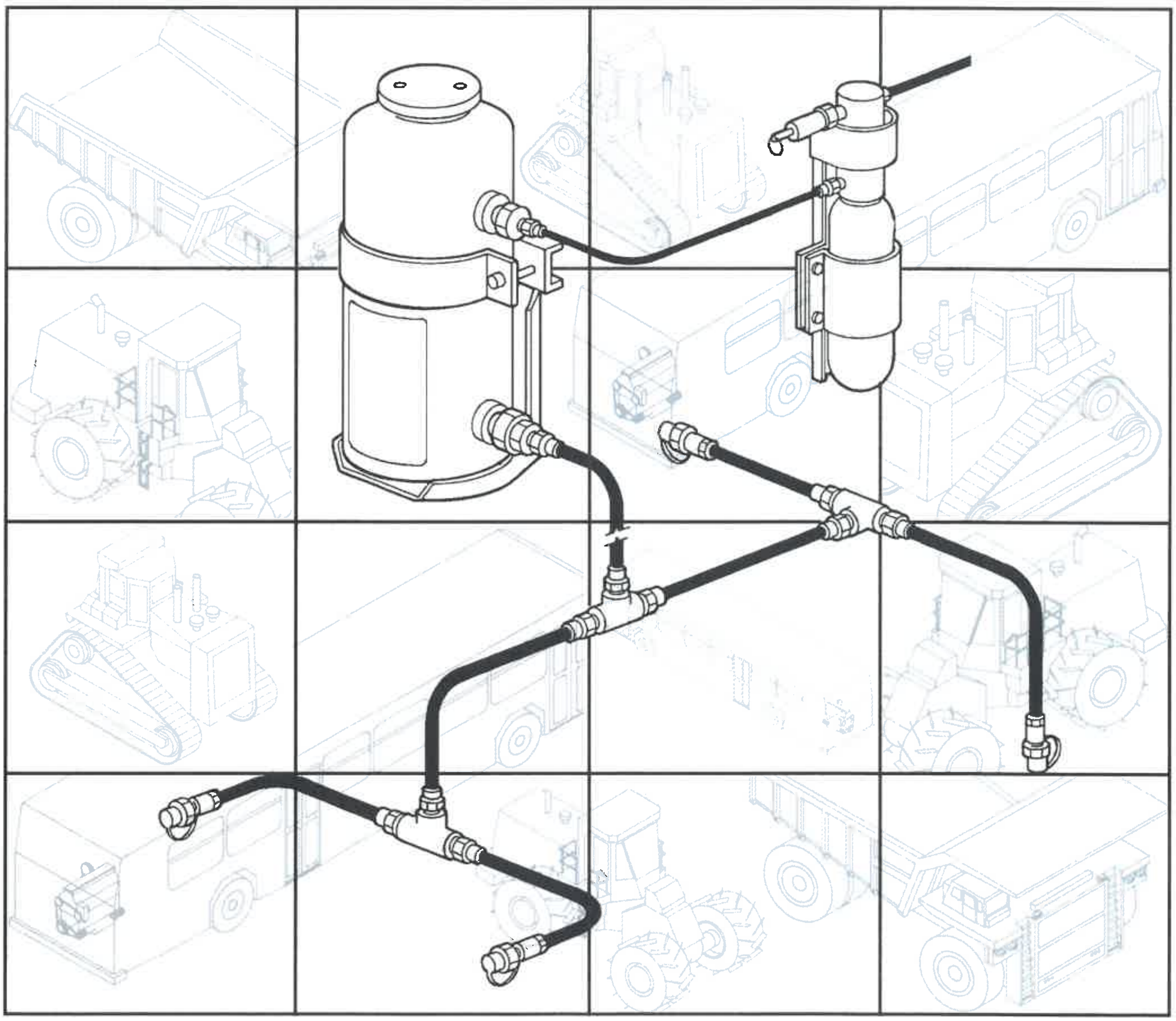
Countersigned
By ____

Mine Foreman ____ or Mine Electrician ____ Date ____________

ANSUL®

INSTALLATION, RECHARGE, INSPECTION, AND MAINTENANCE MANUAL

A-101-10/20/30 LT-A-101-10/20/30 VEHICLE FIRE SUPPRESSION SYSTEMS



This manual is intended for use with the Ansul A-101 Vehicle Fire Suppression Systems.

Those who install, operate, recharge, inspect, or maintain these fire suppression systems should read this entire manual. Specific sections will be of particular interest depending upon one's responsibilities.

As with all mechanical equipment, the A-101/LT-A-101 systems need periodic care to provide maximum assurance that they will operate effectively and safely. Inspection frequency should be based on 250 vehicle operating hours or monthly, whichever comes first. Maintenance should be conducted at 1000 vehicle operating hours or every six months, whichever comes first. Maintenance should be conducted in accordance with this manual and NFPA 17 ("National Fire Protection Association's Standard for Dry Chemical Extinguisher Systems") by a qualified, trained service person.

Additional service and maintenance information can be obtained in other applicable NFPA Standards.

This Ansul systems manual is limited to uses herein described. For other applications, contact your local Ansul distributor or Ansul Incorporated, Pre-Engineered Systems Application Department, Marinette, Wisconsin 54143-2542.

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5-15-02	1-2	2	5-15-02	6-1	1
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► Indicates revised information.

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5-15-02

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5-15-02	11-10	New Page			

▸ Indicates revised information.

INTRODUCTION

The Ansul A-101/LT-A-101 fire suppression system is a pre-engineered, fixed nozzle system for protection of off-highway vehicles, commercial vehicles, or industrial type applications. Typical applications include surface mining equipment, underground mining machines, forest harvesting equipment, construction equipment, farming machinery, and transportation vehicles such as municipal busses.

The A-101/LT-A-101 system consists of three major components: a container to store the dry chemical extinguisher agent; an actuation system operated manually or automatically, and an agent distribution system which delivers the agent from the tank through hydraulic hose and fixed nozzles to the hazard areas.

The fire system described is a suppression system only and is not designed or intended to extinguish all fires, particularly when unusual amounts of combustible materials and an ample oxygen supply are present. It is extremely important that supplement fire fighting equipment be available in case the system does not totally extinguish a fire.

If an automatic fire detection and actuation system has not been supplied or has been disconnected, system actuation and discharge will not occur unless the fire suppression system is manually actuated. (Use of manual system only must be approved by authority having jurisdiction.) Reliance on a manual release system usually results in a slower reaction to fire. Means to shut down the vehicle must be added to a manual or disconnected automatic system.

The basic agent storage container is a tank filled with Ansul FORAY (monoammonium phosphate base) dry chemical which is effective on Class A, B, and C fires. A gas expellant cartridge, either carbon dioxide or nitrogen, provides pressurization of the dry chemical upon actuation.

Automatic detection, either electric or pneumatic, and actuation, is recommended. The A-101/LT-A-101 system is actuated manually by a pneumatic actuator located on the dashboard or on the exterior of the vehicle.

The dry chemical extinguishing agent is delivered from the tank through hydraulic hose and pre-set nozzles into the fire hazard areas or onto the fire prone surfaces.

Along with the fire suppression system, the total system design must include a hand portable fire extinguisher(s) located on board the vehicle that can be used to manually suppress a fire that may be burning in an unprotected area. Refer to NFPA 10, "Standard For Portable Fire Extinguisher," for additional information.

TWIN AGENT SYSTEM (NOT FM APPROVED)

The system consists of both dry chemical and liquid agent. The dry chemical portion of the system is the Ansul A-101/LT-A-101, 125, or 250 system (either standard discharge or extended discharge) and the liquid agent portion of the system consists of an agent storage tank containing a premixed solution of LVS wet chemical.

The LVS-30 (30 gallon) system is designed to discharge for approximately 2 minutes when two agent discharge nozzles are used.

The LVS Fire Suppression System is designed to operate within a temperature range of –40 °F to +120 °F (–40 °C to 49 °C).

The dry chemical system used in conjunction with the LVS system is the Ansul A-101/LT-A-101, 125 or 250. The dry chemical system is connected to the Ansul CHECKFIRE Detection and Control System. the dry chemical system can be designed as a standard discharge or as an extended discharge system per the requirements of the A-101/LT-A-101 vehicle Fire suppression Installation, Recharge, Inspection, and Maintenance Manual. Upon actuation of the dry chemical system, the pneumatic time delay for the LVS system will start. During the end of the dry chemical discharge, the time delay will allow pressure to enter the LVS actuation line. This pressure will then actuate the nitrogen cartridge on the LVS tank(s), causing the LVS system to discharge the wet chemical solution.

For detailed instructions, refer to manual Part No. 427865 regarding the LT-A-101-125/250 system. For detailed instructions, refer to manual Part No. 427109 regarding the LVS system.

FM APPROVAL

The Ansul A-101/LT-A-101 fire suppression system has been tested and is FM approved. These tests require extinguishment of fire initiated in open vessels and within enclosures fueled with flammable liquid. In each case, these fires are allowed to progress to maximum intensity before the system is actuated. The time of actuation in these tests is well beyond the time that a detector would take to detect the fire and actuate the system. Other tests required by FMRC are as follows:

1. Fuel in depth splash tests under a minimum hose length, maximum temperature, and minimum clearance condition to ensure that the nozzle does not cause splashing of fuel.
2. Operational flow rate tests at the minimum, average, and the maximum temperatures, with maximum and minimum hose lengths.
3. Cycle tests on all mechanical and electrical devices to determine their structural integrity.

The A-101 systems which utilize carbon dioxide as the expellant gas are approved for temperature ranges of +32 °F to +120 °F (0 °C to 49 °C).

The LT-A-101 systems which utilize nitrogen as the expellant gas are approved for temperature ranges of –65 °F to +210 °F (–54 °C to 99 °C).

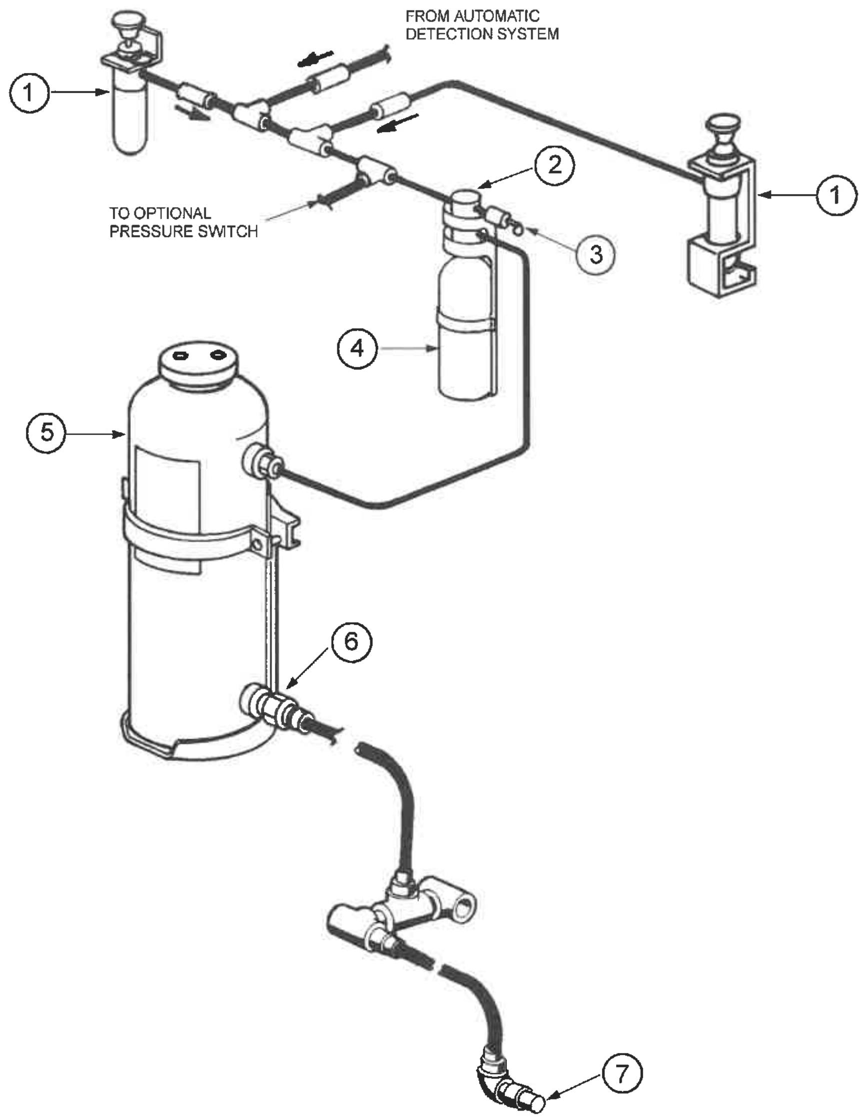


FIGURE 1
002581

HOW THE SYSTEM OPERATES

Discharge of the A-101/LT-A-101 system manually is initiated from a remote actuator (1). Depressing the actuator plunger punctures the seal on the cartridge. The released pressure is transmitted to the pneumatic actuator/cartridge receiver (2). A safety relief valve (3) at this point prevents too high an actuation pressure build-up. The pressure drives a puncture pin through the seal in the expellant gas cartridge (4). This releases the expellant gas which is then transmitted to the dry chemical tank (5) where it fluidizes the dry chemical before carrying it to the fire hazard. A sealed burst disc assembly (6) prevents the flow of dry chemical until sufficient pressure is built up within the dry chemical tank. When the proper pressure is reached, the disc breaks allowing the gas/dry chemical mixture to flow to the nozzle(s) (7) and discharge onto the hazard.

Refer to appropriate CHECKFIRE design, installation and maintenance manual for information on the operation of the automatic detection system.

NOTE: Mechanical or electrical means must be provided to shut down vehicle upon system actuation.

IN CASE OF FIRE

When a fire starts, the way the operator reacts is very important. As soon as the operator is aware of a fire, he should do the following four things:

1. Turn the machine off and set the brake.
2. Quickly actuate the system by pulling the safety ring pin on the manual actuator and strike the red button.
3. Evacuate the vehicle.
4. Stand by with a fire extinguisher.

⚠ CAUTION

The fire system described in this manual is a suppression system only and is not designed or intended to extinguish all fires, particularly when unusual amounts of combustible materials and an ample oxygen supply are present. It is extremely important that supplemental firefighting equipment be available in case the system does not totally extinguish a fire.

APPLICATION METHOD

The A-101/LT-A-101 system provides fire protection using total flooding and local application methods. These methods are described below.

Local Application – Vehicle

When designing a local application system for vehicle protection, each individual hazard area must be surveyed and the correct type nozzle must be chosen to give the proper coverage. It must also be determined if certain local application hazard areas require screening to adequately protect them.

Total Flooding

Total flooding is described as "volume protection" and it is applied only when a hazard is located in an enclosure. Openings such as doors, windows, and grating shall not be more than 15% of the enclosure's total surface area (ceiling, floors, and all walls).

Openings of 5% or less of the total surface area are acceptable and do not require screening. Hazards with openings greater than 5% but not over 15% can be protected by screening.

Total flooding application is accomplished by introducing a sufficient quantity of FORAY dry chemical through fixed nozzles throughout the volume of the enclosure.

To enhance the effectiveness of the total flooding system in industrial applications, all fan air movements should be shut down and/or dampered at discharge of the dry chemical system. Refer to NFPA 17, "Standard For Dry Chemical Extinguishing Systems," for additional information.

PIPING ARRANGEMENT

The A-101/LT-A-101 system utilizes three methods of splitting the dry chemical flow from the tank to the nozzles. Each method is approved for use on vehicle or industrial type applications.

Two Nozzle System

The two nozzle system can be used in either vehicle or industrial hazard protection. It can be used in total flooding, or as a local application system on off-road vehicles. The supply line is split into two branch lines by the use of a 3/4 x 1/2 x 1/2 in. reducing tee. Two nozzles systems can be used with nominal 10, 20, and 30 lb. tank sizes.

Four Nozzle System

The four nozzle system can be used in either vehicle or industrial hazard protection. It can be used in total flooding, or as a local application system on off-road vehicles. The supply line is divided into four branch lines by the use of a triple tee or a split tee. Four nozzle systems can only be used with nominal 20, and 30 lb. tanks. Four nozzle 30 lb. systems are preferred for all systems protecting hazards in environments which are extremely rugged, and very prone to Class A and Class B fuel build up in hard to protect areas, providing more agent per nozzle and longer discharge times.

Six Nozzle System

The six nozzle system can be used in vehicle or industrial hazard protection. It can only be used in local application systems on off-road vehicles, when minimal discharge time and agent discharge per nozzle is acceptable. The supply line is divided into six branch lines by the use of a distribution tee and three 1/2 in. tees. Six nozzle systems can only be used with nominal 20, and 30 lb. tanks.

DETECTION

Automatic electric detection is available for the A-101/LT-A-101 system.

Electric detection systems (CHECKFIRE MP-N*, Series I, and SC-N) are available to provide rugged, automatic detection for vehicle protection. These systems are either powered by the vehicle battery or by the internal module battery.

The electric detection systems can use either linear heat detection or spot thermal detectors, or pneumatic linear detectors.

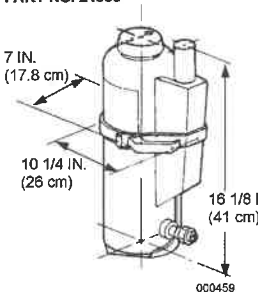
* Not FM Approved

NOTES:

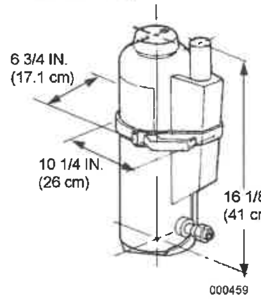
TANK ASSEMBLY

The tank assemblies, nominal 10, 20, and 30 lb. size, are factory filled with 8.5, 17, and 25 lb. respectively of FORAY dry chemical. Each tank is finished in red enamel paint. A nameplate is affixed to the exterior and contains information on recharge and maintenance. Two style of tanks are available: a tank containing a cartridge receiver and pneumatic actuator and a tank with 1/4 in. adapter for a pressure line from a remote cartridge. See Figure 1.

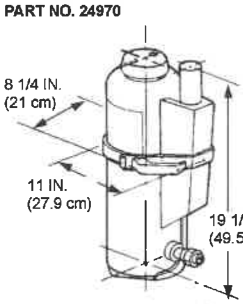
A-101 MODEL 10
PART NO. 24855



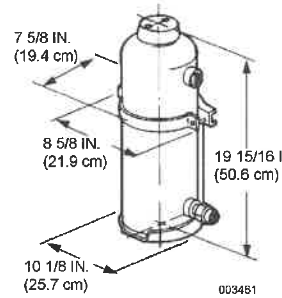
LT-A-101 MODEL 10
PART NO. 24966



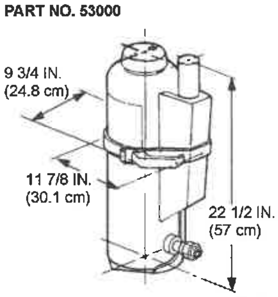
A-101 MODEL 20
PART NO. 24970



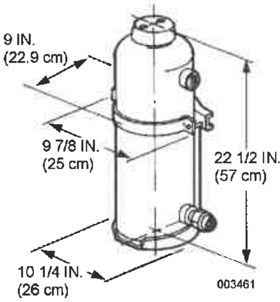
LT-A-101 MODEL 20
PART NO. 24894



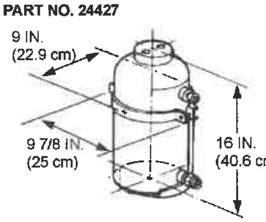
A-101 MODEL 30
PART NO. 53000



LT-A-101 MODEL 30
PART NO. 29375



LP-A-101 MODEL 20-B
PART NO. 24427



LT-LP-A-101 MODEL 20-B
PART NO. 24425

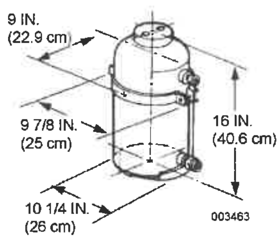
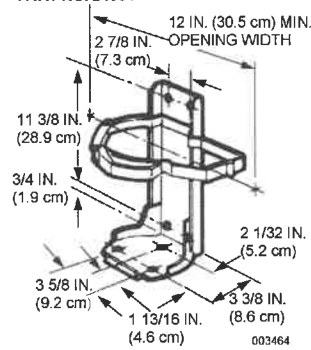


FIGURE 1

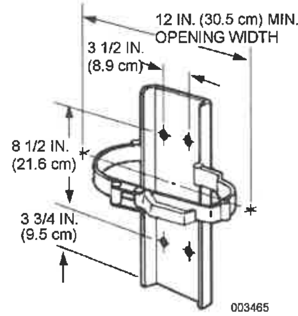
TANK BRACKET

The tank mounting bracket assemblies consist of heavy gauge steel back plates and clamp arms. Each style bracket is constructed to properly retain the agent tank from movement or damage in the rugged environment that these systems are normal used. Each tank bracket contains rubber pads to minimize the shock and vibration effect on the tank. The brackets are finished with red, air dry enamel paint. See Figure 2.

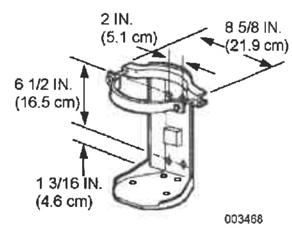
A-101 MODEL 10 / LT-A-101 MODEL 10
PART NO. 24854



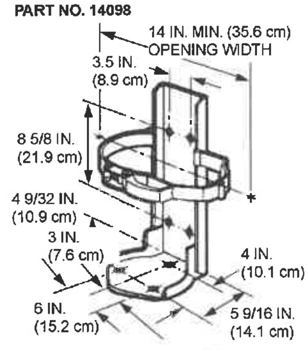
A-101 MODEL 20
PART NO. 24971



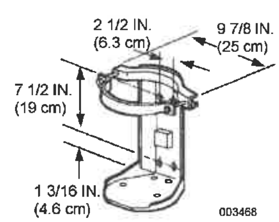
LT-A-101 MODEL 20
PART NO. 24895



A-101 MODEL 30
PART NO. 14098



LT-A-101 MODEL 30
PART NO. 30494



LP-A-101 MODEL 20B / LT-LP-A-101 MODEL 20
PART NO. 31171

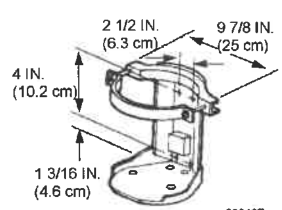


FIGURE 2

DRY CHEMICAL

FORAY is a monoammonium phosphate based dry chemical which is effective on Class A,B, C related fires. FORAY agent is color coded yellow for easy identification. FORAY dry chemical is shipped in 45 lb. pails, Part No. 53080. See Figure 3.

FIGURE 3
000417

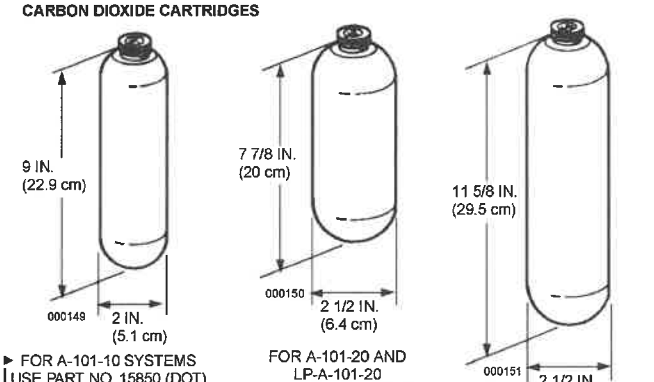
CARTRIDGE – EXPELLANT GAS

▸ The expellant gas cartridges used on the A-101/LT-A-101 system contain either carbon dioxide or nitrogen as their expellant gas. The cartridge is a sealed pressure vessel containing gas under pressure. When the cartridge seal is punctured by the pneumatic actuator pin, the gas flows into the dry chemical tank, fluidizes the dry chemical, and carries it through the distribution piping network and out the nozzles.

The expellant gas cartridges meet the requirements of DOT 3A-2100 or 3AA-1800. See Figure 4.

▸ Several cartridge Part No.'s have been added to comply with the requirements of Transport Canada (TC). These cartridges have been approved for both DOT and TC.

CARBON DIOXIDE CARTRIDGES

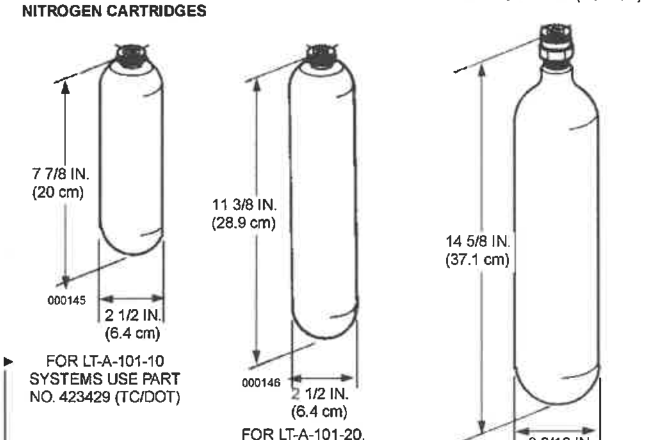


▸ FOR A-101-10 SYSTEMS USE PART NO. 15850 (DOT) PART NO. 423439 (TC/DOT)

FOR A-101-20 AND LP-A-101-20 SYSTEMS USE PART NO. 423441 (TC/DOT)

FOR A-101-30 SYSTEMS USE PART NO. 423443 (TC/DOT)

NITROGEN CARTRIDGES



▸ FOR LT-A-101-10 SYSTEMS USE PART NO. 423429 (TC/DOT)

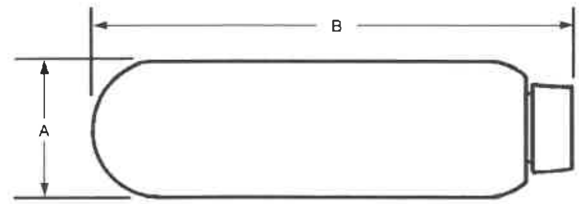
FOR LT-A-101-20, LT-LP-A-101-20 SYSTEMS USE PART NO. 423435 (TC/DOT)

FOR LT-A-101-30 SYSTEMS USE PART NO. 423491 (TC/DOT)

FIGURE 4

CARTRIDGE – ACTUATION GAS

▸ The actuation gas cartridge used on the A-101/LT-A-101 system contains nitrogen as the actuation gas. The cartridge is a sealed pressure vessel containing gas under pressure. When the cartridge seal is punctured by the pin in the remote manual or pneumatic actuator, the gas flows to the actuator on the expellant gas cartridge, causing that actuator to puncture the seal in the expellant gas cartridge. The actuation gas cartridges meet the requirements of DOT 3E-1800. See Figure 5.



	A	B	RIGHT-HAND THREAD	LEFT-HAND THREAD
▸ LT-10	2 IN.	6 13/16 IN.	PART NO. 13193 (DOT)	PART NO. 13177 (DOT)
▸	(5.1 cm)	(17.3 cm)	PART NO. 423423 (TC/DOT)	PART NO. 423425 (TC/DOT)

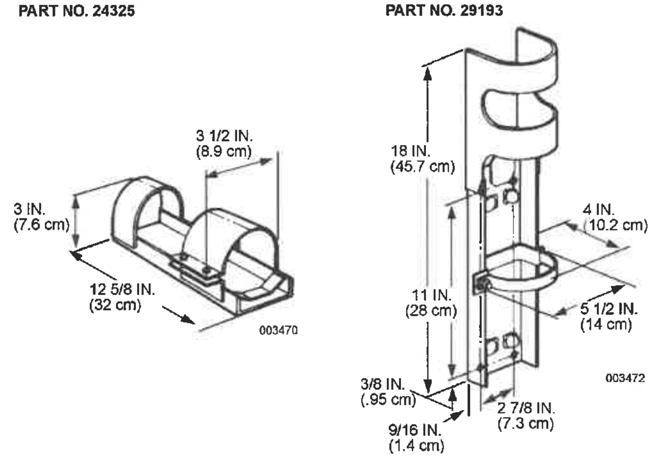
FIGURE 5
000439

CARTRIDGE BRACKET

The cartridge brackets for the expellant gas cartridges are constructed of heavy gauge steel and formed to protect and secure the cartridge. The cartridge brackets are painted with red, air dry enamel paint. See Figure 6.

LT-A-101-20 / LT-LP-A-101-20-B
PART NO. 24325

LT-A-101-30
PART NO. 29193



LP-A-101-20-B
PART NO. 31177

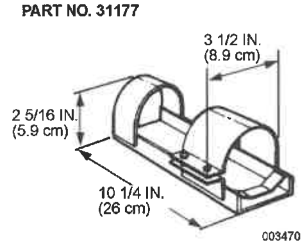


FIGURE 6

PNEUMATIC ACTUATOR

The pneumatic actuator, Part No. 430221, is constructed of brass and mounts on top of the expellant gas cartridge(s). When actuated, the actuator punctures a seal in the cartridge head, allowing the expellant gas to flow into the agent tank. See Figure 6a.

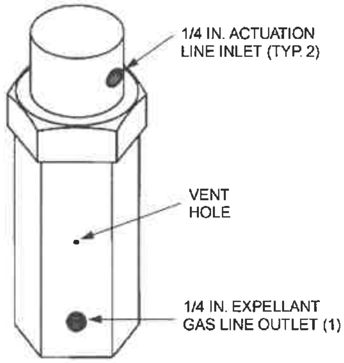
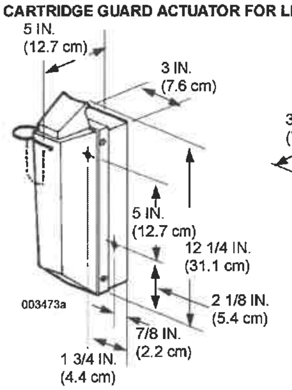


FIGURE 6a
006433

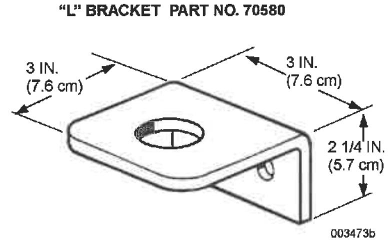
MANUAL ACTUATORS

The manual actuator is available for use with either right or left hand cartridges. Manual actuators should be mounted near the vehicle operator and/or at a point on the vehicle that can be reached from ground level. Two styles of manual actuators are available: the standard actuator with either the "S" type bracket or the "L" type bracket, and the cartridge guard type actuator. See Figure 7.

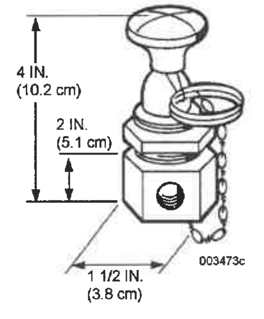
CARTRIDGE GUARD ACTUATOR FOR RIGHT HAND CARTRIDGES PART NO. 19330
CARTRIDGE GUARD ACTUATOR FOR LEFT HAND CARTRIDGES PART NO. 16186



"L" BRACKET PART NO. 70580



REMOTE ACTUATOR FOR RIGHT HAND CARTRIDGES PART NO. 57452
REMOTE ACTUATOR FOR LEFT HAND CARTRIDGES PART NO. 70581



"S" BRACKET PART NO. 57661

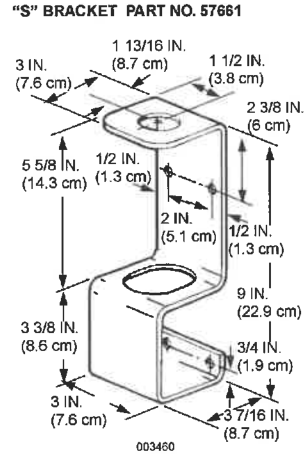


FIGURE 7

1/4 IN. CHECK VALVE

The 1/4 in. actuation line check valve, Part No. 25627, is used at the branch lines to each actuation device (whether manual or automatic). The check valve blocks the flow of actuation gas from the actuator that was actuated to the actuator(s) that was not actuated. This prevents actuation gas from escaping from an open actuator which may have had the cartridge removed. The check valve also keeps the gas from pressurizing all branch actuation lines thus allowing the main line to be of maximum length. See Figure 8.

CHECK VALVE PART NO. 25627

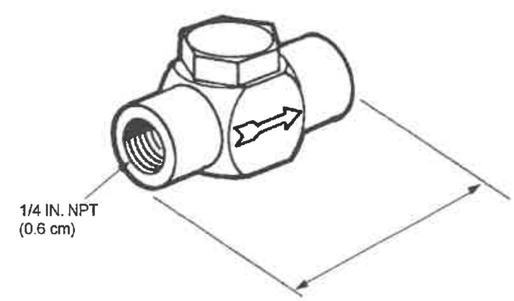


FIGURE 8
000899

DISTRIBUTION TEE

When six nozzles are to be fed from one dry chemical tank, the distribution supply line must enter the inlet of a distribution tee, Part No. 25031, and each branch line must exit from one of three outlets of the distribution tee. This is required to assure equal distribution of dry chemical to each nozzle. See Figure 9.

DISTRIBUTION TEE, 1/2 IN. X 1/2 IN. X 1/2 IN. X 3/4 IN. – PART NO. 25031

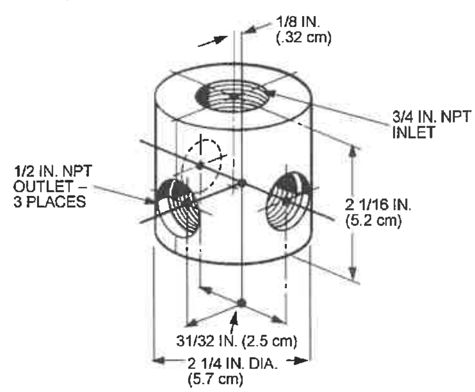


FIGURE 9
002583

REDUCING TEE

When two or four nozzles are to be fed from a single dry chemical tank, a 1/2 x 1/2 x 3/4 in. reducing tee, Part No. 4655, is used to properly distribute the dry chemical from the supply line to two branch lines. See Figure 10.

REDUCING TEE, 1/2 IN. X 1/2 IN. X 3/4 IN. – PART NO. 4655

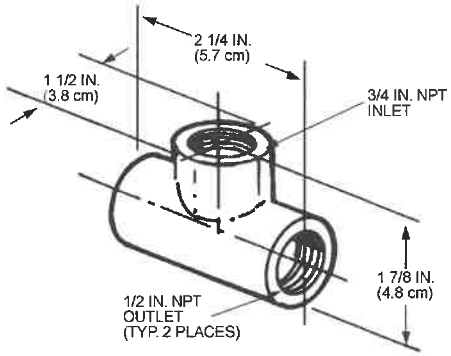


FIGURE 10
003456

TRIPLE TEE

When four nozzles are to fed from a single dry chemical tank, a triple tee, Part No. 16424, can be used to properly distribute the dry chemical from the supply line to two branch lines. See Figure 11.

TRIPLE TEE, 1/2 IN. X 1/2 IN. X 1/2 IN. X 3/4 IN. – PART NO. 16424

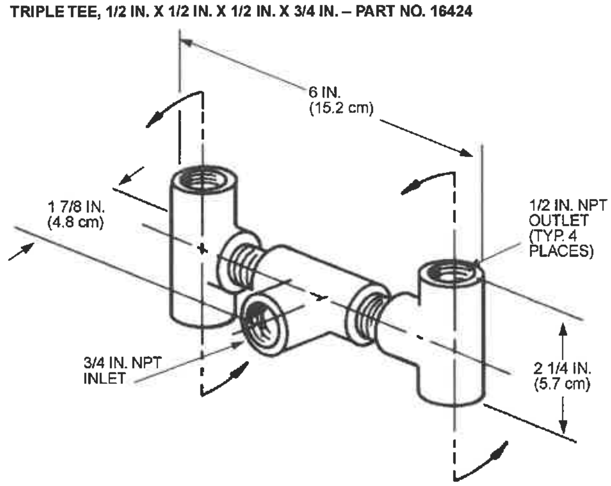


FIGURE 11
003462

SAFETY RELIEF VALVE

A spring-loaded pressure relief valve, Part No. 15677, is used to prevent excessive pressure from building up in the actuation line. The valve is set to relieve at 265 psi (18.3 bar). After system discharge, all pressure in the actuation line can be relieved by pulling the ring on the safety relief valve. See Figure 12.

SAFETY RELIEF VALVE PART – NO. 15677

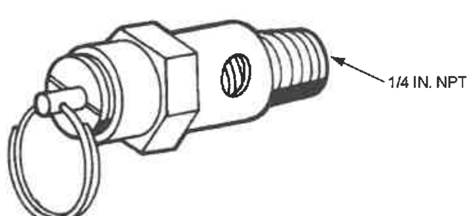


FIGURE 12
000437

AIR CYLINDER (OPTIONAL)

The air cylinder, Part No. 15733, is a system accessory whose function is to shut off the fuel supply to the engine when the fire suppression system is actuated. It is a piston operated by gas pressure from the actuation line. See Figure 13.

AIR CYLINDER PART NO. 15733

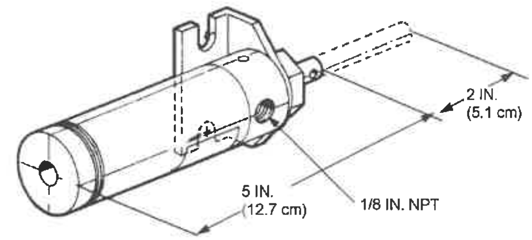


FIGURE 13
003459

PRESSURE SWITCH – WEATHERPROOF

The pressure switch, Part No. 46250, is a DPST (Double-Pole, Single Throw) pneumatically operated, resettable switch used to open or close electrical circuits to either shut down equipment or turn on lights or alarms. The pressure switch is constructed of malleable iron, painted red. A 1/4 in. NPT pressure inlet is used to connect the 1/4 in. hose from the actuation line. The switch rating is 2 HP-240 VAC/480 VAC, 2 HP-250 VDC, 30A-250 VAC/DC, 5A-480 VAC/DC. See Figure 14.

PRESSURE SWITCH PART – NO. 46250

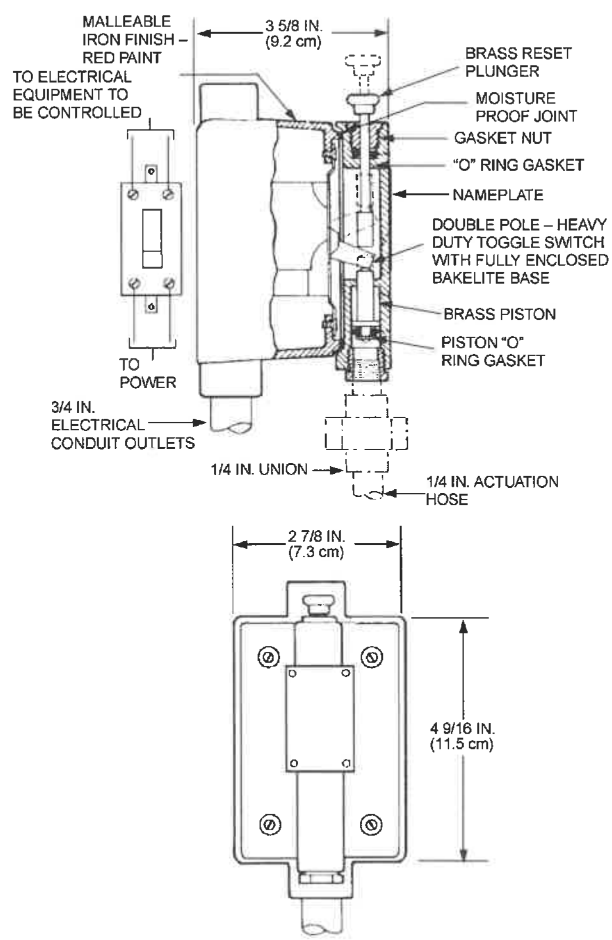


FIGURE 14
000716

PRESSURE SWITCH – NON-WEATHERPROOF

The Electric Pressure Switch, Part No. 8372, is a SPDT (Single Pole-Double Throw) pneumatically operated, resettable switch to be used for turning off pump motors, exhaust fans, conveyors and similar devices; or turning on alarms or electric door closures. The switch contacts are rated at 15 amp, 125, 250, or 480 VAC, 1/4 hp at 125 VAC, 1/2 hp at 250 VAC or 1/2 amp at 125 VDC, 1/4 amp at 250 VDC. See Figure 15.

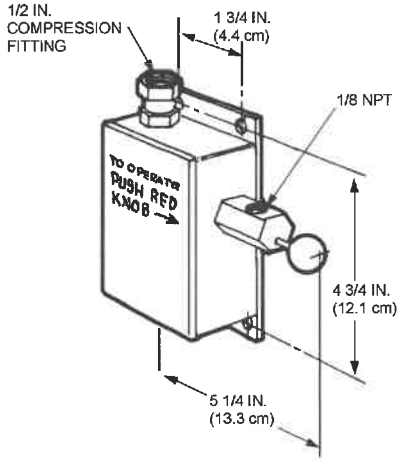


FIGURE 15
000453

Explosion-Proof Pressure Switch – DPDT

The Explosion-Proof Pressure Switch, Part No. 43241, is a DPDT (Double-Pole, Double-Throw) pneumatically operated, resettable switch to be used for turning off pump motors, exhaust fans, conveyors, and similar devices; or turning on alarms or electric door closures. The switch contacts are rated at 10 amp at 125 VAC or 5 amp at 250 VAC. The pressure switch is constructed with an explosion-proof housing suitable for hazardous environments. The switch operates off the nitrogen pressure from the ANSUL AUTOMAN release or remote pneumatic actuator.

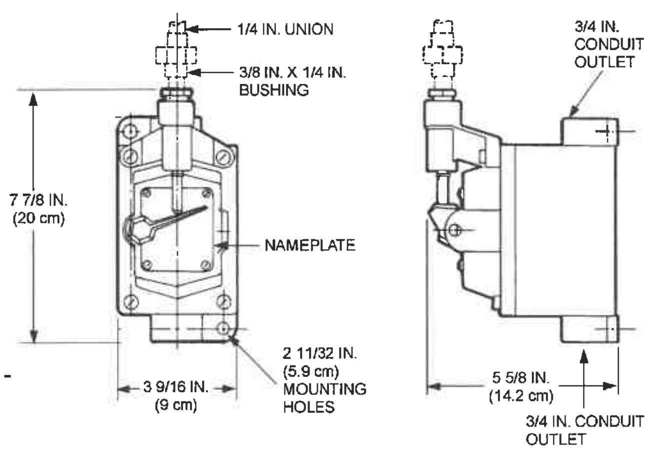
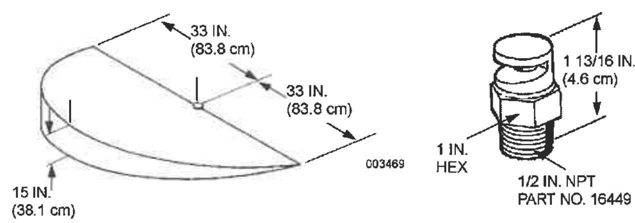


FIGURE 16
000454

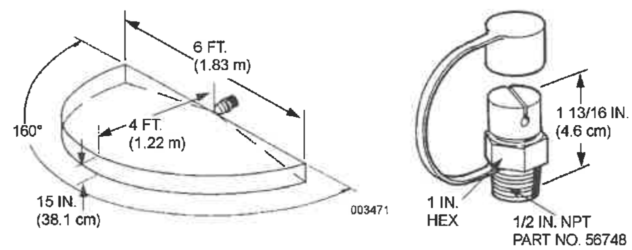
NOZZLES

Three types of nozzles are approved for use with the A-101/LT-A-101 system. One type is the F-1/2 nozzle. This nozzle gives a 180° fan shape pattern and can be used for either total flooding or local application. The second type of nozzle is the C-1/2. This nozzle gives a cone pattern and is used for direct application to a vehicle component or burning surface. The third type of nozzle is the V-1/2. This nozzle produces a 160° fan shape pattern and is generally used for screening engine compartments, torque converters and all other hazard areas. All nozzles are constructed of brass and require protective blow-off caps. Exception: The F-1/2 nozzle can utilize either a blow-off cap or the opening can be packed with a good grade of extreme temperature silicone grease, such as Dow Corning No. 4. See Figure 17.

F-1/2 NOZZLE EFFECTIVE DISCHARGE PATTERN PART NO. 16449



V-1/2 NOZZLE EFFECTIVE DISCHARGE PATTERN PART NO. 56748



C-1/2 NOZZLE EFFECTIVE DISCHARGE PATTERN PART NO. 53791

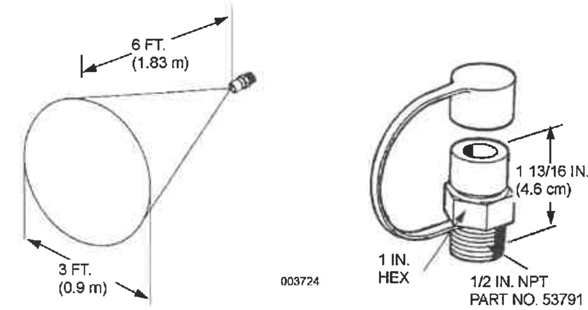


FIGURE 17

NOZZLE BRACKETS

Two styles of nozzle brackets are available for the A-101/LT-A-101 system. Each style of bracket is constructed of unpainted 1/4 in. (6.4 mm) steel. They contain pre-punched mounting holes for the nozzle.

An individual "L"-shaped bracket-shipping assembly, Part No. 427149, is available. This bracket is 2 in. x 3 in. (51 mm x 76 mm). A second "L"-shaped bracket (in packs of 12), Part No. 73871, is also available. This "L" shaped bracket is 2 in. x 2 in. (51 mm x 51 mm).

A straight bracket (in packs of 4), Part No. 427228, is available. this bracket is 5 in. x 2 in. (127 mm x 51 mm). See Figure 18.

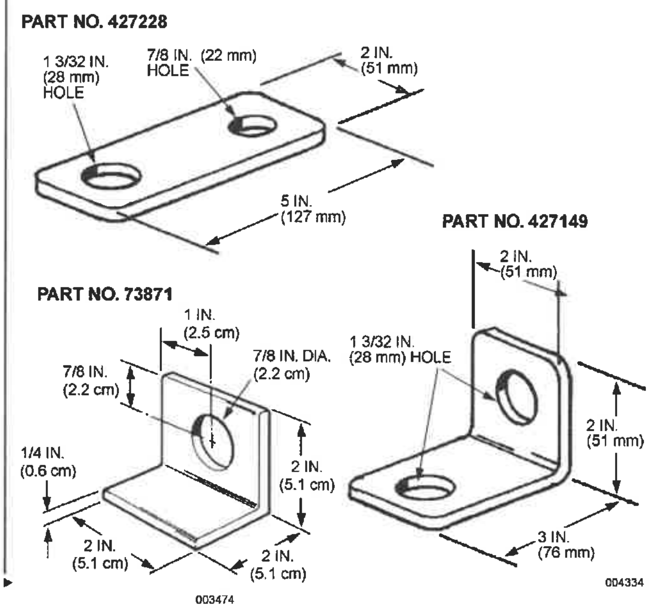


FIGURE 18

HOSE (SUPPLIED BY OTHERS)

To assure proper performance of an A-101/LT-A-101 system, the hose used must meet SAE 100 R5 or 100 R1 (minimum) hose specification. For underground mining applications, the hose must also be accepted by MSHA as flame resistant and marked as follows "Flame-Resistant, USMSHA No. _____"* at intervals not exceeding 3 ft. (.9 m). Letters and numbers must be at least 1/4 in. (.6 cm) high and comply all other SAE requirements including an operating temperature of –65 °F to +250 °F (–54 °C to 121 °C). (*This number is assigned to the manufacturer after samples have passed the required tests. The number will be different for each manufacturer.) See Figure 19.

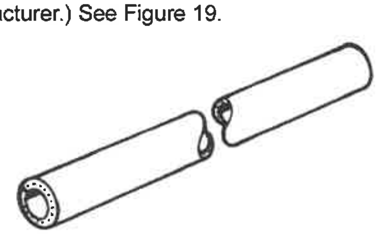


FIGURE 19
003475

SEALED BURST DISC ASSEMBLY

The Sealed Burst Disc Assembly, Part No. 428271, is a machined brass component containing a stainless steel burst disc inside. The disc assembly is designed to rupture when the proper expellant gas pressure is built up within the tank. The disc assembly is part of the agent tank shipping assembly. After tank discharge, the complete burst disc assembly must be removed, discarded, and replaced with a new assembly. Replacement assemblies are available in a 15 pack, Part No. 428363.

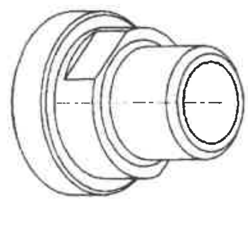


FIGURE 20
004793

ENGINE SHUTDOWN DEVICE

The Ansul Engine Shutdown Device, Part No. 427425, can be used to pneumatically shut down the vehicle fuel rack by venting the hydraulic pressure through the "safety system." This can be accomplished by installing the shutdown device in the actuation line. When the fire suppression system is actuated, the actuation pressure opens the check valve located in the shutdown device, allowing the safety system pressure to bleed into the holding tank. The drop in pressure causes the valves in the fuel rack to close, thus shutting down the engine. See Figure 21.

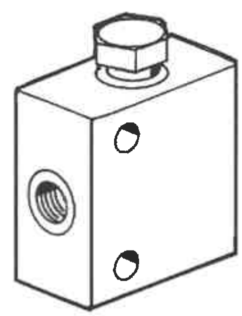


FIGURE 21
004474

CHECKFIRE ELECTRIC DETECTION AND ACTUATION SYSTEM

Three styles of electric detection and actuation systems are available: CHECKFIRE Electric Series I, CHECKFIRE Electric SC-N, and CHECKFIRE Electric MP-N*. Each electric/pneumatic system consists of detection wiring, control module, actuator with nitrogen cartridge, mounting bracket, and squib (Series I and SC-N) or gas motor (MP-N). The CHECKFIRE Electric Series I requires power from the vehicle battery where as the CHECKFIRE SC-N and MP-N contains its own internal Lithium batteries as the power source. All styles of CHECKFIRE electric* are FM Approved when consisting of all basic components.

* CHECKFIRE MP-N is not FM Approved

The temperature ratings of the system are as follows:

CHECKFIRE Series I: Manual Part No. 54894	–40 °F to +140 °F (–40 °C to +60 °C)
CHECKFIRE Series SC-N: Manual Part No. 79061	–40 °F to +140 °F (–40 °C to +60 °C)
CHECKFIRE Series MP-N: Manual Part No. 427310	+32 °F to +120 °F (0 °C to +49 °C)

HAZARD ANALYSIS

Individuals responsible for the design of an A-101/LT-A-101 system must be trained and hold a current Ansul certificate in an A-101/LT-A-101 training program. Knowledge of the fire hazards that exist in the equipment to be protected is also required. Finally, a good understanding of federal and local fire protection codes and standards is necessary. No one should begin designing without previously becoming familiar with the applicable codes.

Having read about the A-101/LT-A-101 system and the basic terminology and operation of the system, you should now begin to identity the fire hazards in the equipment to be protected. Every foreseeable hazard must be identified now while you have design flexibility; once the system is installed, adding protection for another hazard becomes more difficult. Note that the A-101/LT-A-101 system is designed only for the protection of specified equipment for the foreseeable hazards that exist due to that equipment and its operation. The areas of protection are fixed at installation and are limited in number. **An A-101/LT-A-101 system does not remove the need for a hand portable fire extinguisher on the equipment.** Fuel spills, welding (repair) heat or other unforeseeable causes may result in fires not having A-101/LT-A-101 protection. The A-101/LT-A-101 system protects the areas with high likelihood of fire and potential for high damage; seldom would an A-101/LT-A-101 system be designed to protect every square inch of the equipment to be protected.

An effective system design is based on a through hazard analysis. Fire is made up of heat, fuel, and oxygen. A fire hazard is any place that these three elements could be brought together. Because oxygen is always present, identifying fuel and heat sources is most critical.

Large excavators must be considered special type hazards. See the Appendix Section for design information or contact Ansul Application Engineering Department.

Operator safety is also a concern when designing a fire suppression system. The operator must have enough time to safely exit the vehicle. In some situations, an extended discharge dry chemical system (not FM Approved) may offer the operator the additional time he needs to get away from the burning vehicle. Consider egress time when designing the final system. See Appendix Section for extended discharge and twin agent design information.

Some common fuel sources in vehicles include flammable liquids and greases, rubber, plastics, upholstery, and environmental debris such as wood chips or coal dust.

Common vehicle heat sources are engine blocks, exhaust systems, pumps, and turbochargers, as well as bearings, gears, brakes, and electrical equipment. A potential hazard exists when a fuel comes in contact with any heat source.

Where there is dripping or leaking fuel, the hazard can become even more dangerous than initially considered. Consulting with experienced operators or owners of similar equipment can help to identify locations of previous fires and special hazards not normally considered as common hazards.

The following are typical vehicle fire hazards that require consideration:

Engine Compartment – The engine compartment contains an assortment of fluids, fuels, oils, and greases, as well as congested wires, hoses, and accumulated debris, all very near high heat sources.

Battery Compartments – Battery compartments are a potential fire hazard when combustible materials build up on the top of the battery. These materials, in the presents of moisture, can cause a short circuit.

Transmissions, Torque Converters, and Parking Brakes – All these components are a possible high heat source that could cause ignition to combustible material.

High Pressure Hoses – Hot fluid spraying from a ruptured high pressure hose, or leaking from a loose flange or fitting could find its way to a source of ignition.

Belly Pan – The belly pan can accumulate not only leaking fuel from the vehicle, but external debris, and because of its unique location, a fire starting in the belly pan could quickly engulf the entire vehicle.

Hydraulic/Fuel Pumps – Because of the high pressures involved with these pumps, fluid spraying from a leaking pump could find its way to a heat source and cause ignition.

After completing the hazard analysis, determine nozzle coverages.

NOZZLE COVERAGE AND LOCATION

The first step is to determine which nozzles are needed and where they should be placed to best protect the hazard.

Nozzle selection can be made by first determining the size of the hazard and then comparing that to the nozzle's effective discharge pattern.

C-1/2 Nozzle Part No. 53791 – The cone-shape discharge pattern of the C-1/2 nozzle will widen to a 3 ft. (.9 m) diameter at the maximum effective discharge range of 6 ft. (1.8 m). See Figure 1.

V-1/2 Nozzle Part No. 56748 – The V-1/2 nozzle creates a fan-shaped discharge pattern of 160° and has a maximum effective discharge range of 4 ft. (1219 mm) in length by 15 in. (38.1 cm) in height with a maximum width of 6 ft. (1.8 m). See Figure 1.

F-1/2 Nozzle Part No. 16449 – The F-1/2 nozzle also produces a fan-shaped discharge pattern, but with a 180° pattern at a maximum effective range of 33 in. (83.8 cm) in length by 15 in. (38.1 cm) in height with a maximum width of 5 ft. 6 in. (1.7 m) See Figure 1.

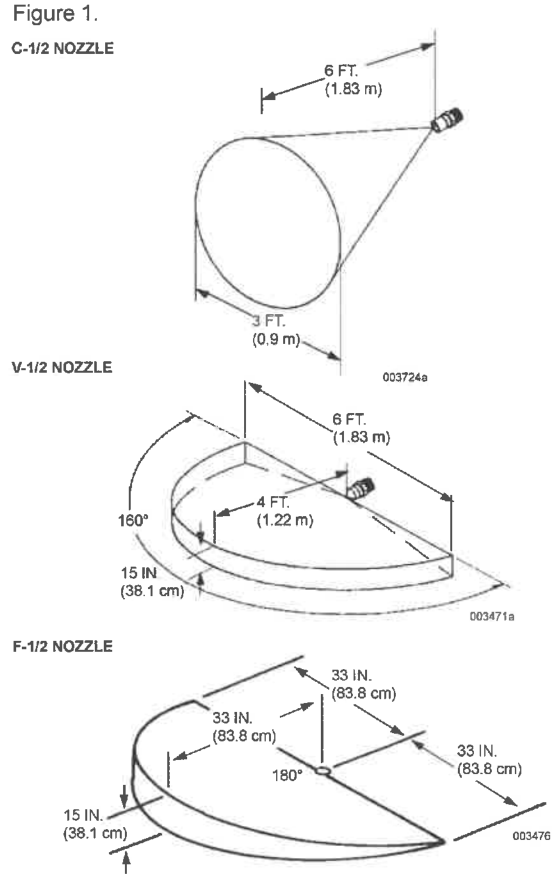


FIGURE 1

NOZZLE COVERAGE AND LOCATION (Continued)

NOTICE

When using any of the nozzle types, make certain no obstructions interfere with the discharge pattern as it is directed to the hazard

The following rules apply to selecting nozzles and nozzle locations:

- When choosing the proper nozzle, remember the entire hazard area must be within the nozzle's pattern and maximum effective discharge range.
- The narrow pattern and longer discharge range of the C-1/2 nozzle make it a good selection for protecting small areas or hazards that are distant from the nozzle mounting location.
- Larger hazard areas may require the use of V-1/2 or F-1/2 nozzles.
- Some areas may exceed the area coverage of one nozzle and may require an additional nozzle(s) for protection.
- In some cases, a single nozzle can cover more than one area of a common hazard such as a transmission and torque converter. **NOTE:** Both areas must be within the discharge pattern of the nozzle.
- When planning nozzle locations, make certain the effective flow of dry chemical to all recognized hazard areas will not be obstructed.
- If obstructions cannot be avoided, an additional nozzle(s) may be needed to provide proper coverage.
- In areas where the environment may cause extreme build up of materials, such as wood debris, coal dust, garbage, or oil, it is always a good idea to use the largest system tank available and keep the nozzles per tank to a **maximum of four.** This allows the maximum amount of chemical per nozzle and gives the longest discharge time (excluding two nozzle systems).
- Never settle for less than full coverage of each fire hazard.

After establishing nozzle locations and number required, the type and quantity of A-101/LT-A-101 tanks can be determined.

TANK QUANTITY REQUIREMENTS

First consider the type of environment the vehicle will be operating in and its temperatures. This will determine the type of tank to choose.

A-101/LT-A-101 systems are available in the standard model A-101 which has a temperature range of +32 °F +120 °F (0 °C to +49 °C) and are generally used on sub-surface mining equipment.

Also available is the extreme temperature model LT-A-101 which has a temperature range of –65 °F to +210 °F (–54 °C to +99 °C) and is typically used on above surface vehicles.

Knowing the number of nozzles required, next determine the type or size of tank(s) required. The following "System Selection Chart" will point out the various options.

System Selection Chart

Model Capacity	Nozzle Quantity	Effective Discharge Time	Agent per Nozzle
10	2	8.5 sec.	4 1/4 lb. (1.9 kg)
20	4	8.5 sec.	4 1/4 lb. (1.9 kg)
20	6	5.7 sec.	2 7/8 lb. (1.3 kg)
30	4	12.5 sec.	6 1/4 lb. (2.8 kg)
30	6	8.3 sec.	4 1/8 lb. (1.9 kg)

Nozzle quantities, discharge times and amount of agent per nozzle are all factors to consider in determining the proper tank size.

Keep in mind, a longer discharge time and a greater amount of agent discharge per nozzle will offer better hazard protection.

It is always best to choose the largest size tank available, but if space is a problem, choose a smaller tank or choose the low profile version.

When the number of tanks have been determined based on the number of nozzles for total protection, the next step in the design process is to determine the distribution hose network required.

DISTRIBUTION SYSTEM REQUIREMENTS

After the tank(s) and nozzle(s) location(s) have been determined, it is necessary to sketch the hose routings to each nozzle to make certain they can be run without interfering with vehicle components and that the length of the supply line(s) and branch line(s) are not exceeded.

Hose Specifications

To ensure proper performance of the Ansul A-101/LT-A-101 system, the hose used must meet either SAE 100 R5 or 100 R1 hose specifications as a **minimum.** The hose must have an operating temperature of –40 °F to +200 °F (–40 °C to +93 °C). The following list of appropriate standards is for reference.

SAE Selection, Installation, and Maintenance of Hose and Hose Assemblies	J1273 (latest revision)
SAE Hydraulic Hose Fitting Standard	J516 (latest revision)
SAE Hydraulic Hose Standard	J517 (latest revision)
SAE Test and Procedures For SAE 100R Series Hydraulic Hose and Hose Assembly Standard	J343 (latest revision)

For underground mining applications, hose must comply with USBM specified flame resistance acceptance and all applicable SAE requirements.

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Listed below is a partial list of hose manufacturers who manufacture hose that meets the required SAE specification noted on Page 4-2:

Aeroquip	Parker
Dayco	Swagelok
Gates	Weatherhead
Goodyear	

Critical Specifications from SAE J517 are listed below for reference:

SAE 100R1 Hose

Size	Hose ID	Maximum Operating Pressure	Minimum Burst Pressure	Minimum Bend Radius
1/4 in.	.250 in. +.023 –.008	2750 psi	11000 psi	4.0 in.
1/2 in.	.500 in. +.031 –.015	2000 psi	8000 psi	7.0 in.
3/4 in.	.750 in. +.031 –.015	1250 psi	5000 psi	9.5 in.
7/8 in.	.875 in. +.031 –.015	1250 psi	5000 psi	11.0 in.

SAE 100R5 Hose

Size	Hose ID	Maximum Operating Pressure	Minimum Burst Pressure	Minimum Bend Radius
1/4 in.	.250 in. +.031 –.000	3000 psi	12000 psi	3.4 in.
1/2 in.	.500 in. +.039 –.000	1750 psi	7000 psi	5.5 in.
3/4 in.	—	—	—	—
7/8 in.	.875 in. +.042 –.000	800 psi	3200 psi	7.4 in.

Hydraulic Hose Couplings

Before connecting a hydraulic hose to the A-101/LT-A-101 fire suppression system, it must first be assembled utilizing a hose coupling attached to each end of the hose. Hose couplings installed on hydraulic hose can be the permanent crimp-on type or the reusable type. Female or male swivel hose couplings of either the crimp-on type or the reusable type are also acceptable. All couplings used with SAE 100R1 or SAE 100R5 hydraulic hose must be suitable for the hose chosen and must comply with Hydraulic Hose Fitting Standard J516 as a minimum.

When attaching a hose coupling to a hose, it is very important to follow all manufacturer's installation instructions. SAE J1273, Selection, Installation, and Maintenance of Hose and Hose Assemblies, paragraph 3.2, requires that the manufacturer's assembly instructions be followed.

NOTICE

SAE J1273, paragraph 2.10, Proper End Fitting, states that, "Care must be taken to insure proper compatibility exists between the hose and coupling selected based on the manufacturer's recommendations substantiated by testing to industry standards such as SAE J517."

Under no circumstances should hose and couplings from different manufacturers be interchanged.

Many hose manufacturers require only the couplings that they supply to be used with their hose. One manufacturer warns that they "will not be responsible when interchanging their hose and/or couplings with hose and/or couplings of any other manufacturer."

Permanent Crimp-on Hose Couplings

A permanent crimp-on hose coupling is installed as a one-piece assembly attached to the hose end and crimped on. The crimp is to be made following the manufacturer's requirements for proper hose and coupling assembly, using a machine that will hydraulically or electrically crimp the coupling permanently to the hose end.

When using permanent crimp-on type couplings, lubricate the hose end, if necessary, and push the hose end all the way into the fitting in accordance with hose and hose coupling assembly instructions. Then place the hose end in the appropriate crimping machine and crimp the coupling. Follow all hose crimping machine operating instructions using equipment specified by the hose/coupling manufacturer.

Reusable Hose Couplings

Reusable hose couplings can be attached to new hose in the field with no other tools than a wrench and a vise (or two wrenches). When reusable hose couplings are used, make certain the corresponding couplings and the assembly procedures used are in accordance with the manufacturer's specifications. **Failure to follow the manufacturer's instructions in their entirety may result in plugged nozzle orifices at system discharge due to chips and pieces of rubber cut from the inside of the hose during improper assembly.**

Reusable hose couplings include a coupling shell that fits over the end of the hydraulic hose and a coupling insert that installs inside the end of the hose and mates with the coupling shell threads. A mandrel tool may be required when using 1/4 in. through 1/2 in. SAE 100R5 hose to facilitate installation of the coupling insert.

To attach a reusable coupling to the hose, clamp the coupling shell in a vise and turn the end of the hydraulic hose counterclockwise into the coupling shell until the end is seated against the bottom of the shell. Then, back off 1/4 to 1/2 turn to allow for expansion.

NOTE: Some-rubber covered hydraulic hose ends must be skived (stripped of the rubber cover) before attaching the coupling. Refer to the appropriate manufacturer's instructions.

Lubricate the hose, coupling insert, and mandrel tool (when required) in accordance with manufacturer's instructions and screw the insert clockwise into the coupling shell and hose. Wrench tighten the insert until the hex on the insert contacts the shell. If a female swivel end is being used, use the appropriate assembly tool and leave approximately 1/32 in. to 1/16 in. (.8 to 1.6 mm) clearance between the nut and the shell to allow the nut to swivel.

NOTE: It is important to lubricate only those surfaces specified by the manufacturer of the hose and coupling used. The lubricant will minimize the risk of cutting or shaving the inside of the hose. **Failure to use the proper lubricant or follow the appropriate lubrication instructions may result in pieces of hose plugging the gas tube in the agent storage tank or plugging a discharge nozzle orifice. Improper lubricant or lubrication procedures may also result in contamination of the hose due to the use of an incompatible lubricant.**

After attaching hose couplings to the hose, make certain that the hose is clean, dry and oil free. Use a solvent that is compatible with the hose, such as Stoddard Fluid or Varsol, to dissolve any oil remaining in the hose. Using dry air or nitrogen, blow out each hose length until dry and clear of metal or rubber shavings and any foreign matter before making any connections to the A-101 system.

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

JIC Hose Fittings and 150 lb. Fittings

JIC hose fittings meeting Hydraulic Hose Fitting Standard J516 can be used in most applications. When using JIC hose fittings as elbows, use only elbows that have a radiused bend. 150 lb. NPT elbows and tees can also be used to assemble hose or pipe and attach hose or pipe to the discharge nozzles. Make certain that all elbows used in the agent distribution line, are of the same type (i.e., either all JIC or all 150 lb. NPT elbows). Refer to the Installation Section for maximum and minimum elbow requirements.

NOTE: When figuring the maximum and minimum amount of elbows in the A-101/LT-A-101 system, two (2) 45 ° fittings can be counted as one 90° fitting.

Heat Resistant Fire Jacket for Hydraulic Hose (Non-FM Approved)

All hose assemblies, including actuation lines, expellant gas lines, and agent distribution hose that will be normally exposed to or located in areas with temperatures exceeding 200 °F (93 °C), should be sleeved with an extreme temperature heat-resistant fire jacket. (Do not route actuation hose through fire hazard areas. If this cannot be avoided, the hose must be fire jacketed.) Information concerning fire jacketing should be available through your local hose supplier. If not, Bentley Harris manufacturers a fire jacket that will withstand continuous operating temperatures from –65 °F to 500 °F (–54 °C to 260 °C) and short term exposures up to 2000 °F (1093 °C). For a listing of distributors in your area, call Bentley Harris at either 610-363-2600 or, 800-321-2295.

Dry Chemical Flow Characteristics

The assembly of piping (hose) for a dry chemical system probably lends itself to the greatest chance for error when installing the system. Dry chemical-gas mixtures do not flow like liquids, and, as a result, certain basic rules must be followed to assure correct dry chemical distribution to the nozzles.

In order to obtain equal distribution at a tee, the dry chemical must enter the center opening (bull) of the tee and exist the two side opening which are 180° apart. See Figure 2.

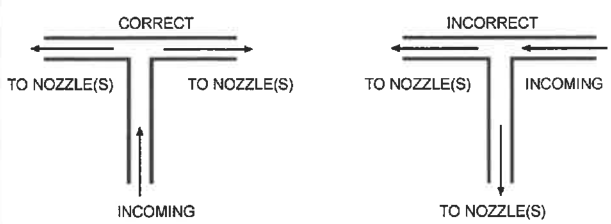


FIGURE 2
003477

When dry chemical makes a change of direction through an elbow, a tee, or a hose bend, a separation of the dry chemical and gas mixture occurs. If a tee follows this change of direction where separation can occur, and if this tee lies in the same plane as the change in direction through an elbow, tee, or hose bend, more dry chemical will discharge through one of the tee outlets and more gas will discharge out the other tee outlet. A certain minimum length of hose must be allowed from the bend (elbow) to the tee or from the first tee to the second tee in order to permit the dry chemical and gas to intermix before striking the tee. The minimum length required is equal to 20 hose diameters. 18 in. (457 mm) is required for 7/8 in. hose, 15 in. (381 mm) is required for 3/4 in. hose, and 10 in. (254 mm) is required for 1/2 in. hose. See Figure 3.

NOTE: When using the distribution tee, Part No. 25031, a minimum length of 15 in. (381 mm) of 3/4 in. or 18 in. (457 mm) of 7/8 in. hose, will always be required between any bend or elbow and the distribution fee.

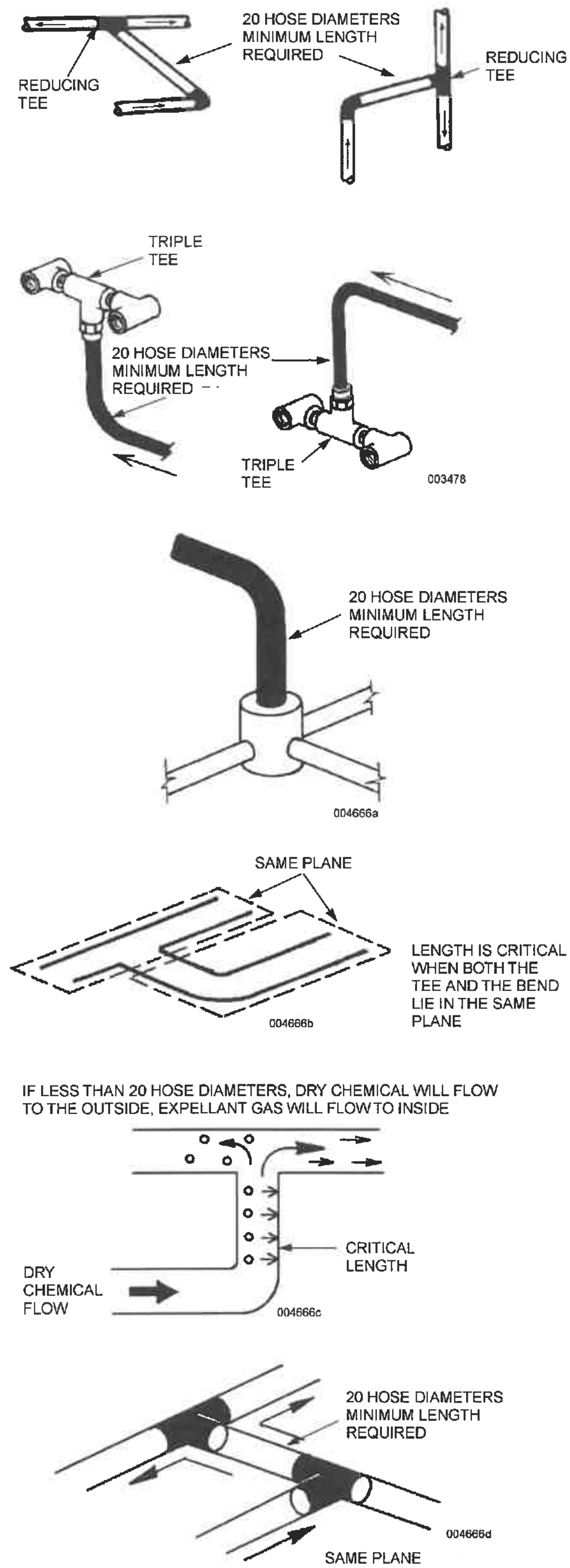


FIGURE 3

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Dry Chemical Flow Characteristics (Continued)

If a tee follows a change in direction through an elbow, another tee, or a hose bend and the directional change is in a plane that is perpendicular to the plane of the tee following, the dry chemical particles and gas will strike the rear of the tee before branching, intermixing of the dry chemical and gas will occur through turbulence and the length of hose from the bend (elbow) or tee proceeding it is not critical. See Figure 4.

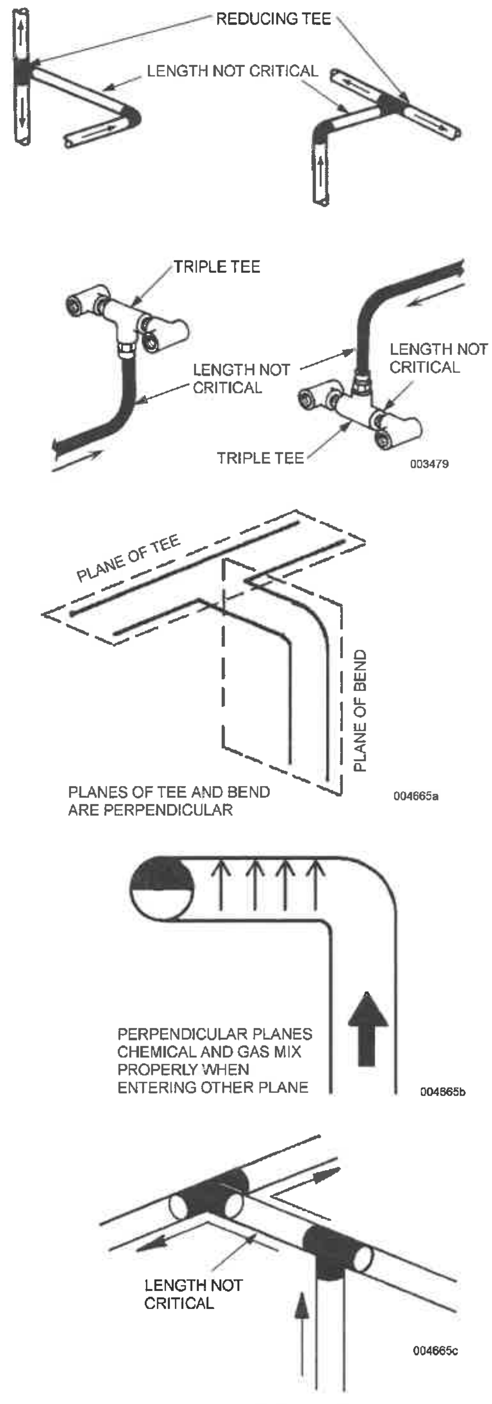


FIGURE 4

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements

Supply and branch lines for the A-101/LT-A-101 system are defined as follows:

TWO NOZZLE SYSTEM – Two nozzle systems consist of a 3/4 in. or 7/8 in. supply line, a 3/4 in. x 1/2 in. x 1/2 in. reducing tee, and 1/2 in. branch lines each connected to one nozzle. See Figure 5.

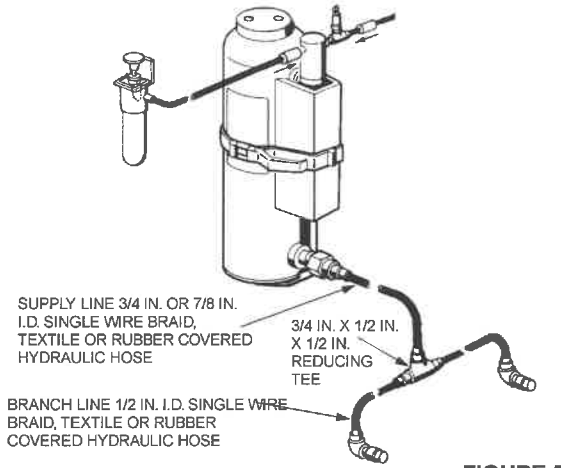


FIGURE 5
003480

FOUR NOZZLE SYSTEM – Four nozzle systems are divided into two types: Four nozzle triple tee arrangement and four nozzle split tee arrangement. Four nozzle triple tee systems consist of a 3/4 in. or 7/8 in. supply line into a triple tee assembly consisting of a 1/2 in. x 1/2 in. x 3/4 in. reducing tee, two close nipples, and two 1/2 in. tees. The primary branch line is the close nipple that connects the 1/2 in. tee to the reducing tee. Four separate secondary branch lines are run from the 1/2 in. tee outlets each connected to one nozzle. See Figure 6.

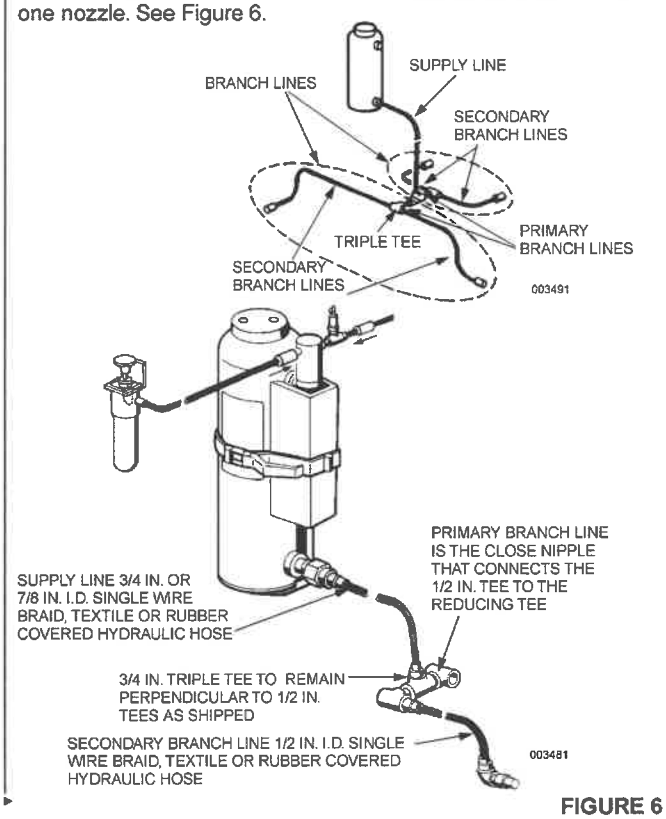


FIGURE 6

The four nozzle split tee arrangement consists of a 3/4 in. or 7/8 in. supply line, a 1/2 in. x 1/2 in. x 3/4 in. reducing tee, two 1/2 in. primary branch lines, two 1/2 in. tees, and four 1/2 in. secondary branch lines each connected to one nozzle. See Figure 7.

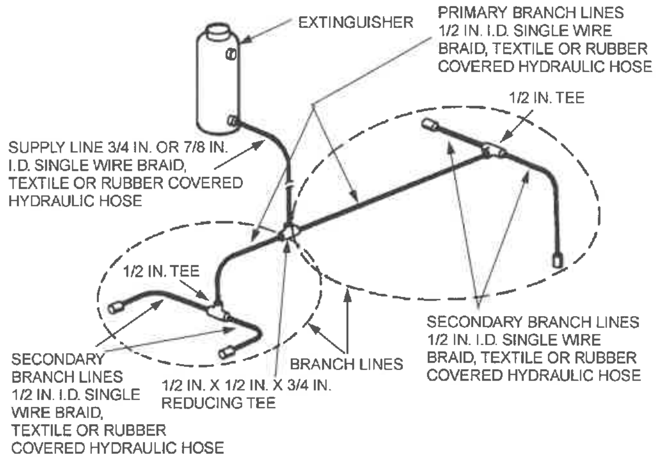


FIGURE 7
003482

NOTE: On split tee arrangements, if the 1/2 in. secondary branch line tee is not more than 20 hose diameters from the 1/2 x 1/2 x 3/4 in. primary branch line tee, then the orientation of the tees must be perpendicular to each other as they are in a triple tee arrangement.

SIX NOZZLE SYSTEM – Six nozzle systems consist of a 3/4 in. or 7/8 in. supply line, a special three outlet distribution tee, three 1/2 in. primary branch lines, three 1/2 in. tees, and six secondary branch lines each connected to one nozzle. See Figure 8.

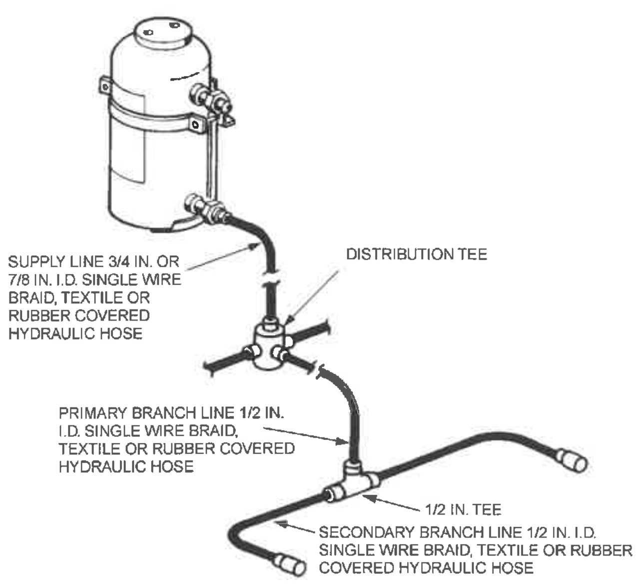


FIGURE 8
003483

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

Depending upon the hazards to be protected and the placement of the system components, a selection can be made from several balanced and unbalanced distribution network arrangements:

– A balanced system must be a distribution network where the linear length of the primary branch line on one side of the primary tee to the secondary tee must be within 10% of the linear length of the other primary branch line from the primary tee to the secondary tee. Also, the linear length of the secondary branch line on one side of the secondary tee must be within 10% of the linear length of the other secondary branch line sharing the same tee. A balanced system can be used with two, four, or six nozzle systems. See Figure 9A.

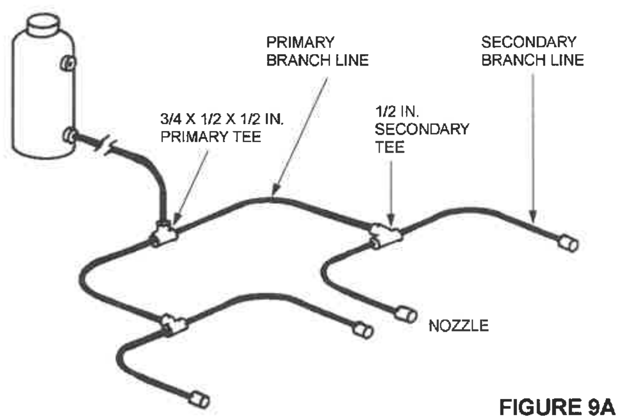


FIGURE 9A
003484

– In an unbalanced system, the longest branch line must be no longer in length than 3 times that of the shortest branch line, with a maximum of 18 ft. total (primary plus two secondary branches). See Figure 9B.

6 NOZZLE UNBALANCED DISTRIBUTION TEE

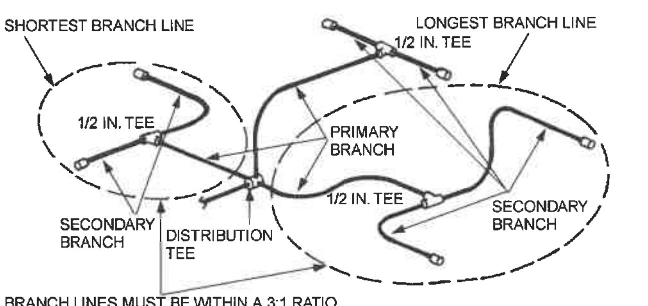


FIGURE 9B
003485

– Unbalanced secondary branch line lengths must also be within a 3 to 1 ratio when they are located in the same branch line. See Figure 9C.

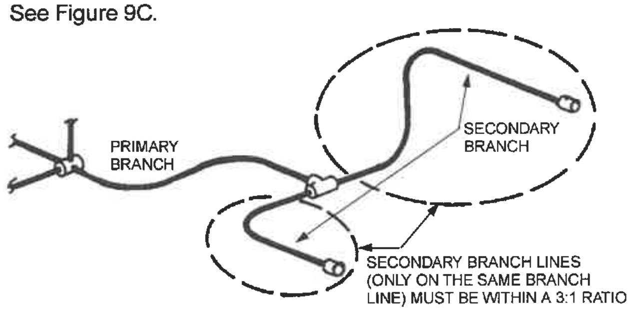


FIGURE 9C
003486

– The ten pound system must be a balanced system having two branch lines within 10% of each other, utilizing one reducing tee and a maximum of two nozzles. See Figure 9D.

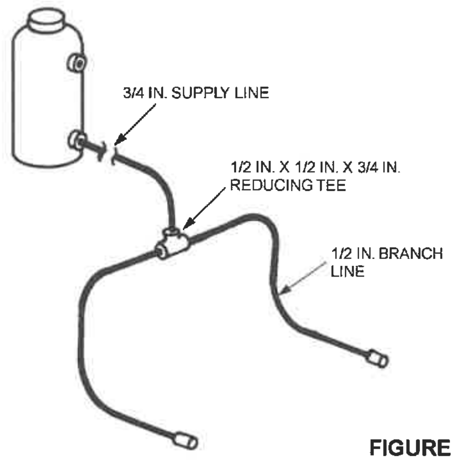


FIGURE 9D
003487

– The twenty and thirty pound systems can be either balanced or unbalanced systems, and can be arranged utilizing three different network combinations. These include the triple tee arrangement which utilizes the triple tee and four nozzles (See Figure 9E), the split tee arrangement utilizing one 3/4 in. x 1/2 in. x 1/2 in. reducing tee, two 1/2 in. tees, and four nozzles (See Figure 9F), and the distribution tee arrangement which utilizes a distribution tee, three 1/2 in. tees, and six nozzles (See Figure 9G).

4 NOZZLE UNBALANCED TRIPLE TEE

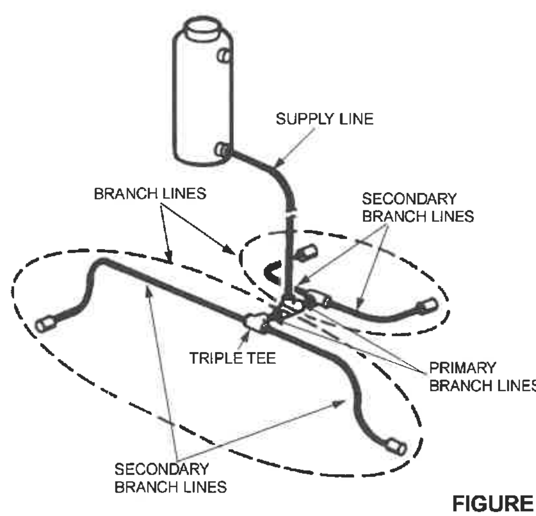


FIGURE 9E
003491

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

4 NOZZLE UNBALANCED SPLIT TEE

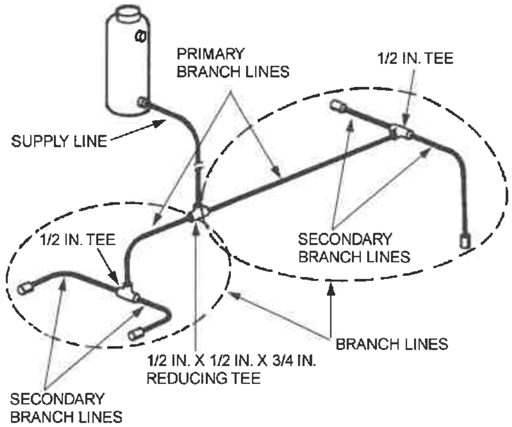


FIGURE 9F
003482

6 NOZZLE UNBALANCED DISTRIBUTION TEE

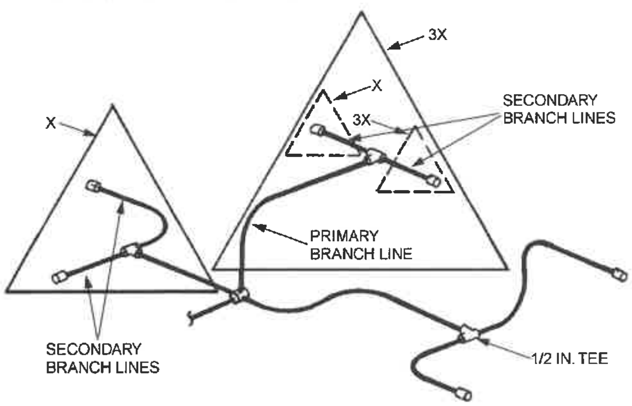


FIGURE 9G
003490

10 lb. 2 Nozzle Balanced System With Reducing Tee
See Figure 10 and 10A.

- Maximum supply line length from extinguisher to reducing tee is 30 ft. 0 in. (9.1 m).
- Maximum total length from extinguisher to farthest nozzle is 50 ft. 0 in. (15.2 m).
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Two (2) nozzles maximum.
- Maximum unbalanced allowed on the total system is 10% different in length from reducing tee to nozzle on one line compared to the same distance between reducing tee to nozzle on the other line.

NOTE: See Page 6-5 for fitting and bend limitations..

2 NOZZLE BALANCED WITH REDUCING TEE – 10 LB. SYSTEM

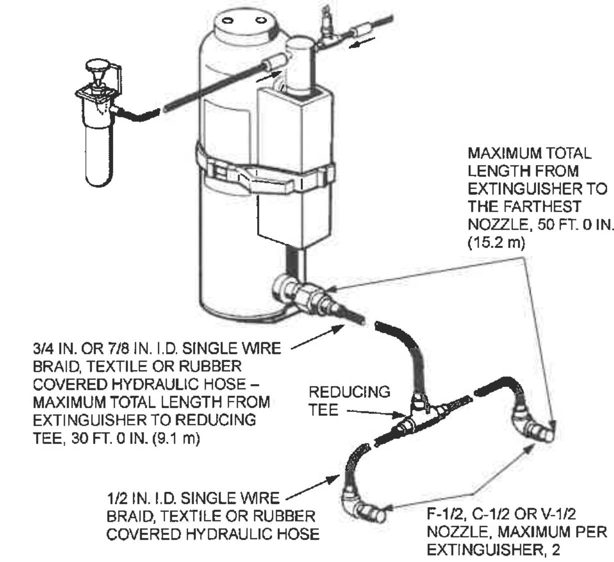


FIGURE 10
003480

EXAMPLES OF TYPICAL 2 NOZZLE SYSTEMS

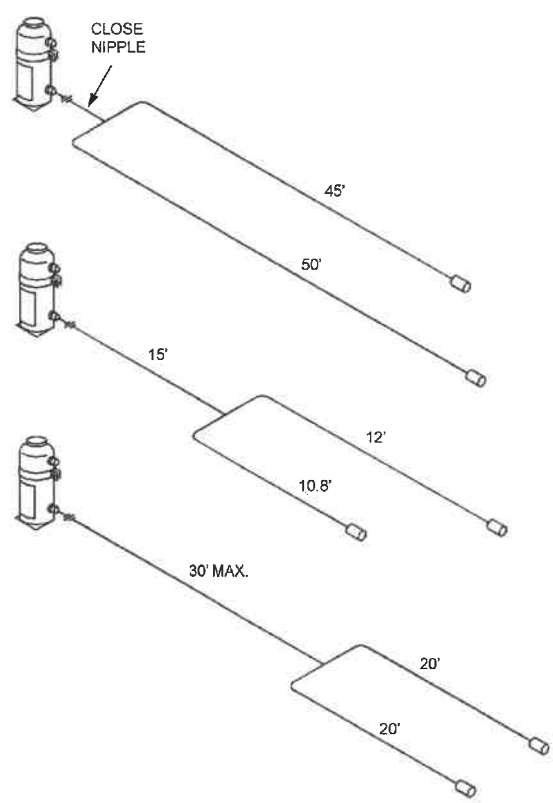


FIGURE 10A
003492

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

20, 30 lb. 2 Nozzle Balanced System With Reducing Tee
See Figure 11 and 11A.

- Maximum supply line length from extinguisher to reducing tee is 40 ft. 0 in. (12.2 m).
- Maximum total length from extinguisher to farthest nozzle is 50 ft. 0 in. (15.2 m).
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Two (2) nozzles maximum.
- Maximum unbalanced allowed on the total system is 10% difference in length from reducing tee to nozzle on one line compared to the same distance between reducing tee to nozzle on the other line.

NOTE: See Page 6-5 for fitting and bend limitations.

2 NOZZLE BALANCED WITH REDUCING TEE – 20 LB.-30 LB. SYSTEMS

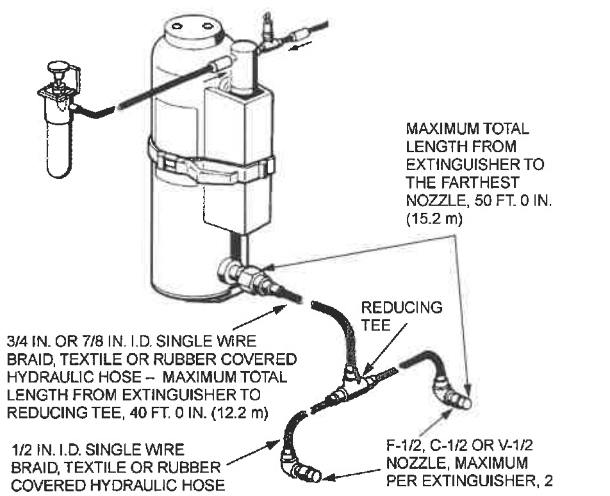


FIGURE 11
003480

EXAMPLES OF TYPICAL 2 NOZZLE SYSTEMS

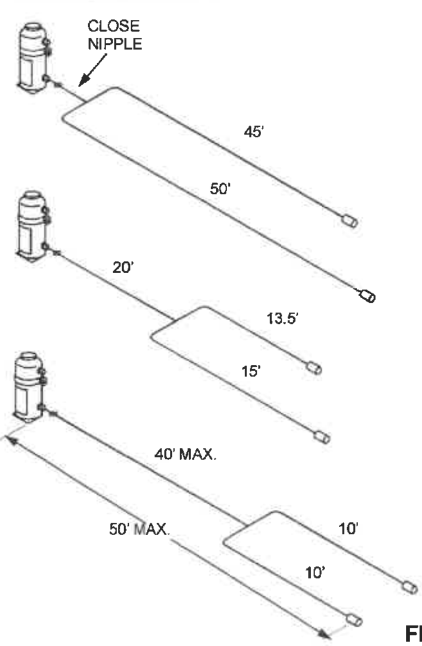


FIGURE 11A
003494

20, 30 lb. 4 Nozzle Balanced System With Triple Tee
See Figure 12 and 12A.

- Maximum supply line length from extinguisher to triple tee is 40 ft. 0 in. (12.2 m)
- Maximum total length from extinguisher to farthest nozzle is 50 ft. 0 in. (15.2 m).
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Four (4) nozzles maximum.
- Maximum unbalanced allowed on the total system is 10% different in length from 1/2 in. tee to nozzle on one line compared to the same distance between the same 1/2 in. tee to nozzle on the other line.

NOTE: See Page 6-5 for fitting and bend limitations.

4 NOZZLE BALANCED WITH TRIPLE TEE – 20 LB.-30 LB. SYSTEMS

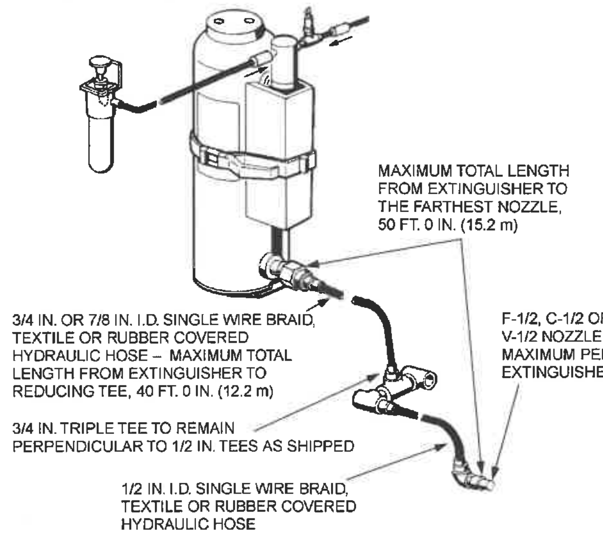


FIGURE 12
003481

EXAMPLES OF TYPICAL 4 NOZZLE SYSTEMS

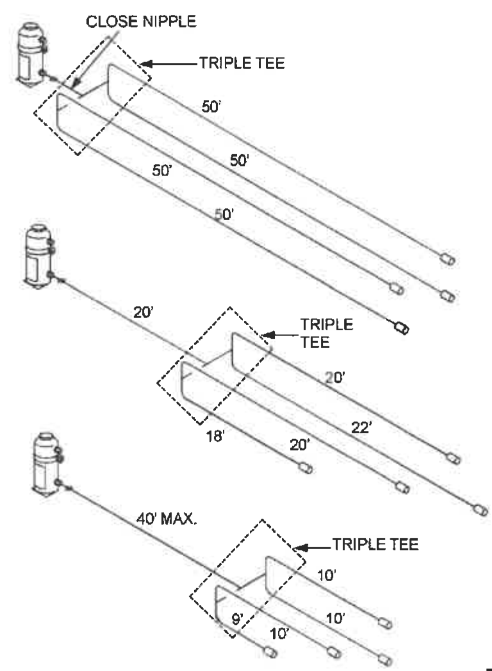


FIGURE 12A
003496

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

20, 30 lb. 4 Nozzle Unbalance System With Triple Tee See Figure 13 and 13A.

- Maximum supply line length from extinguisher to the triple tee is 40 ft. 0 in. (12.2 m).
- The longest branch line (including one primary and two secondary) is 18 ft. 0 in. (5.5 m) and must not exceed a 3:1 ratio of any other branch line(s).
- The triple tee assembled using close nipples. It must remain in the configuration as shown in Figure 13.
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Four (4) nozzles maximum.
- Secondary branch lines located on the same branch line (sharing the same tee) must not exceed a 3:1 ratio between each other but are not required to be within a 3:1 ratio with secondary branch line located on other branch lines.

NOTE: See Page 6-5 for fitting and bend limitations.

4 NOZZLE UNBALANCED WITH TRIPLE TEE – 20 LB.-30 LB. SYSTEMS

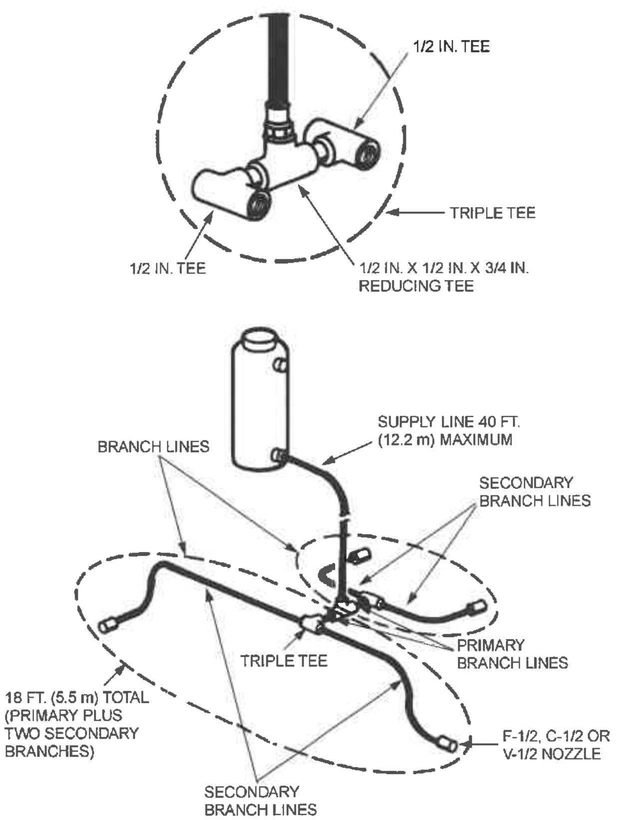


FIGURE 13
003497

EXAMPLES OF TYPICAL 4 NOZZLE SYSTEMS

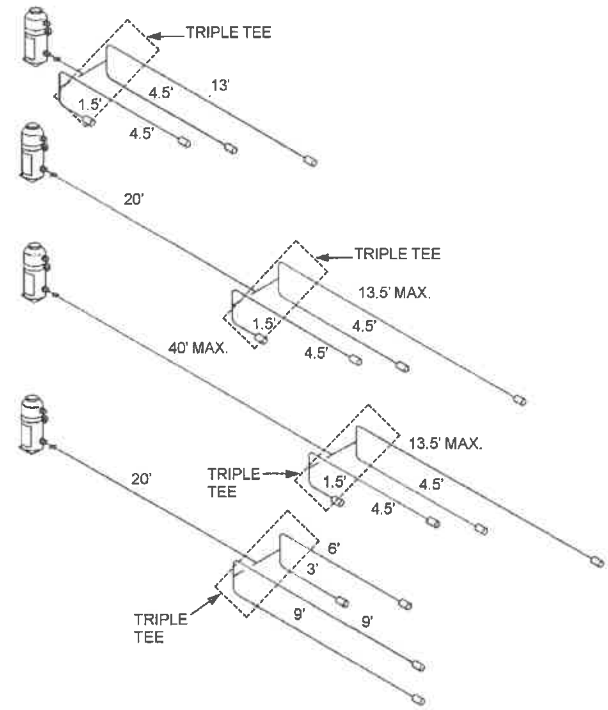


FIGURE 13A
003498

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

20, 30 lb. 4 Nozzle Balanced System With Reducing Tee See Figure 14 and 14A.

- Maximum supply line length from extinguisher to triple tee is 40 ft. 0 in. (12.2 m).
- Maximum total length from extinguisher to farthest nozzle is 50 ft. 0 in. (15.2 m).
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Four (4) nozzles maximum.
- Linear length of the primary branch line on one side of the primary tee to the secondary tee must be within 10% of the linear length of the other primary branch line from the primary tee to the secondary tee.

  Also, the linear length of the secondary branch line on one side of the secondary tee must be within 10% of the linear length of the other secondary branch line sharing the same tee.

NOTE: See Page 6-5 for fitting and bend limitations.

4 NOZZLE BALANCED WITH REDUCING TEE – 20 LB.-30 LB. SYSTEMS

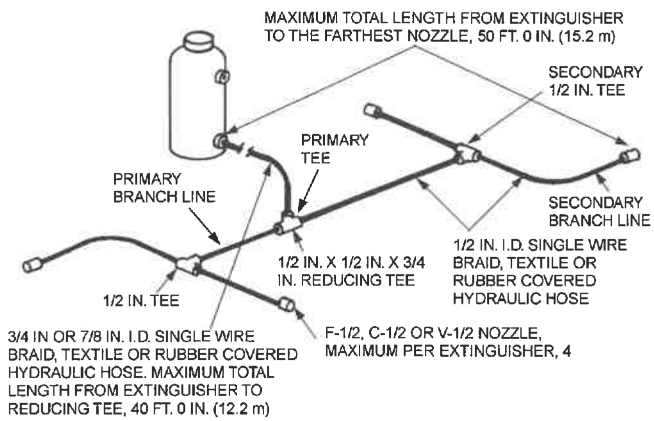
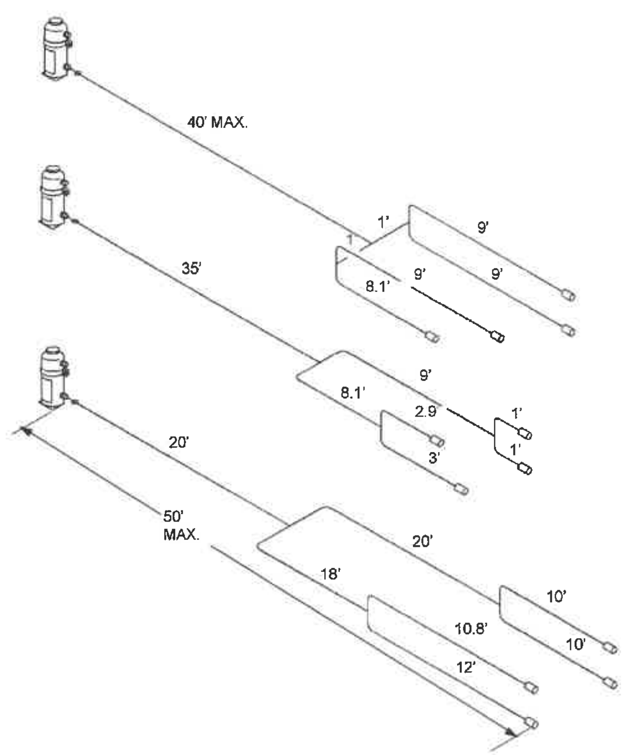


FIGURE 14
003499

EXAMPLES OF TYPICAL 4 NOZZLE SYSTEMS



EXAMPLES OF TYPICAL 4 NOZZLE SYSTEMS

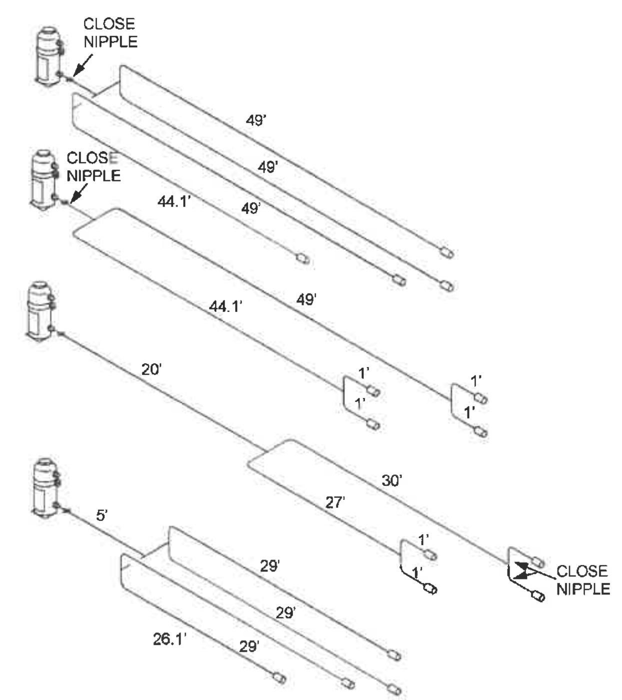


FIGURE 14A
003500

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

20, 30 lb. 4 Nozzle and 6 Nozzle Unbalanced System With Reducing Tee
See Figures 15 and 15A, 16 and 16A.

- Maximum supply line length from extinguisher to the reducing tee is 40 ft. 0 in. (12.2 m).
- The longest branch line (including one primary plus two secondary) length is 18 ft. 0 in. (5.5 m) and must not exceed a 3:1 ratio of any other branch line(s).
- Two secondary branch lines located on the same branch line (sharing the same tee) must not exceed a 3:1 ratio between other but are not required to be within a 3:1 ratio with secondary branch lines located on other branch line.
- Any combination of F-1/2, C-1/2, or V-1/2 nozzles are acceptable. Four (4) nozzles maximum.

NOTE: See Page 6-5 for fitting and bend limitations.

4 NOZZLE UNBALANCED WITH TEE REDUCING

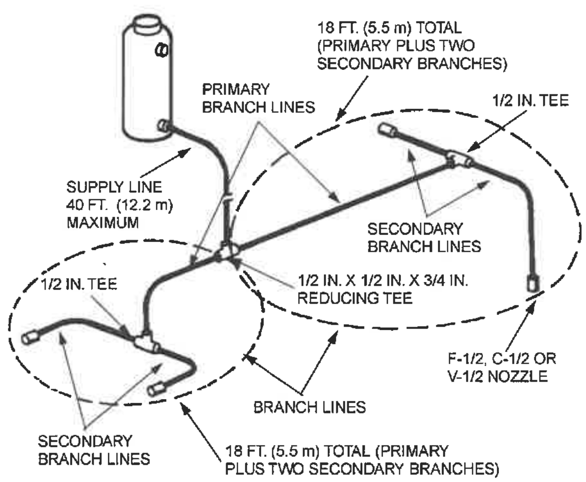


FIGURE 15
003482

EXAMPLE OF TYPICAL 4 NOZZLE SYSTEMS

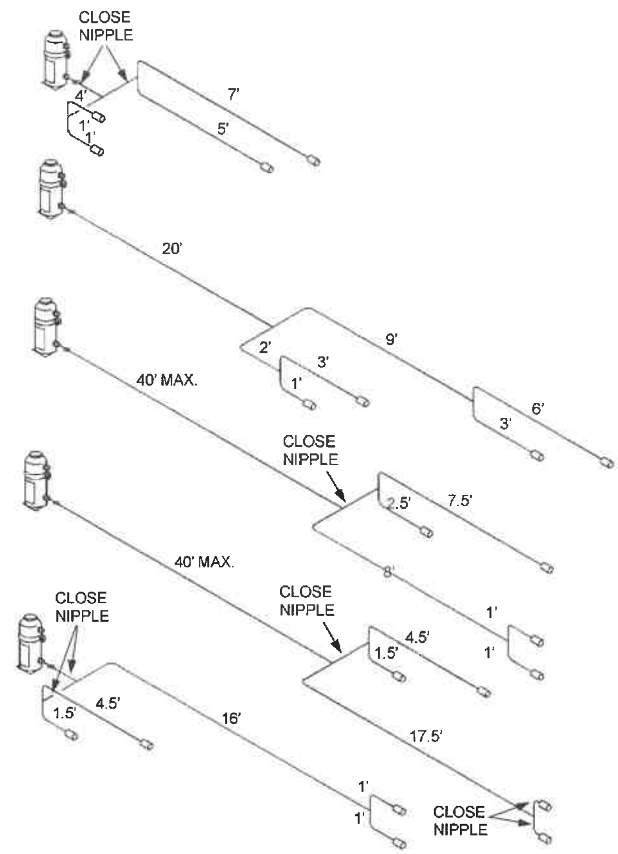


FIGURE 15A
003502

DISTRIBUTION SYSTEM REQUIREMENTS (Continued)

Supply and Branch Line Requirements (Continued)

20, 30 lb. 6 Nozzle Unbalanced System With Distribution Tee See Figure 16 and 16A.

6 NOZZLE UNBALANCED WITH DISTRIBUTION TEE – 20 LB.-30 LB. SYSTEMS

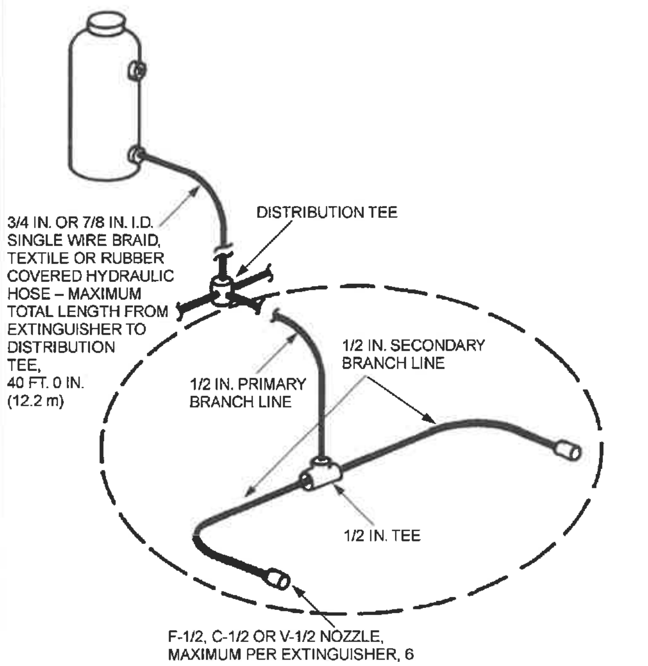


FIGURE 16
003503

EXAMPLE OF TYPICAL 6 NOZZLE SYSTEMS

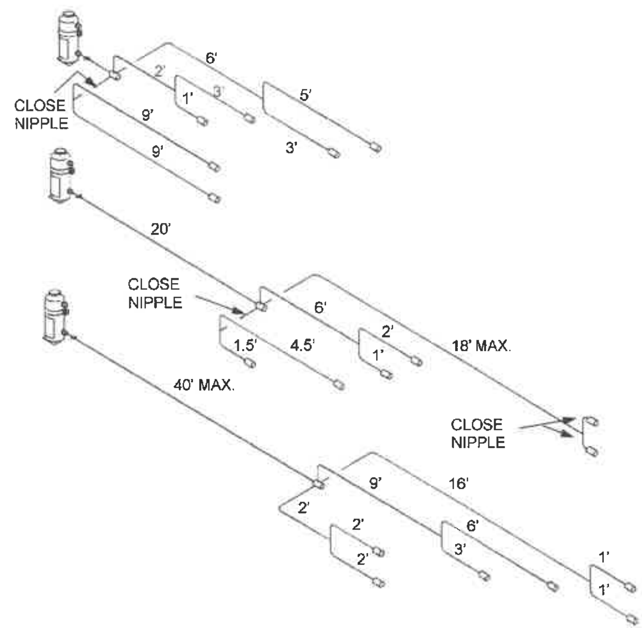


FIGURE 16A
003504

ACTUATION AND EXPELLANT GAS LINE REQUIREMENTS

Actuation Gas Line

The actuation gas line is the line from the manual remote actuators and/or the gas cartridge on the automatic detection system to the gas cartridge actuator located on the last A-101/LT-A-101 tank or the gas cartridge actuator for the last LT or LP style tanks. The maximum number of actuators that can be actuated from a single actuator cartridge is ten (10). The actuation line can be a maximum of 100 ft. (30.5 m) when using an LT-10 cartridge. When more than one actuation cartridge is in the system, a 1/4 in. check valve, Part No. 25627, must be installed to prevent the lose of actuation gas from an actuator that may have a cartridge removed. See Figure 17.

NOTE 1: If only eight (8) or less actuators are used, the actuation line can be extended to 125 ft. (38.1 m).

NOTE 2: The actuation line can also utilize an LT-5 cartridge. When this is done, only eight (8) actuators or less can be used, with a maximum length of 75 ft. (22.9 m).

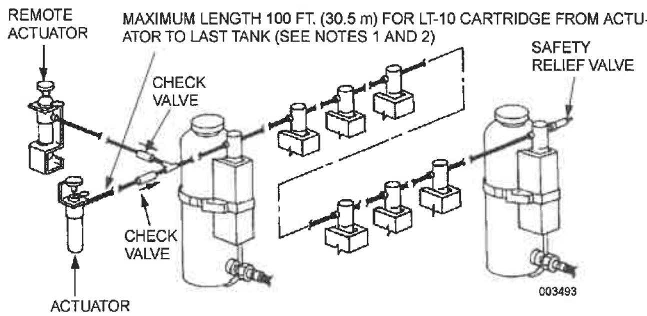
If more than one actuator is in the system, the total length of actuation line allowed from the actuator to the last tank must also include any amount of hose in the other actuation lines up to the check valves located in those lines.

The hose for the actuation system must meet the same specifications as the hose used for the dry chemical distribution network. See Pages 4-2 and 4-3 for hose and fitting specifications.

Expellant Gas Line

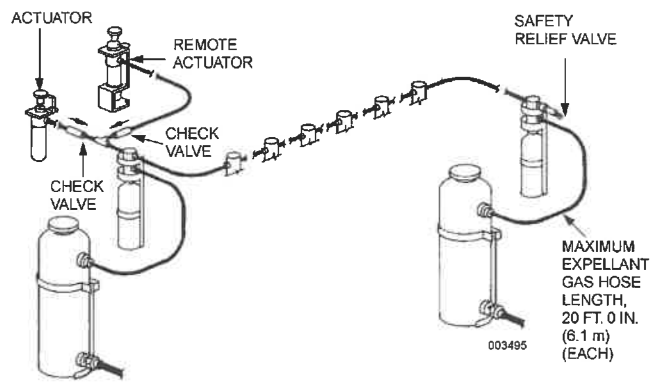
The expellant gas line is the length of 1/4 in. hose located between the remote expellant gas cartridge (required for LT and LP style tanks), and the expellant gas inlet on the tank. The maximum length of this line is 20 ft. (6.1 m). See Figure 17.

A-101 SYSTEM



NOTE: A MAXIMUM OF (10) TEN A-101/LT-A-101 SYSTEMS CAN BE ACTUATED SIMULTANEOUSLY IN ANY COMBINATION (I.E., A-101, LT-A-101, LP-A-101, OR LT-LP-A-101) (SEE NOTES 1 AND 2)

LT-A-101 SYSTEM



NOTE: REDUCE THE MAXIMUM ALLOWABLE NUMBER OF BASIC EXTINGUISHING UNITS BY ONE FOR EACH NON-EXTINGUISHING PNEUMATICALLY OPERATED DEVICE EMPLOYED, I.E., BRAKE CONTROL VALVE, FUEL CONTROL AIR CYLINDER.

FIGURE 17

The hose for the expellant gas line must meet the same specifications as the hose used for the dry chemical distribution network. See Pages 4-3 through 4-4 for hose and fitting specifications.

DETECTION SYSTEM REQUIREMENTS

Several types of automatic detection is available for use with the A-101 Fire Suppression System. Three types of electric detection and one type of pneumatic.

See the following Installation Manuals for detailed information on each type of system:

- CHECKFIRE MP-N ELECTRIC SYSTEM – Manual Part No. 427310
- CHECKFIRE SC-N ELECTRIC SYSTEM – Manual Part No. 423522
- CHECKFIRE ELECTRIC SERIES I SYSTEM – Manual Part No. 54894

SHUTDOWN REQUIREMENTS

When protecting any vehicle, especially vehicles with large amounts of hydraulic fluid and fuel on board, the engine must be shut down and hydraulic pumps shut off and lines depressurized. To accomplish this, it is necessary to wire the shutdown of these devices into the CHECKFIRE SC-N Module shutdown relay contacts. A brief description of how this is accomplished is as follows:

Engine Shutdown – Engine shutdown can be accomplished through a normally energized fuel solenoid (supplied by others) which is wired in series with the normally closed "shutdown" relay contacts of the CHECKFIRE SC-N Control Module or in a pressure switch. These "shutdown" relay contacts will operate (open) after the first time delay cycle is complete on the module.

Hydraulic Fluid Tank Air Shut Off and Venting – Solenoid valves (supplied by others) can be connected to air vents of the hydraulic tank. They can be wired to N.O. contacts on a relay (supplied by others). A solenoid (supplied by others), connected to the air supply line, if used, going to the hydraulic tank, can be wired to N.C. contracts of the same relay. The coil to the relay is wired in series with N.C. pressure switch contacts. The pressure switch is connected to the pneumatic actuation line of the dry chemical system. The relay coil is normally energized. When the pressure switch is activated by pressure in the actuation line, the switch contacts will open. Loss of power or an open circuit will cause the solenoid valves to transfer, thus shutting down the air supply.

Another means available for fuel shutdown is to pneumatically shutdown the fuel rack by venting the hydraulic pressure through the "safety system." This can be accomplished by installing the Ansul Engine Shutdown Device, Part No. 427425, in the dry chemical system actuation line. (This is normally only an option on some underground mining applications.) When the Ansul fire suppression system is actuated, the actuation pressure opens the check valve located in the engine shutdown device, allowing the safety system pressure to bleed into the holding tank. The drop in pressure causes the valves in the fuel rack to close, thus shutting down the engine. See Figure 18.

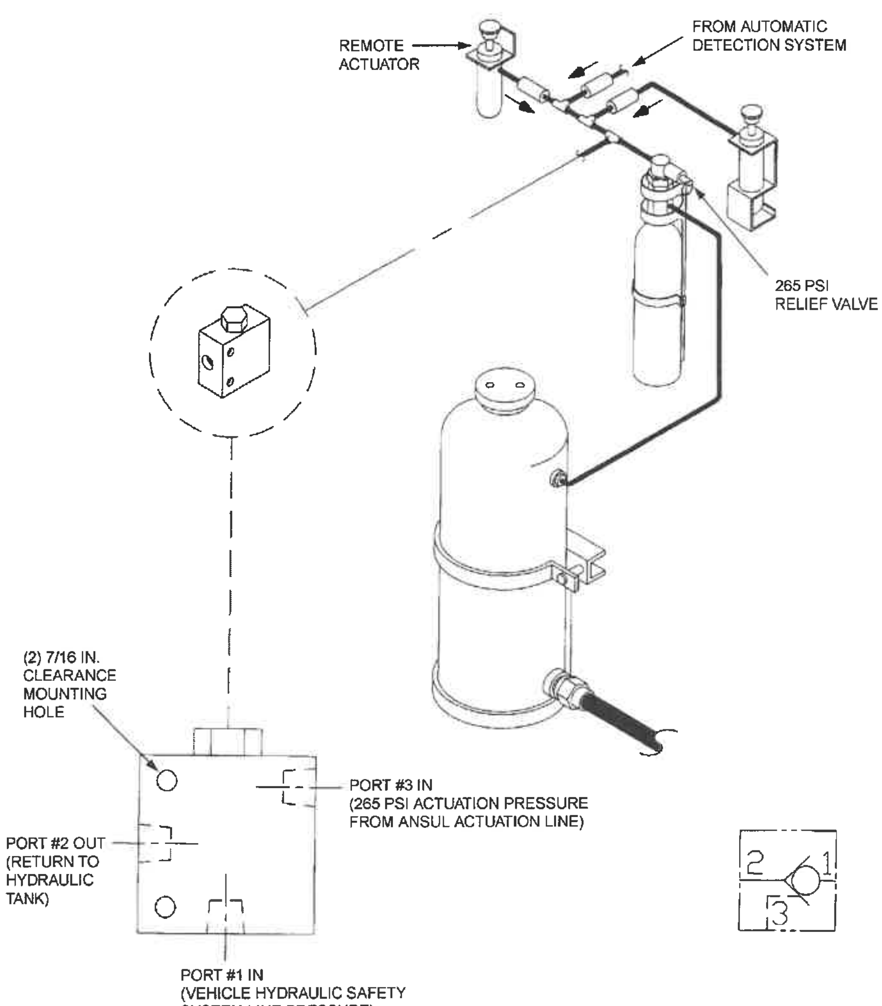


FIGURE 18
004668

ACCESSORIES

Accessories can be added to the pneumatic actuation line to mechanically shut off fuel, electrically shut off engines, and electrically sound alarms.

Air Cylinder

This component is a system accessory whose function is to shut off the fuel supply to the engine when the fire suppression system is actuated.

The fuel shut-off is a spring-return rocker arm on the side of the engine which has a cable link to the vehicle dashboard. The air cylinder rod will tie into this rocker arm, in parallel to, but not interfering with, the operator's cable control. See Figure 19.

NOTE: WHEN USING AN LT-10 CARTRIDGE, AT 125 FT. OF HOSE, THE MAXIMUM FORCE AT THE AIR CYLINDER IS 70 LBS.

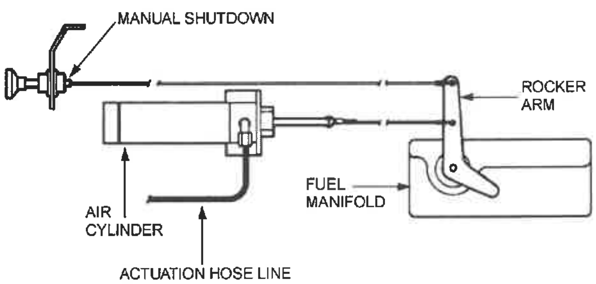


FIGURE 19
003489

Pressure Switch

Two styles of pressure switches are available for various electrical functions:

PRESSURE SWITCH PART NO. 46250 (Weatherproof) – This pressure switch is a single pole, double throw (SPDT) pressure switch constructed with a gasketed, water tight housing. The switch is rated at 10A – 125V, 5A – 250 VAC. This switch is suitable for outdoor applications.

PRESSURE SWITCH PART NO. 8372 (Non-Weatherproof) – This pressure switch is a single pole, double throw (SPDT) pressure switch. It is rated at 15A, 125, 250, or 480 VAC, 1/4 HP at 125 VAC, 1/2 HP at 250 VAC, or 1/2 A at 125 VDC. This switch is not weather-proof and should not be used for outdoor applications.

PRESSURE SWITCH PART NO. 43241 – This pressure switch is a double-pole, double-throw (DPDT) pressure switch. The switch is constructed with an explosion-proof housing suitable for hazardous environments. The switch contacts are rated at 10 amp at 125 VAC or 5 amp at 250 VAC.

NOTE: When installing pressure switches in the actuation line, the hose running to the switch must always be located downstream of any actuation check valves.

The following are typical industrial type hazards which can be protected by using the total flooding method: flammable liquid storage, dip tanks, solvent cleaning tanks, transformer vaults, quench tanks, and furnace rooms.

HAZARD ANALYSIS

A thorough hazard analysis is required to determine the type and quantity of protection required.

Review each of the following requirements when doing a hazard analysis:

1. **Hazard Type**

   Record the size of the hazard, any obstructions, unclosable openings, size and location of external ductwork or anything else which would concern system performance. Briefly describe the type of hazard being protected. If protecting prefabricated booths, record the manufacturer model number and anything unique about the hazard.

2. **Hazard Atmosphere**

   The A-101/LT-A-101 system can be used in most industrial environments. If the hazard atmosphere is considered corrosive, such that the solvents, chemicals, or gases present are damaging to the A-101 system tank or actuators, the hardware should not be located in the hazard. When protecting an area defined as hazardous per NFPA 70 National Electric Code, Article 500, only equipment that has been listed or approved for the hazardous location, may be located in that area.

3. **Hazardous Materials**

   The A-101/LT-A-101 system uses FORAY (ABC) dry chemical as the extinguishing agent. The agent effectiveness and limitation is based on its ability to suppress the fire with the design parameters of the pre-engineered system.

   a. FORAY dry chemical is effective on the following types of fire materials:

      Class A – Surface Fires: These fires involve ordinary combustible materials such as cloth, paper, rubber, and many plastics.

      Class B – Flammable Liquid and Gas Fires: These fires involve such materials as oils, grease, tars, oil-based paints, lacquers, and gasoline.

      Class C – Energized Electrical Equipment Fires: Common Class C devices include control rooms, transformers, oil switches, circuit breakers, rotating equipment, pumps, and motors

   b. FORAY dry chemical is **NOT** effective on the following types of fire materials:

      Deep-seated Class A Materials: Deep-seated or burrowing fires in ordinary combustibles where the FORAY dry chemical cannot reach the point of combustion.

      Class D – Combustible Metals: Class D type materials are reactive such as sodium, potassium, magnesium, and titanium.

      Chemicals Capable of Rapid Oxidation: Chemicals or mixtures of chemicals such as cellulose nitrate.

4. **Ventilation Considerations**

   The hazard ventilation system is very important when considering total flooding application, but should also be considered for local application overhead and tankside.

   The ventilation system should be shut down and/or dampered before or simultaneously with the start of the A-101/LT-A-101 system discharge.

5. **Electrical Considerations**

   It is recommended that all electrical power sources associated with the protected hazard be shut down before system discharge. This eliminates the potential of a fire being electrically-reignited.

6. **Temperature Range**

   The following temperature ranges must be determined and noted to ensure proper placement and operation of the A-101 system:

   Hazard Area: Determine the minimum and maximum temperature of the hazard to be protected. This temperature may be any temperature that the distribution piping and detectors can withstand – only if the agent tank and accessories are located outside of the hazard area.

   Agent Tank: The temperature range for all applications is +32 °F to +120 °F (0 °C to +48 °C) for standard type A-101 tanks and –65 °F to +210 °F (–54 °C to +99 °C) for LT-A-101 low temperature type tanks.

DISTRIBUTION SYSTEM REQUIREMENTS

The distribution system for industrial hazards must follow the same requirements as listed for vehicle systems. See Section IV, SYSTEM DESIGN – VEHICLE, for detailed hose requirements for agent distribution and actuation/expellant gas lines.

Exception: For industrial hazards, only F-1/2 nozzles, Part No. 16449, are approved for total flood.

NOZZLE COVERAGE

The only nozzle approved for use with A-101/LT-A-101 industrial total flooding protection is the F-1/2 nozzle.

Single System Capabilities

Model	10 lb.	20-lb.	30-lb.
Total Max. Flooding	350 cu. ft. Max. (9.9 cu. m)	700 cu. ft. Max. (19.8 cu. m)	1000 cu. ft. (28.3 cu. m)
	5 ft. x 10 ft. x 7 ft. high (1.5 x 3.0 x 2.1 m)	10 ft. x 10 ft. x 7 ft. high (3.0 x 3.0 x 2.1 m)	10 ft. x 10 ft. x 10 ft. high (3.0 x 3.0 x 3.0 m)
Maximum No. of Nozzles	(2) Two F-1/2	(4) Four F-1/2	(4) Four F-1/2

See Figures 1 through 3 for nozzle layouts.

NOZZLE COVERAGE (Continued)

► **10 LB. FIRE SUPPRESSION SYSTEM – TOTAL FLOODING APPLICATION (2 NOZZLES)**

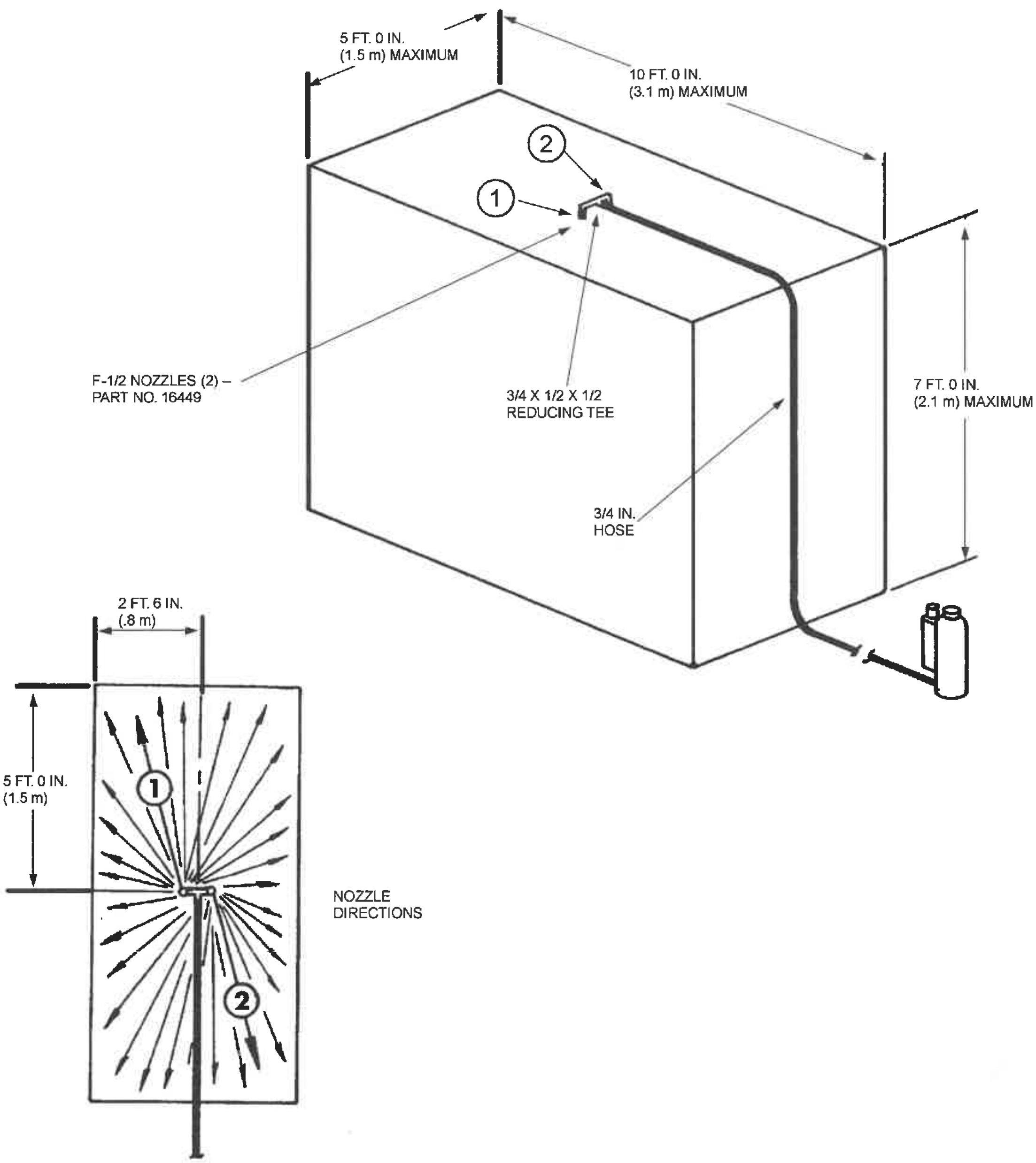


FIGURE 1
003501

Nozzle Coverage (Continued)

► **20 LB. FIRE SUPPRESSION SYSTEM – TOTAL FLOODING APPLICATION**

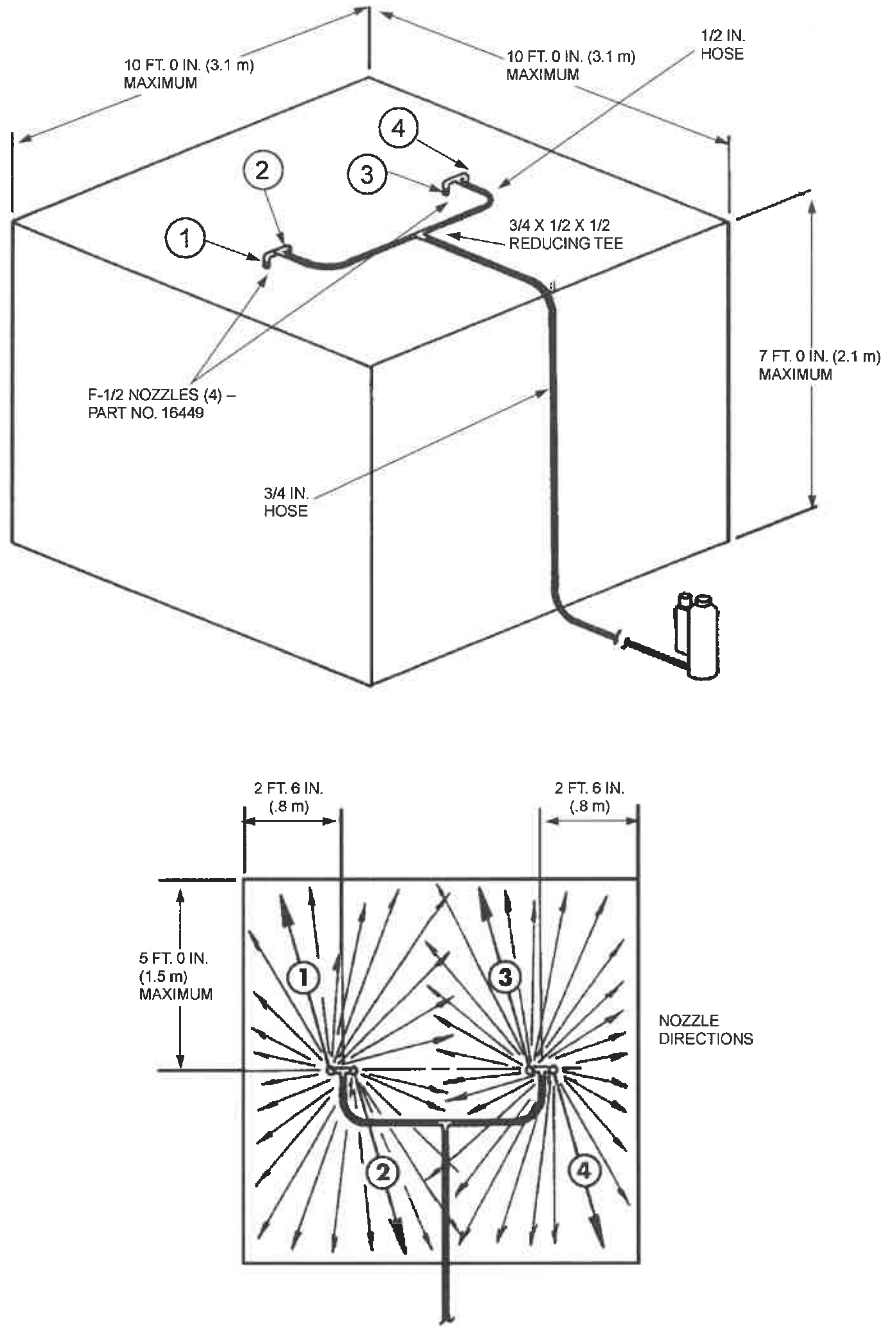


FIGURE 2
003505

Nozzle Coverage (Continued)

30 LB. FIRE SUPPRESSION SYSTEM – TOTAL FLOODING APPLICATION

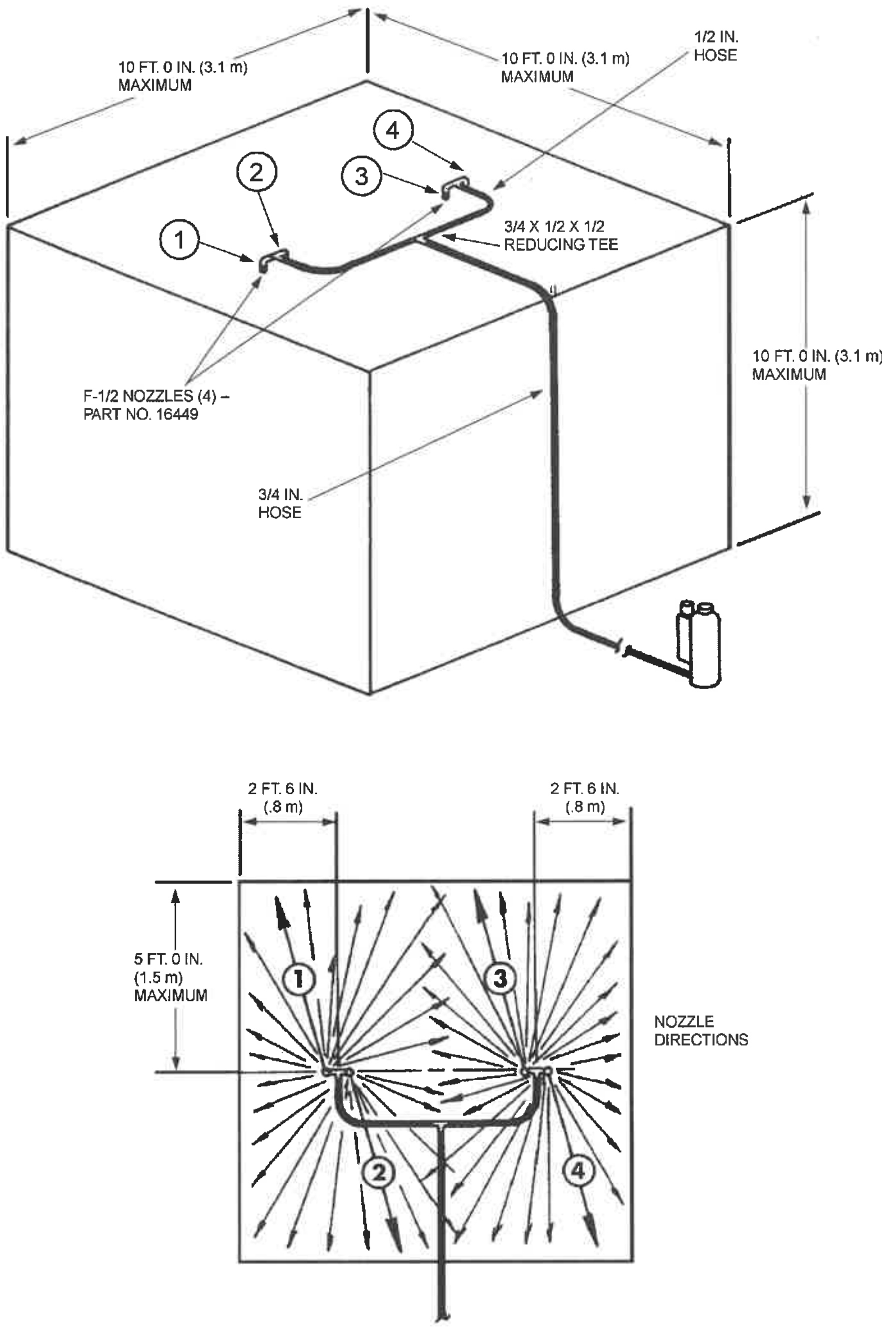


FIGURE 3
003505

The installation of an Ansul A-101/LT-A-101 Fire Suppression system is based on the sketch developed in the System Design Section IV.

When deciding on locations for mounting the agent tanks, pneumatic actuators and manual actuators, locate areas where the components will not be abused or will not interfere with vehicle operation. Keep in mind not only the requirements for each individual component, but how the components are connected, and the maximum hose lengths required between each component.

Although the sequence of installation steps may vary with each installation, a basic A-101/LT-A-101 installation consists of four general procedures: mounting the brackets, installing the components, connecting the hoselines, and finally, installing the gas cartridges.

MOUNTING THE BRACKETS

Nozzle Bracket

The first step is to mount the nozzle brackets. Plan to attach nozzle brackets to secure places that will not be subjected to abuse and make sure the locations will not interfere with operator or vehicle functions.

NOTICE

When mounting the nozzle brackets, make certain the mounting surface is rigid and that it is allowed by the vehicle manufacturer to weld or bolt onto that surface.

1. Based on the layout sketch, locate a secure place for mounting the nozzle bracket so that the nozzle will be properly aimed, and weld the bracket to the mounting surface. When welding the bracket, make certain there is enough weld to keep the bracket properly in place. See Figure 1.

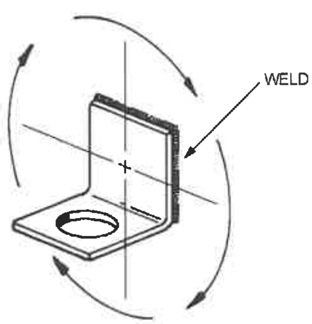


FIGURE 1
003507

If welding is not possible, the bracket can be drilled and bolted to the mounting surface with the appropriate fasteners. Make certain the bolting method does not allow the mounting bracket to rotate out of position or interfere with the nozzle discharge.

NOTE: A minimum of two bolts are required for proper mounting.

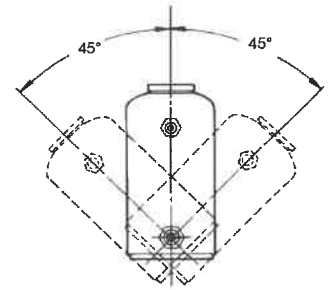
Tank Bracket

NOTICE

The location of the tank must not cause the hose length limitations to be exceeded.

When deciding on a mounting location for the agent tank, locate a rigid area where the tank can be mounted in an upright position. If necessary, the tank can be mounted up to 45° tilted to the left or right of true vertical, or tipped 45° forward from true vertical. The agent tank cannot be tipped backwards. See Figure 2.

NOTE: The tank must be located in an area that will not exceed temperature limitations or be subject to fire or damage.



NOTE: TANK SHOULD BE MOUNTED IN THE UPRIGHT POSITION SHOWN (SOLID LINES), BUT DISCHARGE WILL NOT BE IMPAIRED IF THE CENTER LINE OF THE MOUNTED TANK DOES NOT EXCEED 45° LEFT OR RIGHT OF TRUE VERTICAL.

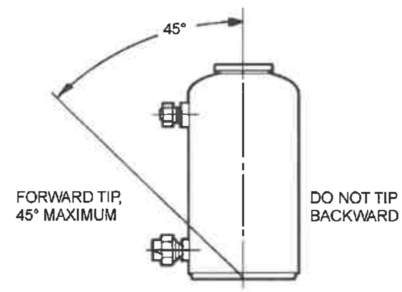


FIGURE 2
003508

1. Remove the agent tank from the bracket and weld the bracket to the mounted surface. The bracket can be secured at the base, at the back, or both, depending on the mounting surface. If the bracket cannot be welded, bolting is acceptable. 7/16 in. mounting holes are provided in the bracket to accommodate 3/8 in. fasteners. See Figure 3. Make certain when mounting the bracket that the clamp arms can swing open wide enough for removal of the tank when required.

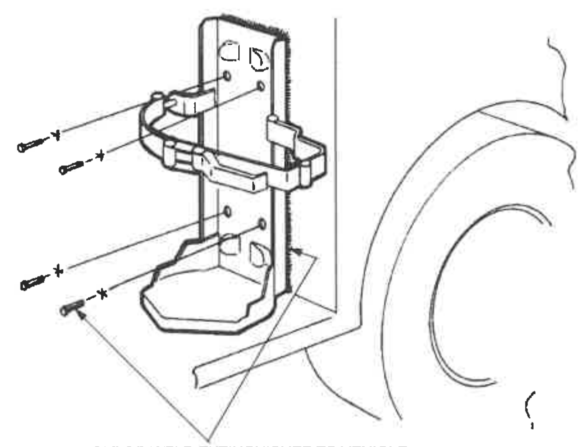


FIGURE 3
003509

Cartridge Bracket

When installing low temperature or low profile type systems, it is necessary to mount the remote cartridge bracket also. The location of this bracket must be such that the length of 1/4 in. hose between the bracket and the pneumatic inlet on the agent tank does not exceed 20 ft. (6.1 m) and the 1/4 in. hose from each remote actuator does not exceed 100 ft. (30.5 m) with 10 actuators maximum or 125 ft. (38.1 m) with 8 actuators maximum for LT-10 cartridges.

1. Remove the cartridge from the bracket. Locate a rigid, protected surface and weld or bolt the cartridge bracket securely. When bolting the bracket, use 5/16 in. fasteners. Make certain mounting location allows for easy removal of the cartridge when required.

NOTE: The cartridge must be located in an area that will not exceed temperature limitations or be subject to fire or damage.

Remote Actuator Bracket

A remote manual actuator must be located in the drivers compartment within reach of the operator, and a remote manual actuator should be located at a point on the vehicle accessible from ground level. When mounting any actuator, make certain the length of hose between the actuator and the tank or remote expellant gas cartridge does not exceed 100 ft. (30.5 m) with 10 actuators maximum or 125 ft. (38.1 m) with 8 actuators maximum for LT-10 cartridges or 75 ft. (22.9 m) with 8 actuators maximum using an LT-5 cartridge. Also, make certain there is enough room for cartridge removal.

NOTE: The actuator must be located in an area that will not exceed temperature limitations or be subject to fire or damage. Try to avoid mounting actuator near engine compartment.

1. Choose a suitable mounting location and weld or bolt each actuator bracket in place. If bolting the bracket(s), use 3/8 in. fasteners. If welding, to avoid corrosion, paint welded surface. See Figure 4.
2. If mounting the remote manual actuator in the dashboard of a vehicle, the actuator can be mounted by drilling a 1 5/16 in. (33.3 mm) diameter hole as shown in Figure 4. Make certain there is enough room for the actuator body, cartridge and 1/4 in. actuation line connection under the dash.

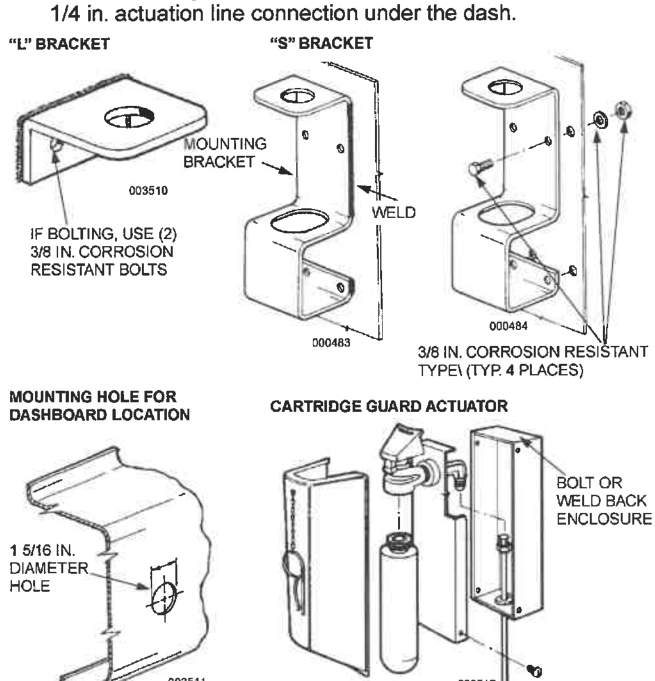


FIGURE 4

MOUNTING THE DISTRIBUTION, REDUCING, AND TRIPLE TEES

Based on the sketch done in the Design Section, locate each tee at a point which will not cause the supply line and branch line lengths to be exceeded.

1. All distribution network fittings must be welded or clamped to the mounting surface. See Figure 5. All welds must be made before any hose has been installed to avoid damage to the hose due to high welding temperatures.
2. When locating tees, make certain the locations do not cause the hose to be exposed to extreme heat or physical abuse.
3. Make certain the end tees on the triple tee are not twisted from their original position. See Figure 5.

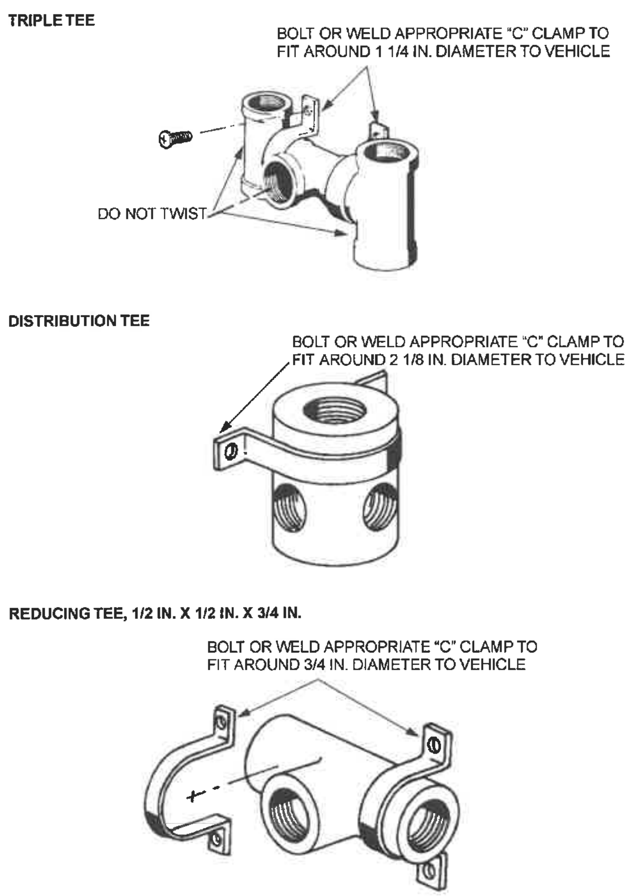


FIGURE 5
003513

INSTALLING THE COMPONENTS

Installing the Tank

1. Check each tank to make certain it is filled to its rated capacity with FORAY dry chemical. Then, re-tighten fill cap.
2. Unscrew the bursting disc union and check that the disc is free from wrinkles, dents or other deformities.
3. Reconnect the bursting disc union. Use a good grade of extreme temperature silicone grease, such as Dow Corning No. 4 or equal, on the male threads to facilitate removal during maintenance.
4. Position the tank(s) in the mounting bracket(s), and secure clamps or retaining bolts.

Installing the Nozzles

1. Refer to this system layout sketch from the Design Section IV. This sketch should give you the information concerning what nozzle to use where and the correct aiming point.
2. Choose the correct nozzle(s) for each hazard area.
3. Install nozzle(s) in bracket by using two lockwashers, and either 1/2 in. elbow(s) or coupling. See Figure 6. **Aim the nozzle correctly and securely tighten.**

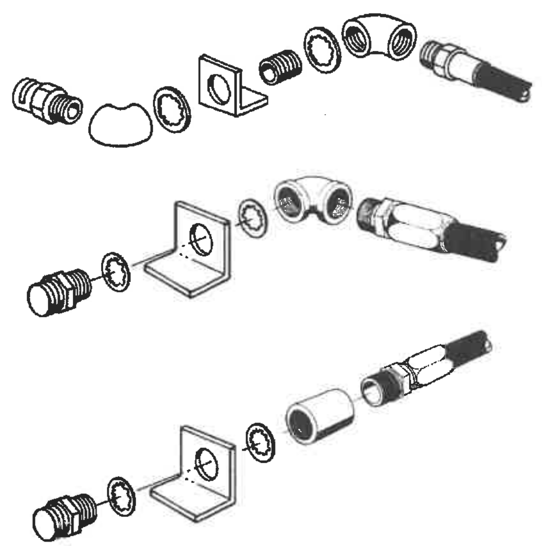


FIGURE 6
003515

4. Either install nozzle blow-off cap(s) or pack nozzle opening(s) with silicone grease to avoid build-up of foreign materials. **NOTE:** The F-1/2 nozzle is the only nozzle which silicone grease can be used in the opening.

Installing Manual Actuators

Three types of manual actuators brackets are available for the A-101/LT-A-101 system: "S" bracket, "L" bracket, and cartridge guard. Location of all actuators must be visible and easily reached by operator. Location must not expose actuator to physical abuse. Actuators using the "S" bracket and the cartridge guard type bracket are suitable for both internal and external mounting. The "L" type bracket is not suitable for external mounting and must be installed in a way that will provide protection for the exposed cartridge.

REMOTE MANUAL ACTUATOR WITH "S" BRACKET

1. If not already done, weld or bolt mounting bracket to the selected surface. If welding, to avoid corrosion, paint welded surface. See Figure 4.

NOTICE

Where bolting the mounting bracket is performed, use 3/8 in. (corrosion-resistant) bolts of appropriate length with lockwashers and nuts.

2. Unscrew the RED actuator button from the actuator stem, remove locknut, and slide actuator body through mounting hole on bracket. See Figure 7.
3. Rotate actuator body for desired location of actuation hose outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Apply a non-permanent thread adhesive, such as Locktite 242 or equal, to the RED actuator button threads and then screw button onto the stem. See Figure 7.

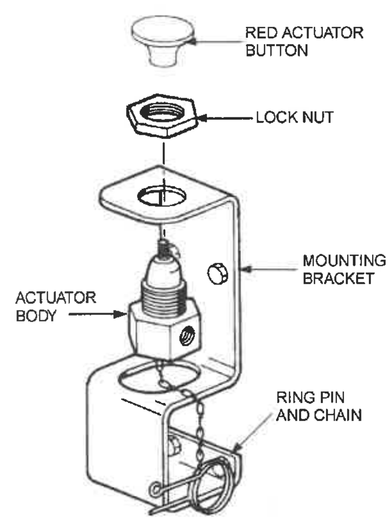


FIGURE 7
000485

INSTALLING THE COMPONENTS (Continued)

Installing Manual Actuators (Continued)

4. Affix the appropriate operating nameplate adjacent to the manual actuator so that it is visible to attending personnel. See Figure 8.

FIGURE 8
000486

5. Make certain ring pin is inserted through the RED actuator button to ensure safe cartridge installation. See Figure 9.
6. Seal ring pin to actuator stem with visual inspection seal, Part No. 197. Make certain visual inspection seal is looped through ring pin and around actuator stem. Do not wrap seal around the boot cover. See Figure 9. DO NOT INSTALL CARTRIDGE AT THIS TIME.

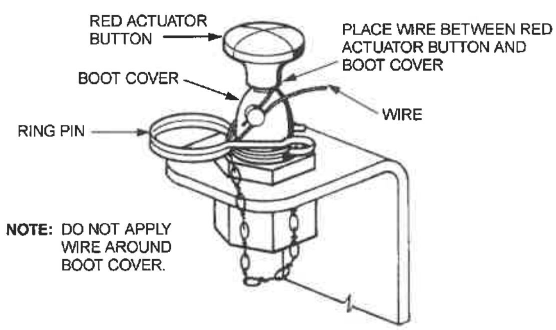


FIGURE 9
000487

REMOTE MANUAL ACTUATOR MOUNTED IN DASHBOARD

1. Punch or drill a 1 5/16 in. (33.3 mm) diameter hole for mounting the actuator body. See Figure 10. Make certain there is enough room under the dash for the actuator body, cartridge, and the 1/4 actuation hose connection.

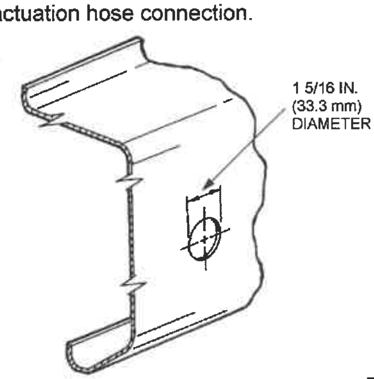


FIGURE 10
003511

2. Unscrew RED actuator button from actuator stem, remove locknut, and slide actuator body through mounting hole. See Figure 11.
3. Rotate actuator body for desired location of actuation hose outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Apply a non-permanent thread adhesive, such as Locktite 242 or equal, to the RED actuator button threads and then screw the button onto the stem. See Figure 11.

NOTICE

The ring pin chain may not be long enough in certain dashboard mounted locations. When this occurs, remove the chain from the drive pin in actuator body and attach it to an appropriate location using either a pop rivet or a sheet metal screw. See Figure 11.

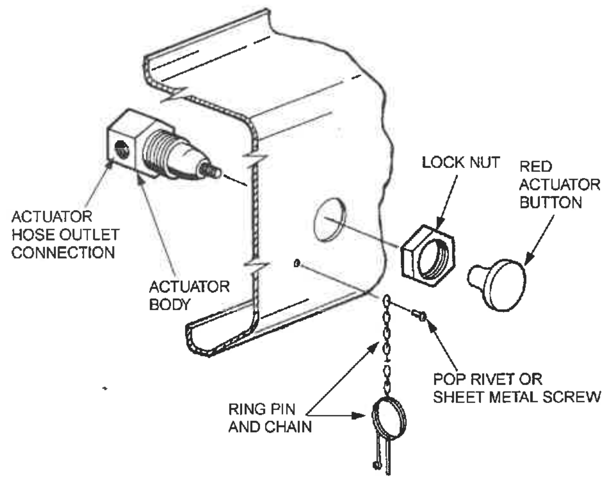


FIGURE 11
003517

4. Affix the appropriate operating nameplate adjacent to the manual actuator and visible for attending operator. See Figure 12.
5. Make certain ring pin is inserted through the RED actuator button to ensure safe cartridge installation. See Figure 12.
6. Seal ring pin to actuator stem with visual inspection seal, Part No. 197. Make certain visual inspection seal is looped through ring pin and around actuator stem. Do not wrap seal around the boot cover. See Figure 12. DO NOT INSTALL CARTRIDGE AT THIS TIME.

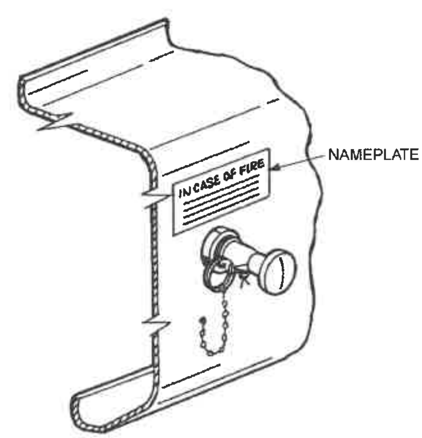


FIGURE 12
003518

INSTALLING THE COMPONENTS (Continued)

Installing Manual Actuators (Continued)

REMOTE MANUAL ACTUATOR WITH "L" BRACKET

NOTICE

Actuator must be installed in a way that will provide protection for the exposed cartridge from physical damage.

1. If not already done, weld or bolt mounting bracket to the selected surface. If welding, to avoid corrosion, paint welded surface. See Figure 4.

   NOTICE

   Where bolting the mounting bracket is performed, use 3/8 in. (corrosion-resistant) bolts of appropriate length with lockwashers and nuts.

2. Unscrew the RED actuator button from the actuator stem and slide actuator body through mounting hole on bracket.
3. Rotate actuator body for desired location of actuation hose outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Apply a non-permanent thread adhesive, such as Locktite 242 or equal, to the RED actuator button threads and then screw button onto the stem.
4. Affix the appropriate operating nameplate adjacent to the manual actuator so that it is visible to attending personnel.
5. Make certain ring pin is inserted through the RED actuator button to ensure safe cartridge installation.
6. Seal ring pin to actuator stem with visual inspection seal, Part No. 197. Make certain visual inspection seal is looped through ring pin and around actuator stem. Do not wrap seal around the boot cover. See Figure 9. DO NOT INSTALL CARTRIDGE AT THIS TIME.

REMOTE MANUAL ACTUATOR WITH CARTRIDGE GUARD

1. Remove back box from actuator assembly.
2. If not already done, weld or bolt back enclosure to the selected surface. If welding, to avoid corrosion, paint welded surface. See Figure 4.

   NOTICE

   Where bolting the back enclosure is performed, use 3/8 in. (corrosion-resistant) bolts of appropriate length with lockwashers and nuts.

INSTALLING THE DISTRIBUTION NETWORK

General Requirements

Refer to the system layout sketch completed in the Design Section IV. Make certain all hose lengths do not exceed the maximum allowed.

When installing the distribution hose, once again remember the following:

1. Make certain the proper type and size of hose is used.
2. In order to obtain equal distribution at a tee, the center opening must be used as an inlet and the opposing openings used as outlets.
3. When any 90° bend or elbow is located in the distribution hoseline preceding a tee, a minimum length of 20 hose diameters is required between the 90° bend and the tee. This length of hose is called a "critical length" and exists only when the 90° bend and the tee lie in the same plane.
4. The use of street elbows is not allowed.
5. Per SAE J1273, "Care must be taken to insure that fluid and ambient temperatures, both static and transient, do not exceed the limitations of the hose. Special care must be taken when routing near hot manifolds."
6. Use of 90° elbows is allowed if the following requirements are not exceeded:
   — Maximum of 4 elbows from the agent tank to any nozzle
   — Maximum of 2 elbows in a primary branch line
   — Maximum of 2 elbows in a secondary branch line
   — Minimum of 1 elbow from agent tank to a nozzle
7. When bends are formed in the distribution hose, the following minimum bend radius must not be exceeded:

Hose Size	100RI	100R5
1/4 in.	4 in.	3 in.
1/2 in.	7 in.	5 1/2 in.
3/4 in.	9 1/2 in.	—
7/8 in.	11 in.	7 3/8 in.

NOTE: Minimum bend radius measured to inside of hose radius.

Distribution Hose Installation

1. Starting at the tank outlet, connect the distribution hose from the bursting disc union to the triple, distribution, or reducing tee. Make certain hose is routed in an ordering manner and avoid routing hose through fire hazard areas if possible.
2. After hose has been connected, tighten bursting disc union.
3. Follow the sketch (completed in Hazard Analysis portion of Design Section IV) and complete all hose branch line runs.
4. When connecting the hose to each nozzle, make certain the aiming angle of each nozzle is not disturbed.
5. When routing hose through bulkheads, take precautions to protect the hose from excessive wear due to constant vehicle vibration.
6. When all distribution hose has been routed, make certain all fittings are wrench tightened.
7. Finally, clamp the discharge hose securely at least every five feet using industrial duty cable ties or conduit clamps.
8. When passing through bulkheads or grates, Schedule 40 nipples up to 6 in. in length may be used in the distribution line. (Refer to NFPA17, Section 2-5 (Pipe and Fittings)).

   NOTE: 3/4 in. and 1/2 in. Quik-Seal Adaptors can also be used.

INSTALLING ACTUATION AND EXPELLANT GAS LINES

General Requirements

1. Use only 1/4 in. hose for actuation and expellant gas lines when used on mobile or vibrating type of installations. Hose must meet the specifications noted in Design Section, Pages 4-3 through 4-4.
2. On non-mobile or non-vibrating type installations, 1/4 in. pipe is acceptable. Pipe must be 1/4 in. Schedule 40 black iron, hot-dipped galvanized, chrome-plated, or stainless steel pipe and fittings conforming to ASTM A120, A53, or A106. Refer to Design Section for maximum allowable lengths.
3. When using pipe, make certain all ends are carefully reamed and blown clear of chips and scale. Inside of pipe and fittings must be free of oil and dirt.
4. When using pipe, the pipe and fitting connections must be sealed with pipe tape. When applying pipe tape, start at the second male thread and wrap the tape (two turns maximum) clockwise around the threads, away from the pipe opening.

   NOTICE
   Do not allow tape to overlap the pipe opening, as this could cause possible blockage of the gas pressure. **Thread sealant or compound must not be used.**

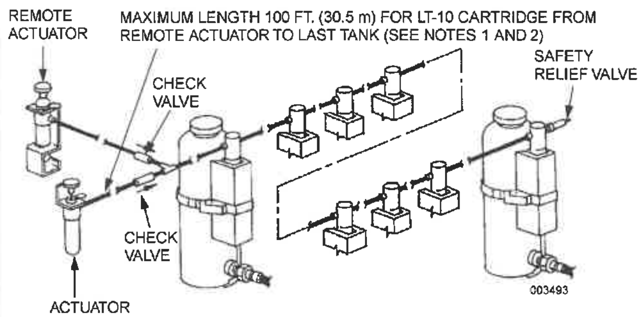
5. When passing through bulkheads or grates, up to 6 in. of Schedule 40 pipe may be used in the actuation and/or expellant gas lines. (Refer to NFPA17, Section 2-5 (Pipe and Fittings)). **NOTE:** 1/4 in. Quik-Seal Adaptors can also be used.
6. Cast iron pipe and fittings are not allowed.
7. Per SAE J1273, "Care must be taken to insure that fluid and ambient temperatures, both static and transient, do not exceed the limitations of the hose. Special care must be taken when routing near hot manifolds."

Installing The Actuation Gas line(s) and Pneumatic Actuator(s)

NOTICE
When installing actuation gas lines, teflon tape must be utilized on all male threads. Do not allow tape to overlap the pipe opening, as this could cause possible blockage of the gas pressure. **Thread sealant or compound must not be used.**

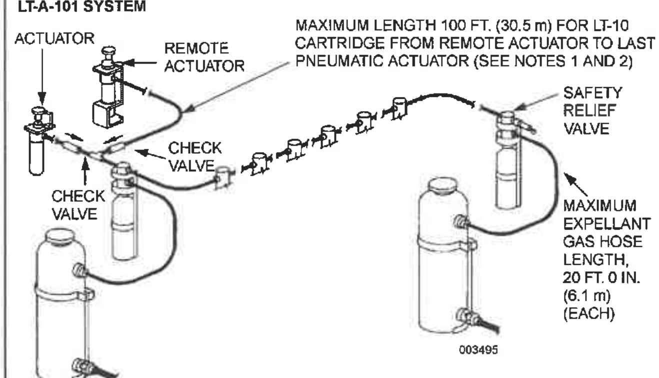
The actuation gas line is the 1/4 in. hose installed from the remote manual/automatic actuator(s) to the pneumatic actuators(s) on the agent tank expellant gas cartridge(s). See Figure 13.

A-101 SYSTEM



NOTE: A MAXIMUM OF (10) TEN A-101 SYSTEMS CAN BE ACTUATED SIMULTANEOUSLY IN ANY COMBINATION (I.E., A-101, LT-A-101, LP-A-101, OR LT-LP-A-101) (SEE NOTES 1 AND 2

LT-A-101 SYSTEM



NOTE: REDUCE THE MAXIMUM ALLOWABLE NUMBER OF BASIC EXTINGUISHING UNITS BY ONE FOR EACH NON-EXTINGUISHING PNEUMATICALLY OPERATED DEVICE EMPLOYED, I.E., BRAKE CONTROL VALVE, FUEL CONTROL AIR CYLINDER.

FIGURE 13

If more than one remote actuator is in the system, the total length of actuation line allowed from the actuator to the last tank must also include any amount of hose in the other actuation lines up to the check valves located in those lines.

NOTE 1: If only eight (8) or less actuators are used, the actuation line can be extended to 125 ft. (38.1 m) when using an LT-10 nitrogen cartridge.

NOTE 2: The actuation line can also utilize an LT-5 cartridge. When this is done, only eight (8) actuators or less can be used, with a maximum length of 75 ft. (22.9 m).

INSTALLING ACTUATION AND EXPELLANT GAS LINES (Continued)

Installing The Actuation Gas line(s) and Pneumatic Actuator(s) (Continued)

Complete the installation of all dry chemical actuation lines and components by completing the following:

1. Install all pneumatic actuators as follows:

   a When removing actuator from the carton, check pin to make certain it is in the upright position. See Figure 14.

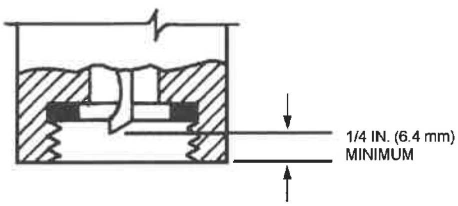


FIGURE 14
004357

   b. Securely hand tighten the pneumatic actuator cartridge body to cartridge.

   c. Position actuator and cartridge assembly into bracket.

   d. Using two wrenches, one on the swivel nut and one on the bottom portion, loosen the swivel nut, and rotate the top portion of the actuator to the correct position to align the two actuation line ports with the incoming and outgoing 1/4 in. actuation line(s).

CAUTION

Each actuator contains two (2) 1/4 in. actuation ports. If both ports are not utilized, the open port must be plugged with a 1/4 in. pipe plug. Failure to plug the port will cause loss of actuation gas pressure upon system actuation.

2. Install required 1/4 in. actuation lines from the remote actuator outlet port to all actuation ports on the upper portion of each pneumatic actuator.

3. Once all lines are securely installed, wrench tighten the swivel nut on the upper portion of each pneumatic actuator.

Installing Expellant Gas Line(s)

The expellant gas line is the 1/4 in. line between the remote expellant gas cartridge and the agent tank. The gas line is only required when the system is using either an LT or LP type tank. See Figure 13.

The maximum length of 1/4 in. expellant gas line is 20 ft. (6.1m).

Make certain the hose meets all the requirements as stated in the Design section.

INSTALLING THE DETECTION SYSTEM

When automatic detection is part of the total system design, see the appropriate Design, Installation Manual for detailed Information.

- CHECKFIRE ELECTRIC SERIES I SYSTEM – Manual Part No. 54894
- CHECKFIRE SC-N ELECTRIC SYSTEM – Manual Part No. 423522
- CHECKFIRE MP-N ELECTRIC SYSTEM – Manual Part No. 427310

INSTALLING ACTUATION CARTRIDGES

1. Weigh each manual actuator cartridge to make certain it is within the weight specifications stamped on the cartridge body. This weight check must be performed with the shipping cap removed. Refer to appropriate manual for detailed installation instructions if the system contains an automatic CHECKFIRE Detection System.
2. Check that the puncture pin in each manual actuator is fully retracted so that the pin will not pierce the cartridge seal during installation.
3. Install an LT-10 nitrogen cartridge into each manual actuator and hand tighten firmly.
4. At this time, the cartridge may be installed in the CHECKFIRE detection system actuator.
5. Finally, document the entire installation with drawing, photographs, and/or written description of the entire vehicle system and store these documents in a permanent file for future reference.

NOTES:

Inspection is a "quick check" that the system is operable. It is intended to give reasonable assurance that the system is fully charged and will operate. This is done by seeing that the system has not been tampered with and there is no obvious physical damage, or condition, to prevent operation. The value of an inspection lies in the frequency, and thoroughness with which it is conducted.

The system shall be inspected visually every 250 hours of vehicle use or monthly (whichever comes first) by competent personnel following an approved schedule necessitated by conditions as determined by the operator.

▸ To provide reasonable assurance that your Ansul A-101/LT-A-101 system is charged and operable:

1. Note general appearance of system components for mechanical damage or corrosion.
2. Check all hose to make certain it is securely fastened and not cut or show signs of abrasion.
3. Make certain all hose fittings are tight.
4. Make certain the nozzles are correctly aimed, openings are clean and not obstructed and the blow off caps are properly installed.
5. Check nameplate(s) for readability and make certain they are properly attached.
6. The automatic detection system should be inspected as follows: If system is equipped with a CHECKFIRE SC-N or ▸ MP-N electric automatic detection system, make certain green "Power" LED is blinking. If system is equipped with a CHECKFIRE Series I, push button on top of module and note illumination of indicator light. If the system is equipped with a CHECKFIRE Series II, push and hold the test/control button momentarily. The internal alarm will sound and the two outside LED's will flash. If system is equipped with a CHECKFIRE pneumatic detection system, make certain yellow "Low Pressure" indicator light is not on.
7. Check to make certain hazard size or components being protected have not changed since original installation.
8. If there are any broken or missing lead and wire seals, or any other deficiency is noted, immediately contact the authorized Ansul Distributor.
9. Keep a permanent record of each inspection.

NOTES:

Maintenance is a "thorough check" of the system. It is intended to give maximum assurance that the system will operate effectively and safely. It includes a thorough examination and any necessary repair or replacement. It will normally reveal if there is a need for hydrostatic testing of the tank.

Maintenance shall be performed every 1000 hours or semi annually (whichever comes first). The fire suppression system including alarms, shutdown and associated equipment shall be thoroughly examined and checked for proper operation by the fire protection manufacturer, authorized distributor or their designee in accordance with this manual.

SEMI-ANNUAL/1000 HOUR MAINTENANCE

To provide maximum assurance that your Ansul A-101/LT-A-101 system will operate effectively and safely:

1. Check to see that the hazard has not changed.
2. Remove all cartridges, install safety shipping caps, and put in a safe place for future reinstalling.
3. Note the general appearance of the system components checking for mechanical damage or corrosion, and check that the components are securely fastened and all hose fittings are tight.
4. Check nameplates to make certain they are clean, readable, and properly attached.
5. Remove tank fill cap(s) and check that the agent tank is filled to approximately 3 in. (76 mm) from the bottom of the fill opening with Ansul FORAY dry chemical. Check the dry chemical for lumps.If lumps are present, drop one from a height of 4 in. (102 mm) onto a hard surface. If the lump does not break up completely, the dry chemical must be replaced.
6. Inspect threads on fill cap and on tank fill opening for nicks, burrs, or cross-threading.
7. Check fill cap gasket and quad ring for elasticity, cuts, or checking, and lightly coat them with an extreme temperature silicone grease, such as Dow Corning No. 4 or equal.
8. Disconnect bursting disc union and make certain the disc is free from wrinkles, dents or other deformities.
9. Examine the disc to ensure that it is not wrinkled, kinked, dented, or deformed in any way and then apply a thin coat of a good grade of extreme temperature silicone grease, such as Dow Corning No. 4 or equal, to the male threads and reconnect the bursting disc union. **NOTE:** Before reconnecting, if needed, blow all lines clear with dry air or nitrogen.
10. Check that the nozzle openings are not obstructed and that the nozzles are properly aimed and have not rotated out of position.
11. Make certain each nozzle has a blow-off cap (the opening of an F-1/2 nozzle can be packed with an extreme temperature silicone grease, such as Dow Corning No. 4 or equal, to avoid build-up of foreign material) and check that the caps are pliable and free of cuts and checks.
12. Unscrew the pneumatic actuator(s) from the cartridge receiver(s) and inspect all threaded areas for nicks, burrs, and cross threads.
13. Clean actuator(s) (Part No. 430221) as follows: (see Figure 1)
    - Using two wrenches, one positioned on the swivel nut, and one positioned on the bottom portion of the actuator, loosen the swivel nut and remove the top portion of the actuator.
    - Using a wooden dowel, push pin assembly and spring out of the actuator body.
    - Remove the gasket from inside the cartridge thread port. Inspect, clean, apply a good grade of low temperature grease, such as Dow Corning No. 4, and reinstall the gasket. Replace if necessary.
    - Remove the O-Rings from the pin assembly and swivel adaptor. Inspect, clean, apply a good grade of low temperature grease, such as Dow Corning No. 4, and reinstall the O-Rings. Replace if necessary.
    - Apply a small amount of grease to the puncture pin shaft. There is a U-Cup guide inside the actuator body and when the pin is reinstalled into the body, the grease on the shaft will lubricate the U-Cup.
    - Clean the inner surface of the actuator body and, using a small diameter wire, clean the vent hole. **Make certain not to scratch the inner surface.**
    - Reinstall spring onto puncture pin shaft and insert into actuator body. Push pin down several times to allow grease to coat U-Cup. When positioned back in body, make certain the tip of the pin is above the gasket in the bottom of the actuator.
    - Reinstall the actuator unto the cartridge. Hand tighten.
    - Reinstall swivel adaptor in the correct position for the actuation lines and wrench tighten the swivel nut. Make certain all actuation and expellant lines are properly tightened into the actuator.
    - Secure the assembly into the bracket.

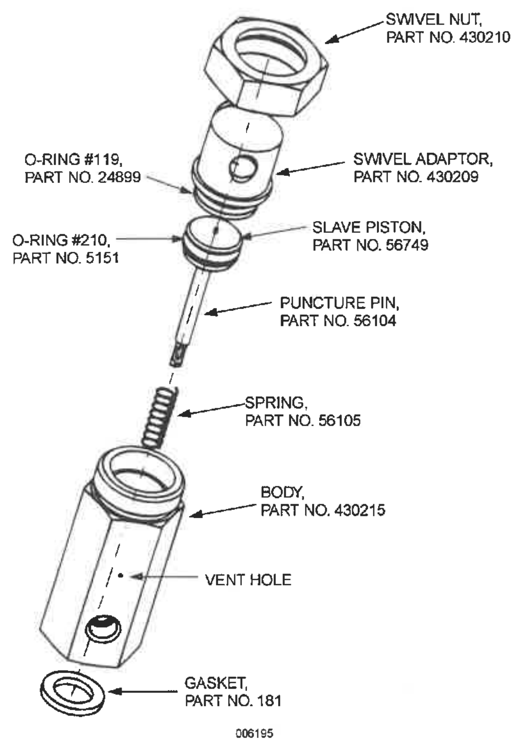


FIGURE 1
006195

SEMI-ANNUAL MAINTENANCE (Continued)

14. Weigh the gas cartridge which was removed earlier. It must be +/– 1/2 oz. from the weight stamped on the cartridge. Weight cartridge with shipping cap removed.
15. Hand tighten the cartridge into the actuator.
16. Next, remove the gaskets from the manual remote actuators. Examine them for elasticity, cuts, and checking and lubricate them with a light coat of extreme temperature silicone grease, such as Dow Corning No. 4 or equal.
17. Inspect the threaded areas for nicks, burrs, or cross threading and clean them with a stiff bristle brush.
18. Make certain cartridge is removed. Pull the ring pin and operate the manual actuator to test the puncture lever for free movement.
19. Next, remove the puncture pin by disassembling the actuator and examine the pin to ensure it is sharp, straight, free of corrosion.
20. Lubricate the puncture pin O-ring and reassemble the actuator.
21. Insert ring pin and install visual seal, Part No. 197, to each actuator stem.
22. Weigh each actuator cartridge. Weight must be +/– 1/4 oz. from weight stamped on cartridge. Weight cartridge with shipping cap removed.
23. Install cartridge into each remote actuator. Hand tighten.
24. Refer to appropriate manual for detailed maintenance instructions if the system contains an automatic CHECKFIRE Detection System.
25. After all actuation devices are re-armed, record date of maintenance and inform personnel that the system is back in operation.

12-YEAR MAINTENANCE EXAMINATION

At the 12-year maintenance examination, along with completing the semi-annual maintenance requirements, some A-101 components require hydrostatic testing.

The components requiring hydrostatic testing are:

– Tank – 600 psi (40.8 bar) hydro pressure.

– Actuation hose – 1000 psi (69 bar) hydro pressure

– Cartridges – After properly discharging cartridge, return to Ansul for hydrotesting

See appropriate hydrotest requirements in NFPA 17, "Standard For Dry Chemical Extinguishing Systems," and Ansul Technical Bulletin No. 50, "Hydrostatic Retest Requirements for Ansul portables, Wheeled Units, and Pre-Engineered Vessels," Form No. F-81301.

The first concern in Recharge is to determine the cause of the system discharge and to have the problem corrected before re-arming the fire suppression system.

In the event of system discharge, the vehicle must not be returned to service until the system has been recharged.

The system must be recharged immediately after use. A fire condition could cause damage to the hose and nozzles and possibly support members. Check all hose supports, hose, and all fitting connections. Take the nozzles off, inspect for damage, corrosion, or obstructions, clean and re-install, making certain they are aimed correctly. Blow-off caps must also be replaced.

See Figure 1 when following the recharge steps.

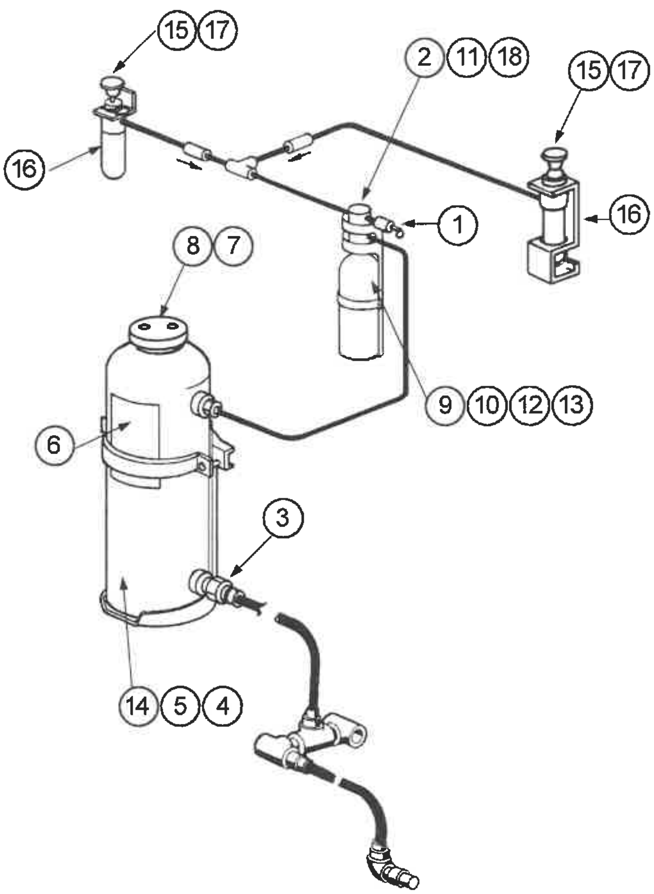


FIGURE 1
003519

1. Pull ring on safety relief valve to relieve actuation pressure.
2. Disconnect actuation system hose at cartridge receiver/actuation assembly.
3. Open bursting disc union assembly.
4. Remove dry chemical tank from its bracket.
5. Replace ruptured sealed bursting disc assembly. Remove used sealed disc assembly from tank outlet. Clean tank threads. Apply a non-permanent thread sealant or Teflon tape to male threads on new burst disc assembly. Install to tank outlet. Wrench tighten. NOTE: Before reconnecting, if needed, blow all lines clear with dry air or nitrogen.
6. Remove the tank fill cap, discard any remaining dry chemical, and fill each tank to its rated capacity with Ansul FORAY dry chemical as specified on the nameplate.
7. Before securing the fill cap, brush the dry chemical from the threads on the fill cap and tank, and clean the gasket seating surface on the tank opening. Coat the gasket lightly with a good grade of extreme temperature silicone grease, such as Dow Corning No. 4 or equal.
8. Secure the fill cap, hand tighten.
9. Loosen the bolts on the expellant gas cartridge bracket or remove the cartridge guard on the tank.
10. Unscrew and remove the empty expellant gas cartridge.
11. Disassemble and clean the cartridge actuator by following the instructions stated in Step No. 13, Section VIII – Maintenance.
12. Install new cartridge per the following chart. Before installing, weigh cartridge to determine if it is within specifications stamped on the cartridge. Weigh cartridge with shipping cap removed.

Type of System	Cartridge Part No.	
A-101-10	15850 (DOT)	423439 (TC/DOT)
LT-A-101-10	423429 (TC/DOT)	
A-101-20	423441 (TC/DOT)	
LT-A-101-20	423435 (TC/DOT)	
LT-LP-A-101-20	423435 (TC/DOT)	
A-101-30	423443 (TC/DOT)	
LT-A-101-30	423491 (TC/DOT)	

13. Re-install cartridge guard or retaining bolts on cartridge bracket.
14. Return tank(s) to its bracket and tighten securely.
15. Depending on the type, either pull up the red button or pull up the puncture lever.
16. Remove spent cartridge. Weigh fully charged one, and install. For actuation lines up to 125 ft. (38.1 m), install LT-10 cartridge.

NOTICE

If automatic detection system was used, refer to appropriate Installation, Recharge Manual for detailed recharge instructions.

17. Insert ring pin in actuator stem and seal with visual seal, Part No. 197.
18. Reconnect actuation and, if necessary, expellant gas hose. Wrench tighten.
19. Notify operating personnel that the suppression system is back in service and record date of recharge.

NOTES:

In order to help understand the design process, the following example hazards are covered in this section. There may be different design approaches that can be taken for each hazard, but the examples are only intended to show the typical areas requiring protection and the number of nozzles and tanks required. They will give the designer an idea of what to look for on these types of vehicles. Also, refer to appropriate CHECKFIRE Design, Installation manual for detailed information concerning detection system requirements.

NOTICE

These are conceptual drawings. They were prepared from information provided through vendor's sales literature to assist field installations. The fire suppression system illustrated constitutes nominal hardware requirements. The detection system has not been shown for the purpose of clarity. The final system design must consider other potential ignition and fuel source areas not in the vendor's literature, meaning a pre-installation in-depth analysis of all likely areas of probable fire incident.

▸ FRONT END LOADER (TYPICAL 2 TANK DESIGN)

Nozzle No. 1 and 2 – Located toward the lower rear of the engine compartment and are aimed forward and toward the center. They are positioned to provide complete coverage of the entire pan area.

Nozzle No. 3 and 4 – Located to provide protection for the sides of the engine. Each is mounted on the side of the engine compartment in front and aimed toward the rear and center to completely cover the engine sides.

Nozzle No. 5 and 6 – Located at the top of the engine compartment toward each side. Each is positioned to discharge toward the rear and center of the engine and the turbocharger.

Nozzle No. 7 – Located under the operator's compartment toward one side and aimed to discharge across the pan area. In addition to the pan, its discharge will protect the parking brake disc.

Nozzle No. 8 – Located under the operator's compartment but is positioned to discharge dry chemical on the hydraulic lines in the compartment. It is oriented so a portion of its discharge will pass through the front bulkhead to protect the hydraulic lines leading to the front bucket.

▸ **NOTE:** Larger front end loaders will require additional protection.

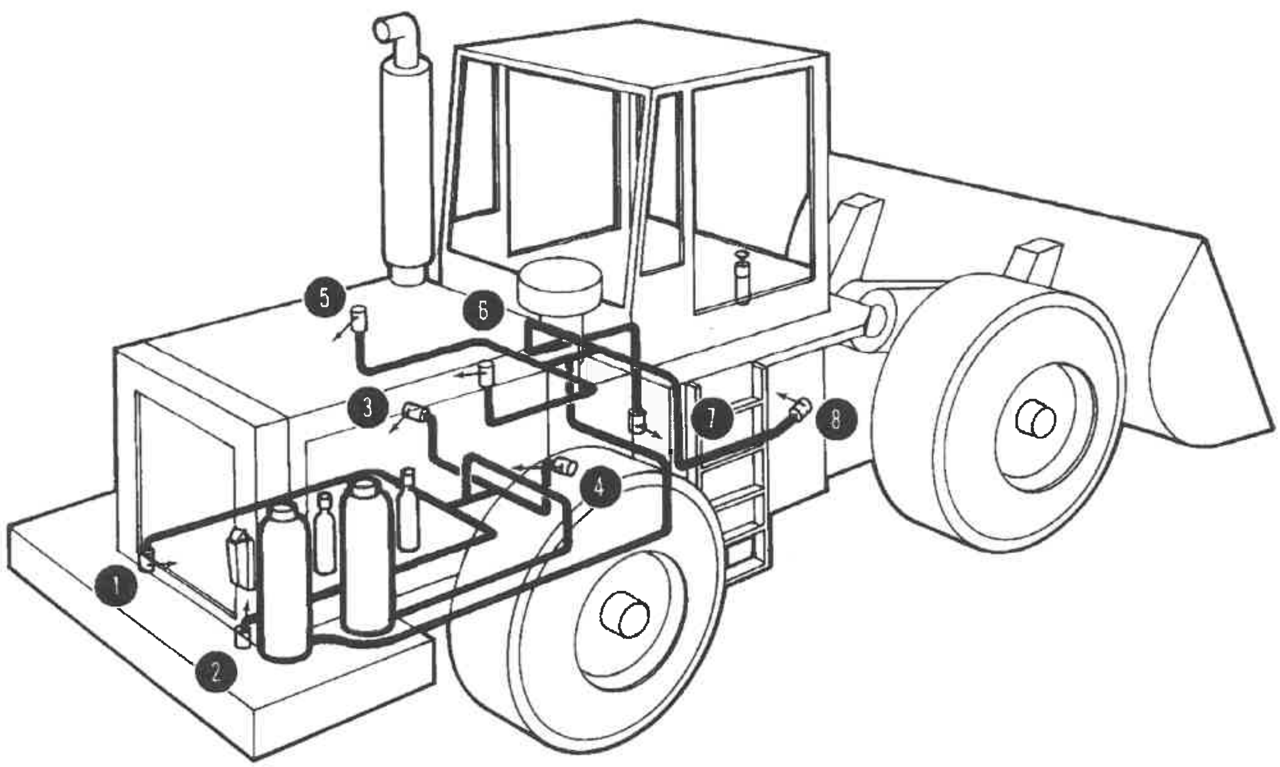


FIGURE 1
003520

▸ DOZER (TYPICAL 3 TANK DESIGN)

Nozzle No. 1 (N1) – Locate (1) C 1/2 nozzle to discharge dry chemical into the engine pan from front to back.

Nozzle No. 2 (N2) – Locate (1) V 1/2 nozzle to discharge dry chemical diagonally over the top of the engine.

Nozzle No. 3 (N3) – Locate (1) V 1/2 nozzle to discharge dry chemical screening right side of engine under exhaust manifold.

Nozzle No. 4 (N4) – Locate (1) V 1/2 nozzle to discharge dry chemical screening left side of engine under exhaust manifold.

Nozzle No. 5 (N5) – Locate (1) C 1/2 nozzle to discharge dry chemical onto the side of engine diagonally from top to bottom.

Nozzle No. 6 (N6) – Locate (1) V 1/2 nozzle to discharge dry chemical diagonally over the top of the engine.

Nozzle No. 7 (N7) – Locate (1) V 1/2 nozzle to discharge dry chemical across front of engine from top to bottom.

Nozzle No. 8 (N8) – Locate (1) C 1/2 nozzle to discharge dry chemical onto the side of engine diagonally from top to bottom.

Nozzle No. 9 and 12 (N9 and N12) – Locate (2) V 1/2 nozzles back to back to discharge dry chemical screening hydraulic lines and top of transmission, discharging from center to right and left sides.

Nozzle No. 10 (N10) – Locate (1) C 1/2 nozzle to discharge dry chemical into the belly pan and bottom of the transmission.

Nozzle No. 11 (N11) – Locate (1) V 1/2 nozzle to discharge dry chemical over the top of the transmission from back to front screening opening under cab and rear end.

▸ **NOTE:** Larger dozers may require additional protection.

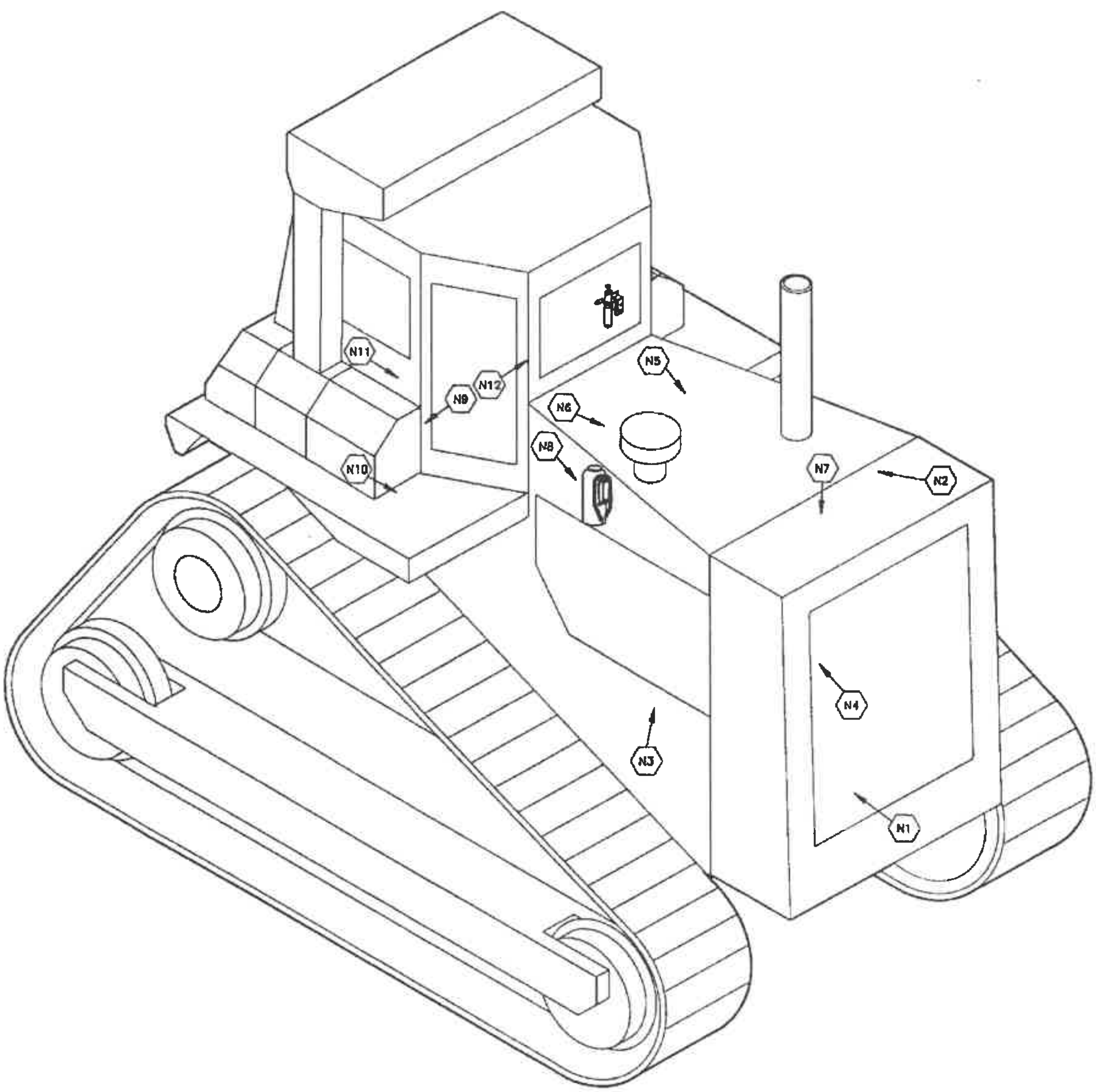


FIGURE 2
003521

▸ TRANSIT BUS (TYPICAL 1 TANK DESIGN)

Nozzle No. 1 (N1) – Locate (1) V 1/2 nozzle at upper left rear end of engine compartment aimed to discharge diagonally across engine rear from top left to bottom rear protecting front of engine and pump filters.

Nozzle No. 2 (N2) – Locate (1) V 1/2 nozzle at top rear aimed at center to discharge horizontally across engine top and turbo charger.

Nozzle No. 3 (N3) – Locate (1) V 1/2 nozzle on left side of engine midway from front to back aimed from rear at an angle to discharge across rear left side of engine, back of engine, and hydraulic lines protecting the generator as well as discharging into transmission area.

Nozzle No. 4 (N4) – Locate (1) V 1/2 nozzle at right side of engine midway from front to back aimed from rear to discharge across steering pump and air compressor at engine front.

Nozzle No. 5 (N5) – Locate (1) V 1/2 nozzle at right side of engine between engine and bus right side aimed from back to front to discharge horizontally across battery connections and hydraulic reservoir.

Nozzle No. 6 (N6) – Locate (1) V 1/2 nozzle midway up at right side of engine rear aimed from back to front to screen right side of engine and starter.

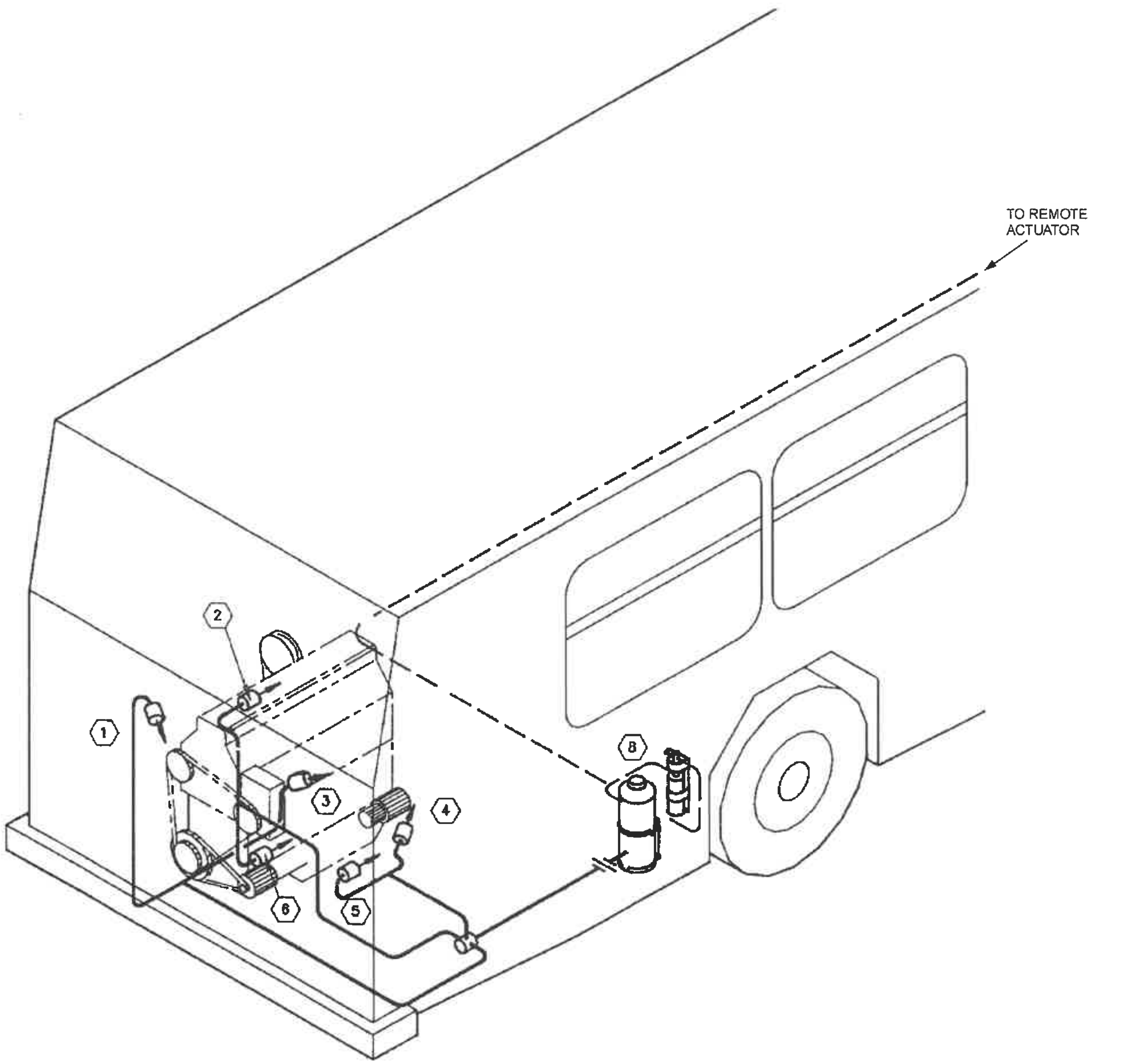


FIGURE 3
003522

▸ LANDFILL COMPACTOR (TYPICAL 3 TANK DESIGN)

Nozzle No. 1 and 12 (N1 and N12) – Locate (2) V 1/2 nozzles to discharge dry chemical under engine in the pan area.

Nozzle No. 2 and 3 (N2 and N3) – Locate (2) V 1/2 nozzles at each side of engine at bottom attached to engine mount-gusset, aimed up to screen engine sides.

Nozzle No. 4 (N4) – Locate (1) V 1/2 nozzle at top middle of engine compartment, in front aimed down at 45° angle, discharging vertically onto center of engine front and top.

Nozzle No. 5 (N5) – Locate (1) V 1/2 nozzle to discharge dry chemical from top left rear of engine compartment onto engine top and turbo.

Nozzle No. 6 and 7 (N6 and N7) – Locate (2) V 1/2 nozzles to discharge dry chemical from front of machine, 1/2 way up in transmission area aimed back at engine screening transmission sides and discharging into bottom of pan area with a vertical discharge pattern.

Nozzle No. 8 and 9 (N8 and N9) – Locate (2) V 1/2 nozzles to discharge dry chemical from top of transmission area aimed to discharge horizontally from rear of compartment to front of transmission top and also under cab area.

Nozzle No. 10 (N10) – Locate (1) V 1/2 nozzle at front under cab aimed to discharge dry chemical horizontally from front to back under cab protecting valve banks.

Nozzle No. 11 (N11) – Locate (1) V 1/2 nozzle up in articulation area aimed down with discharge pattern following vehicle center line, discharging into loader tower and onto hydraulic lines in articulation area.

▸ **NOTE:** Larger landfill compactors may require additional protection.

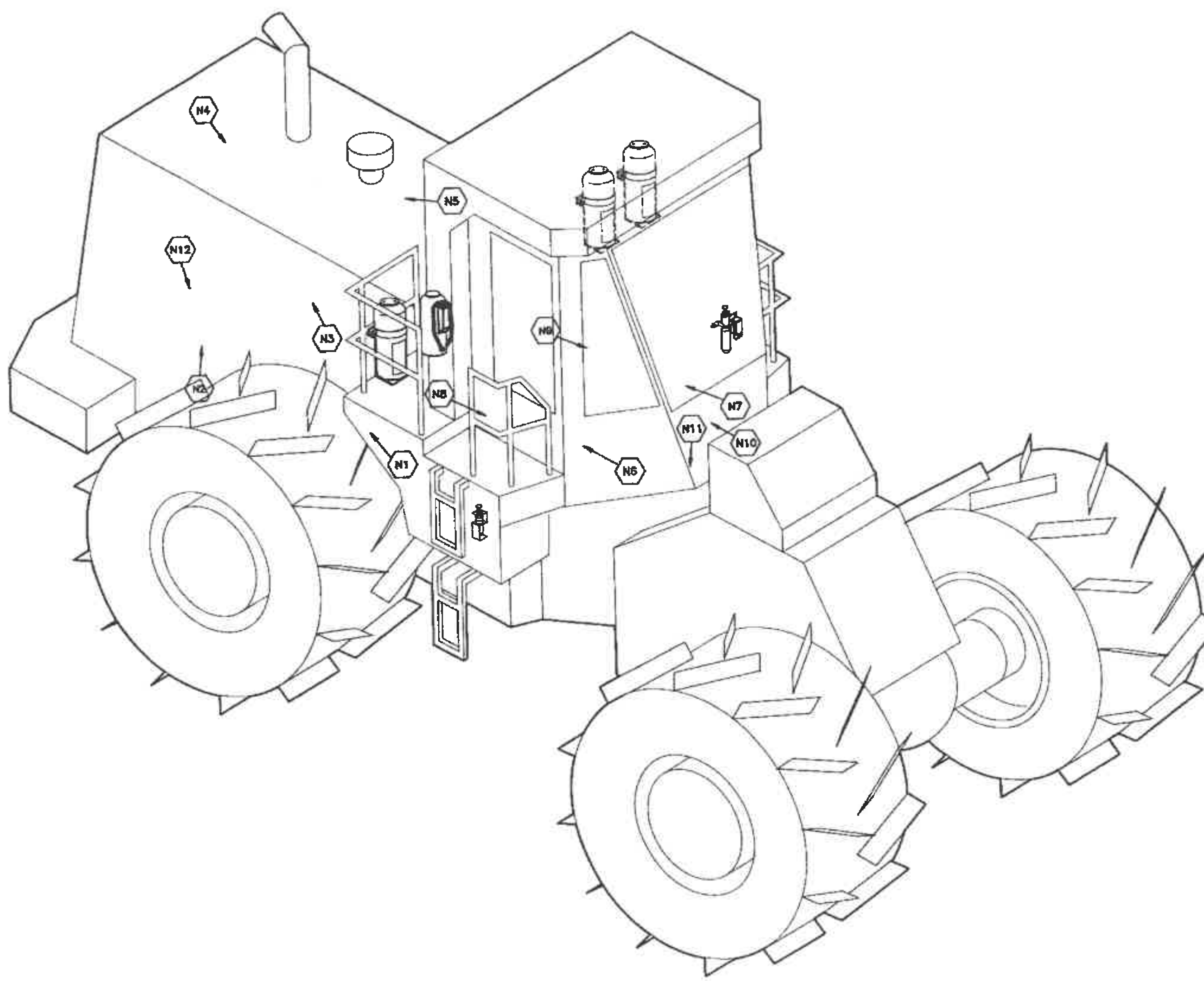


FIGURE 4
003523

▸ ORE HAULAGE TRUCK (TYPICAL 2 TANK DESIGN)

Nozzle No. 1 – Located at the top center of the engine compartment aimed toward the turbocharger at the rear of the engine. It is designed to protect the top of the engine and the front of the turbocharger.

Nozzle No. 2 – Located on the right rear corner of the engine compartment aimed toward the front corner with the pattern oriented vertically. This is intended to screen and protect the right side of the engine.

Nozzle No. 3 – Located at the top right corner of the engine compartment and is aimed across the top of the engine to the opposite corner. Its purpose is to protect the top of the engine and parts of the turbocharger and exhaust manifold.

Nozzle No. 4 – Located at mid-engine height in the right rear corner of the engine compartment. The nozzle pattern is aimed across the rear portion of the engine at the transmission housing. This nozzle is intended to protect the lower portion of the exhaust manifold, and the right side of the transmission and accessory equipment area such as hydraulic pumps, etc.

Nozzle No. 5 – Located at the top left corner of the engine compartment and aimed across the top of the engine to the opposite corner. Its purpose is to protect the top of the engine and parts of the turbocharger and exhaust manifold.

Nozzle No. 6 – Located on the left rear corner of the engine compartment and aimed toward the front corner with the discharge pattern oriented vertically. Its purpose is to screen and protect the left side of the engine.

Nozzle No. 7 – Located at mid-engine height in the left rear corner of the engine compartment. The nozzle pattern is aimed across the rear portion of the engine at the transmission housing. This is done to protect the lower portion of the exhaust manifold, and the left side of the transmission and accessory equipment area such as the hydraulic pumps, etc.

Nozzle No. 8 – Located such that the dry chemical stream will hit the parking break area.

▸ **NOTE:** Larger ore haulage trucks may require additional protection.

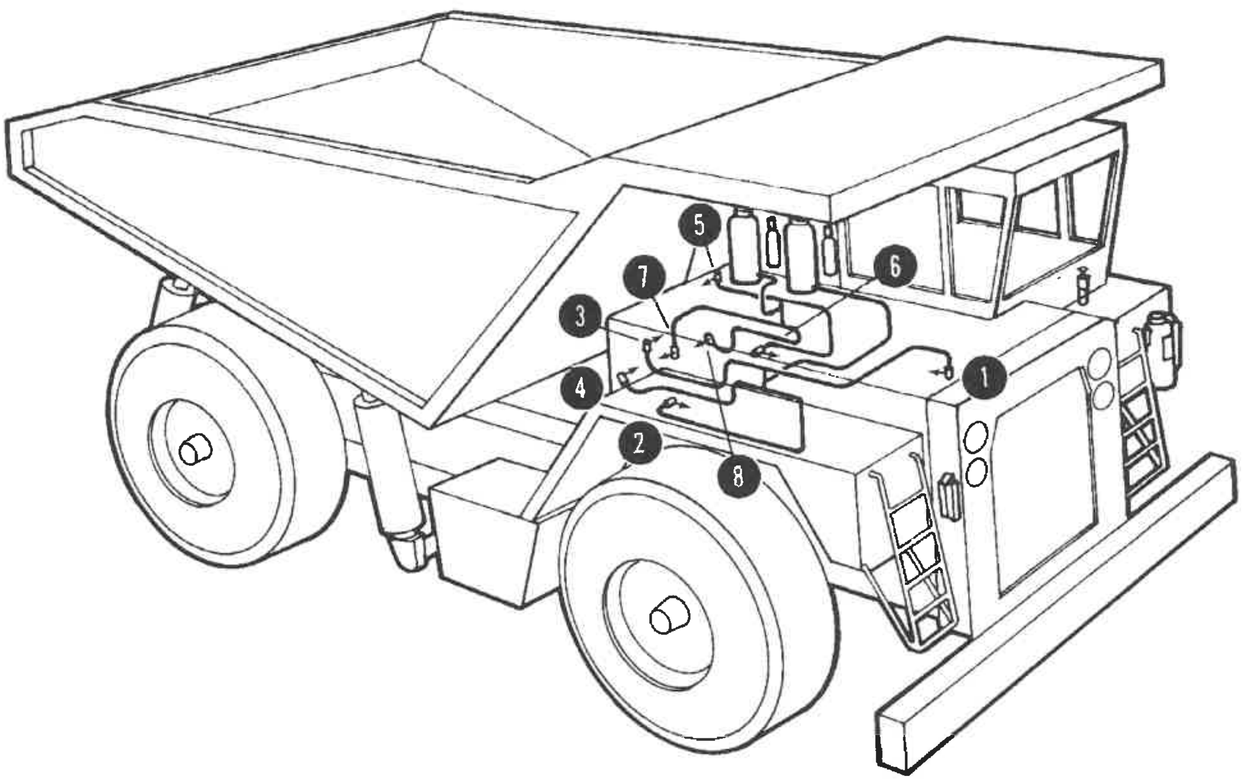


FIGURE 5
003524

▸ LOG SKIDDER (TYPICAL 2 TANK DESIGN)

Nozzle No. 1 and 2 – Located to discharge horizontally in the front lower portion of each side of the engine compartment. This allows each nozzle to be aimed upward and toward the center of the engine's side to completely cover the side of the engine with dry chemical.

Nozzle No. 3 – Located just above the belly pan, aimed to completely cover the pan area.

Nozzle No. 4 – Located toward the rear and top of the engine compartment. It is oriented to discharge dry chemical diagonally across the top of the engine.

Nozzle No. 5 – Located in the compartment directly under the operator's seat. It provides protection for the hydraulic lines, pump and pan area.

Nozzle No. 6 – Located to discharge dry chemical on the parking disc located on the rear portion of the skidder.

Nozzle No. 7 and 8 – Located to provide protection for both sides of the hydraulic cable reel assembly. They are located on the rear portion of the skidder and are aimed toward each side of the reel assembly.

▸ **NOTE:** Larger log skidders may require additional protection.

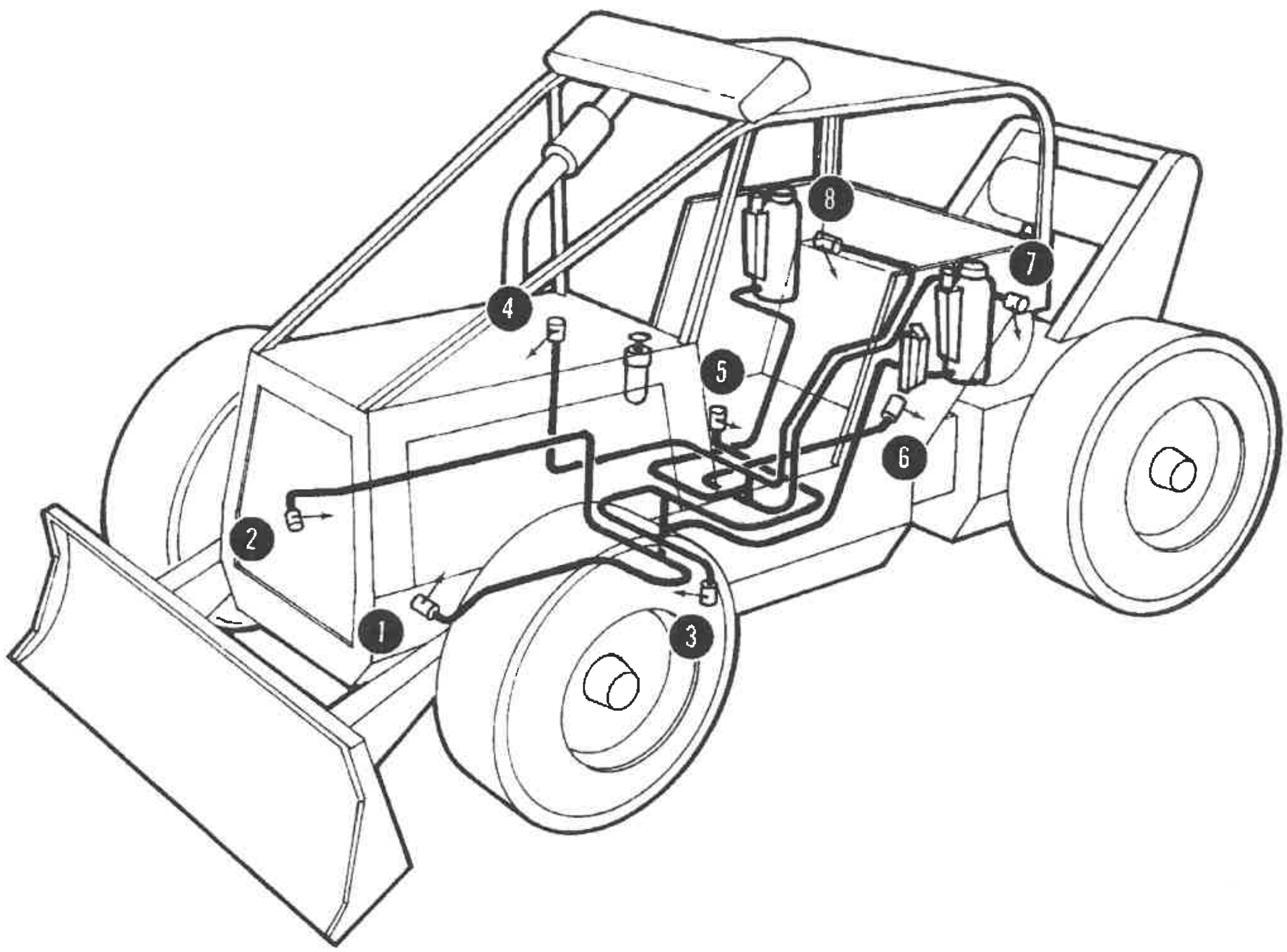


FIGURE 6
003525

SYSTEM COMPONENT INDEX

BASIC UNIT

16559	A-101-10 Includes: Agent Tank, Tank Mounting Bracket, 101-10 Cartridge
16430	A-101-20 Includes: Agent Tank, Tank Mounting Bracket, 101-20 Cartridge
16131	A-101-30 Includes: Agent Tank, Tank Mounting Bracket, 101-30 Cartridge
31581	LT-A-101-10 Includes: Agent Tank, Tank Mounting Bracket, LT-20-R Cartridge
24306	LT-A-101-20 Includes: Agent Tank, Tank Mounting Bracket, LT-30-R Cartridge, Cartridge Bracket, and Pneumatic Actuator
53003	LT-A-101-30 Includes: Agent Tank, Tank Mounting Bracket, (Does Not Include Cartridge, Cartridge Bracket or Pneumatic Actuator)
24883	LT-A-101-30 Cartridge, Cartridge Bracket, and Pneumatic Actuator for LT-A-101-30 Unit
31344	LP-A-101-20-B Includes: Agent Tank, Tank Mounting Bracket, 101-20 Cartridge, Cartridge Bracket, and Pneumatic Actuator
24307	LT-LP-A-101-20-B Includes: Agent Tank, Tank Mounting Bracket, LT-30-R Cartridge, Cartridge Bracket, and Pneumatic Actuator

DISTRIBUTION TEES

53036	Distribution Tee Package Includes: 4 Distribution Tees
25031	Distribution Tee
53038	Triple Tee Package Includes: 2 Triple Tees
16424	Triple Tee
53040	Reducing Tee Package Includes: 2 Reducing Tees (1/2 in. x 1/2 in. x 3/4 in.)
4655	Reducing Tee (1/2 in. x 1/2 in. x 3/4 in.)
► 419695	Y Lateral

NOZZLES

57046	C-1/2 Nozzle Package Includes: 4 Nozzles, 4 Nozzle Brackets, 4 Blow-Off Caps and 8 Lockwashers
57044	V-1/2 Nozzle Package Includes: 4 Nozzles, 4 Nozzle Brackets, 4 Blow-Off Caps and 8 Lockwashers
53042	F-1/2 Nozzle Package Includes: 4 Nozzles, 4 Nozzle Brackets, 4 Blow-Off Caps and 8 Lockwashers
53791	Nozzle C-1/2 Includes: Nozzle, Blow-Off Cap
56748	Nozzle V-1/2 Includes: Nozzle, Blow-Off Cap
16449	Nozzle F-1/2 Includes: Nozzle Only
415192	Blow-Off Cap With Retaining Strap Package Includes: 50 Blow-Off Caps (Part No. 415108) For V-1/2 and C-1/2 Nozzle Only
73870	Blow-Off Cap Package: Includes: 50 Blow-Off Caps, Part No. 4120, For F-1/2 Nozzle
► 73871	Nozzle Bracket Package: Includes: 12 Brackets, 2 in. x 2 in. Angle
427149	Nozzle Bracket, 2 in. x 3 in. Angle
► 427228	Nozzle Bracket, Straight 5 in. x 2 in., 4 Brackets
73872	Nozzle Lockwasher Package: Includes: 50 Lock washers, Part No. 25581

ACTUATION DEVICE

► 70584	Remote Manual Actuator Package Includes: LT-10-L (Left Hand) Cartridge, "S" Bracket, Elbow, Check Valve, Seal, Operating Instruction Labels and Installation Instructions
► 71699	Remote Manual Actuator Package Includes: LT-10-L (Left Hand) Cartridge "L" Bracket, Elbow Check Valve, Seal, Operating Instruction Labels and Installation Instructions
► 57484	Remote Manual Actuator Package Includes: LT-10-R (Right Hand) Cartridge, "S" Bracket, Elbow, Check Valve, Seal, Operating Instruction Labels and Installation Instructions
► 71804	Remote Manual Actuator Package Includes: LT-10-R (Right Hand) Cartridge, "L" Bracket, Elbow, Check Valve, Seal, Operating Instruction Labels and Installation Instructions
► 70581	Remote Manual Actuator for LT-10-L (Left Hand) Cartridge Only
► 57452	Remote Manual Actuator for LT-10-R (Right Hand) Cartridge Only
57661	"S" Type Mounting Bracket for Dashboard Actuator, Part No. 70581 and 57452
70580	"L" Type Mounting Bracket for Remote Manual Actuator, Part No. 70581 and 57452
► 32747	Remote Actuator Package, Cartridge Guard Type (Left Hand) Includes: Actuator, LT-10-L Cartridge, Check Valve, Operating Instruction Labels, Lead Wire Seal
► 32739	Remote Actuator Package, Cartridge Guard Type (Right Hand) Includes: Actuator, LT-10-R Cartridge, Check Valve, Operating Instruction Labels, Lead Wire Seal
► 16033	Operating Instruction Labels for Manual Actuator Includes: Nameplate "IN CASE OF FIRE 1. SHUT OFF ENGINE 2. PULL RING PIN 3. PUSH LEVER"
16459	Operating Instruction Labels for Manual Actuator Includes: Nameplate "IN CASE OF FIRE 1. SHUT OFF POWER 2. PULL RING PIN 3. STRIKE BUTTON"

ACTUATION LINE DEVICES

15677	Safety Vent Relief Valve
53050	Safety Vent Relief Valve Package Includes: 2 Safety Vent Relief Valves
53051	1/4 in. Check Valve (Package of 2)
57488	LT and LP Model Pneumatic Actuator Assembly
16408	A-101 Pneumatic Actuator with Cartridge Receiver Assembly
31579	LT-A-101-10 Pneumatic Actuator Assembly
8372	Pressure Switch (Shutdown)
46250	Pressure Switch, Weather Proof, DPST (shutdown)
► 427425	Engine Shutdown Device

SYSTEM COMPONENT INDEX (Continued)

SYSTEM TANKS

24855	A-101-10 Includes: Charged Agent Tank with Cartridge
24970	A-101-20 Includes: Charged Agent Tank with Cartridge
53000	A-101-30 Includes: Charged Agent Tank with Cartridge
24966	LT-A-101-10 Includes: Charged Agent Tank with Cartridge
24894	LT-A-101-20 Includes: Charged Agent Tank without Cartridge
29375	LT-A-101-30 Includes: Charged Agent Tank without Cartridge
24427	LP-A-101-20-B Includes: Charged Agent Tank without Cartridge
24425	LT-LP-A-101-20-B Includes: Charged Agent Tank without Cartridge

SYSTEM BRACKETS

24854	A-101-10, LT-A-101-10 Tank Mounting Bracket (1)
24971	A-101-20 Tank Mounting Bracket (1)
14098	A-101-30 Tank Mounting Bracket (1)
24910	A-101-30 Tank Mounting Bracket (1) (Extra Heavy)
24895	LT-A-101-20 Tank Mounting Bracket (1)
30494	LT-A-101-30 Tank Mounting Bracket (1)
31171	LP-A-101-20-B, LT-LP-A-101-20-B Tank Mounting Bracket (1)
31177	Cartridge Bracket Assembly for LP-A-101-20-B
24325	Cartridge Bracket Assembly for LT-A-101-20 or LT-LP-A-101-20-B
29193	Cartridge Bracket Assembly for LT-A-101-30

RECHARGE EQUIPMENT AND MATERIAL

53080	FORAY Multi-Purpose Dry Chemical 45 lb. Pail
16511	Fill Cap Spanner Wrench (Low Profile)
428363	Bursting Disc Package (Includes: 15 Bursting Disc Assemblies, Part No. 428271)
75382	Cartridge Scale and Hook Assembly (LT-A-101-30)
3923	Cartridge Scale and Hook Assembly
197	Lead Wire Seal
15496	Bursting Disc Union Assembly
24327	A-101 Installation, Recharge, Inspection and Maintenance Manual
53081	Owner's Manual

SYSTEM CARTRIDGES

15850	A-101-10 Cartridge (DOT)
423439	A-101-10 Cartridge (TC/DOT)
423441	A-101-20, LP-A-101-20-B Cartridge (TC/DOT)
423443	A-101-30 Cartridge (TC/DOT)
423429	LT-A-101-10 Cartridge (TC/DOT)
423435	LT-A-101-20 and LT-LP-A-101-20-B Cartridge (TC/DOT)
423491	LT-A-101-30 Cartridge (TC/DOT)
13193	LT-10-R Cartridge (DOT)
423423	LT-10-R Cartridge (TC/DOT)
13177	LT-10-L Cartridge (DOT)
423425	LT-10-L Cartridge (TC/DOT)

FOR SYSTEM COMPONENT INDEX FOR THE CHECKFIRE AUTOMATIC DETECTION AND ACTUATION SYSTEMS, SEE THE FOLLOWING INSTALLATION MANUALS:

- CHECKFIRE MP-N ELECTRIC SYSTEM – Manual Part No. 427310
- CHECKFIRE SC-N ELECTRIC SYSTEM – Manual Part No. 423522
- CHECKFIRE ELECTRIC SERIES I SYSTEM – Manual Part No. 54894

NOTES:

LARGE EXCAVATORS

Hazards and Protection

The following are generally considered to be fire hazard areas. Hazard areas exist when an ignition source can come in contact with a fuel source. This may be due to the close proximity of the ignition source to the fuel source or due to the configuration of the machine that may allow running or spraying fuel to come in contact with an ignition source. A hazard analysis of the excavator should determine which of the following components will require protection. A hazard analysis should also determine any other areas not listed below that potentially could be considered hazard areas requiring protection.

1. Engine. The engine consists of various components that contain or transfer fuels, components involved with lubrication, and electrical contacts and controls as well as components that generate heat. Protection should include but not be limited to the following components:
   - Manifolds
   - Turbochargers
   - Heat exchangers
   - Fuel lines
   - Engine block
   - Electrical equipment, such as starters, generators, alternators, etc.
   - Exhaust systems
   - Bottom of engine, belly pan or floor area
2. Hydraulic pump(s) and control valve banks/manifolds.
3. Hydraulic hoses and fuel lines, including those under operator's compartment.
4. Transmissions/gear reduction boxes.
5. Brakes and brake valves. **NOTE:** Brakes located in the track mechanism are not required to be protected.
6. Drive train bearings.
7. Swing gear motors and travel clutches.
8. Ring Gear area.
9. Lubrication systems.
10. Hydraulic oil tank and fuel tank fill and outlet connections.
11. Batteries.
12. Large electrical generators and motors.

Design Parameters

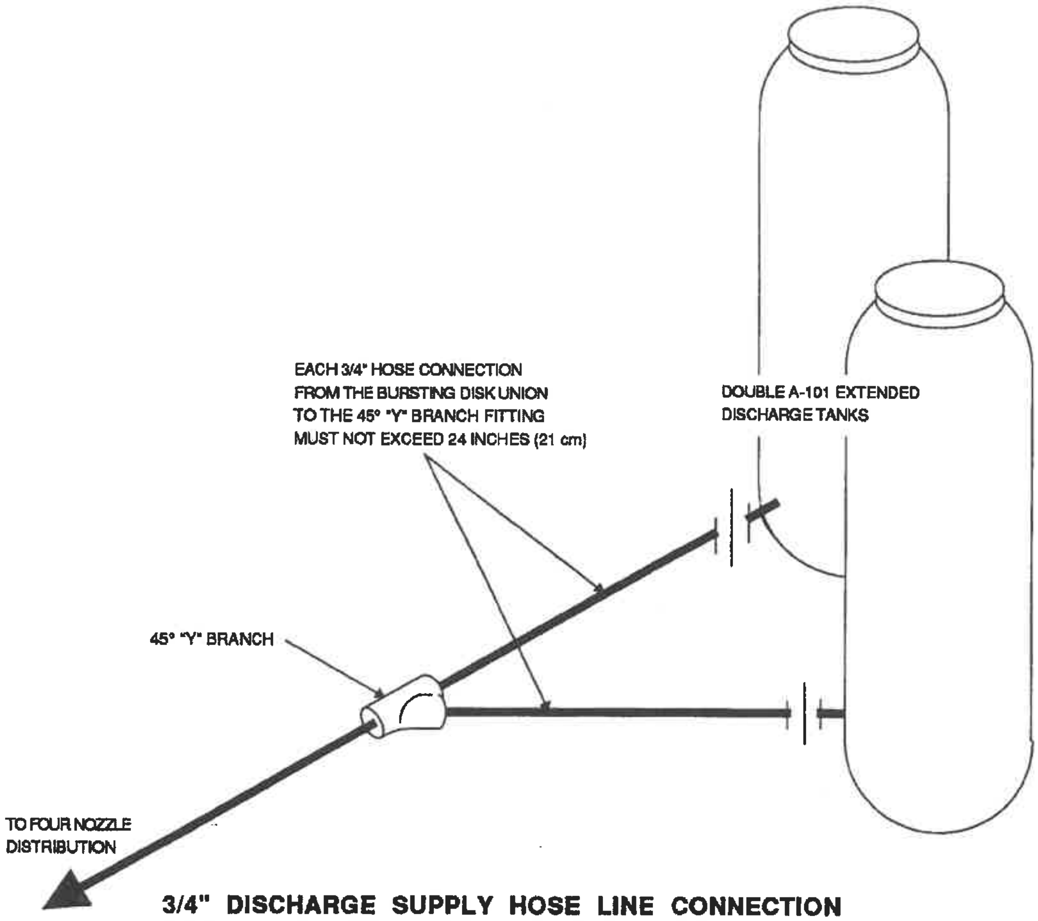
1. Extended Discharge System (Not FM Approved) – Fire suppression on large excavators may require an extended agent discharge time to allow for operator egress from the machine. In order to extend the time of agent discharge from A-101 system nozzles, the number of tanks determined by hazard analysis must be doubled. (Refer to drawings for revised actuation and discharge hose connection parameters and system operation.)
   - 3/4 in. Extended Discharge Supply Hose Line Connection. See Figure 1. (**NOTE:** Maximum of 24 in. from each adjacent tank to the common "Y" fitting.)
   - 1/4 in. Actuation Hose Detail. See Figure 2.
   - CHECKFIRE SC-N Wiring Diagrams. See Figures 3 and 4.
2. Each four nozzle agent distribution network will be connected to two adjacent tanks using a "Y" fitting. See Figure 1. **Six nozzles systems are not allowed.**
3. An automatic detection and actuation system will be required, using the CHECKFIRE SC-N Detection and Actuation system.
4. The fire suppression system must automatically perform the following functions:
   - Engine shutdown.
   - Pressurized hydraulic tank and fuel tank venting.
   - Fuel shutoff.
   - Electrical disconnect (Optional).

   If mine personnel refuse to allow any of the above items to be performed, it should be **documented** and kept in the job file.
5. The system must also include a Remote High Level Alarm Horn, Part No. 79559 and should also include a remote visual alarm.
6. As part of the total fire suppression system package, training for mine personnel and the machine operator(s) must be conducted and documented. Training should include but not be limited to:
   - A-101 and CHECKFIRE SC-N system description.
   - System operation.
   - System limitations and primary intent.
   - What to do in case of fire.
   - Vehicle maintenance and fire suppression system maintenance.
7. An A-101/CHECKFIRE SC-N Maintenance Contract allowing periodic service and maintenance at scheduled intervals should also be included.

NOTE: Extended discharge can also be obtained by using the larger LT-A-101-125/250 tanks. Refer to manual, Part No. 427865, for details.

LARGE EXCAVATORS (Continued)

Design Parameters (Continued)



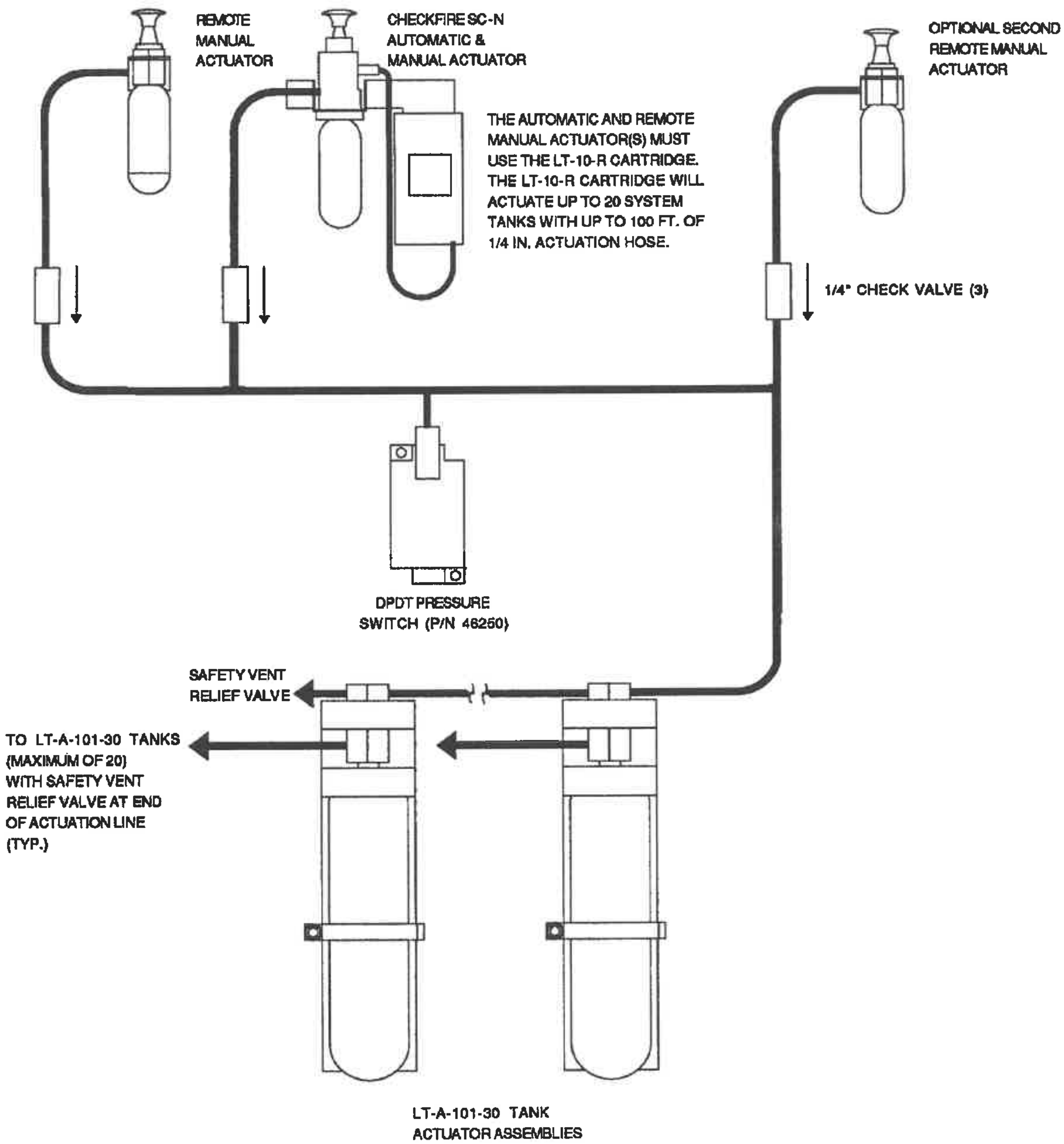
3/4" DISCHARGE SUPPLY HOSE LINE CONNECTION FOR A-101 EXTENDED DISCHARGE SYSTEM

FIGURE 1

003526

LARGE EXCAVATORS (Continued)

Design Parameters (Continued)



1/4" ACTUATION HOSE DETAIL FOR A-101 EXTENDED DISCHARGE SYSTEM
(Not FMRC Approved)

FIGURE 2
003527

LARGE EXCAVATORS (Continued)

<u>Design Parameters</u> (Continued)

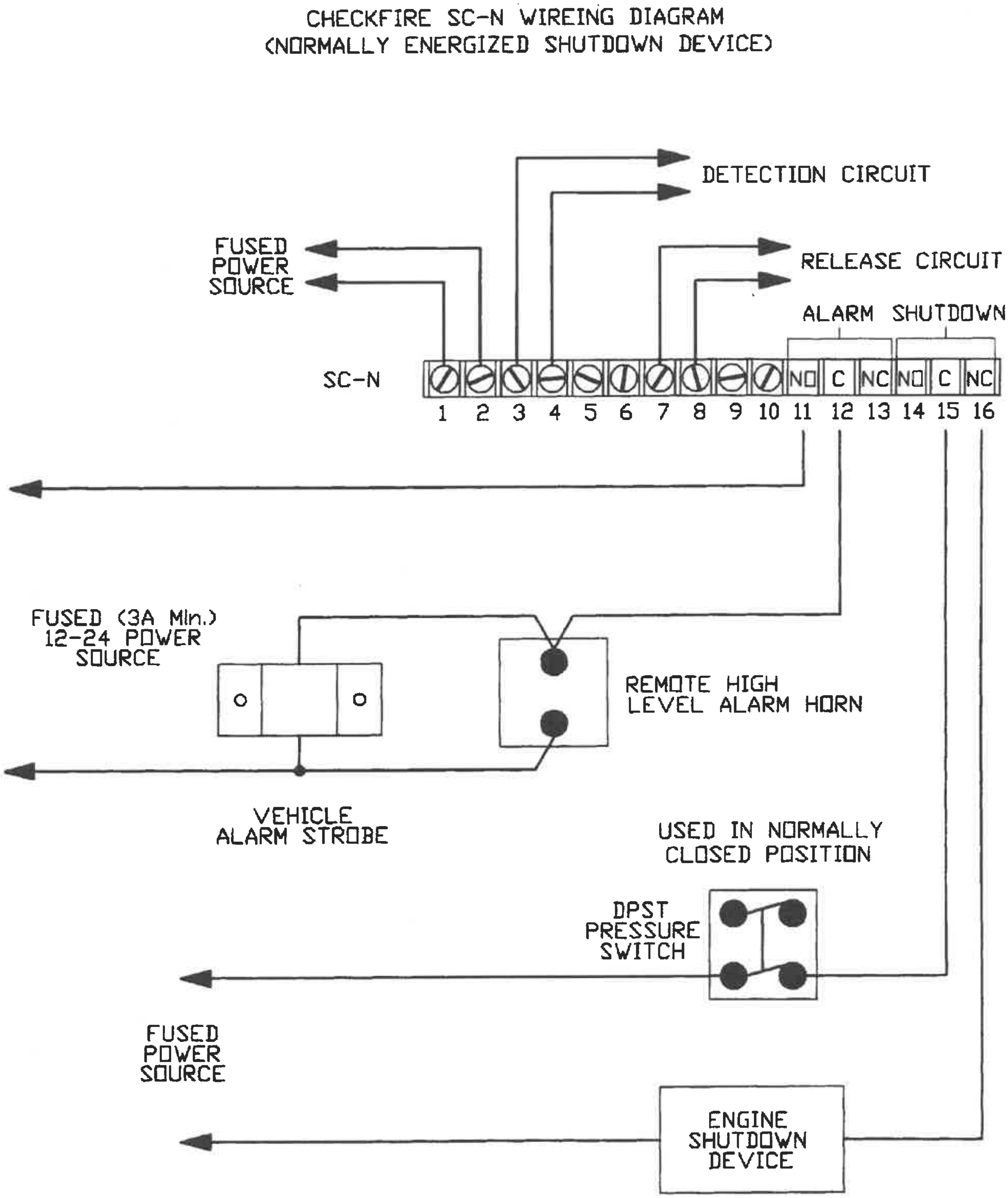


FIGURE 3
008435

LARGE EXCAVATORS (Continued)

Design Parameters (Continued)

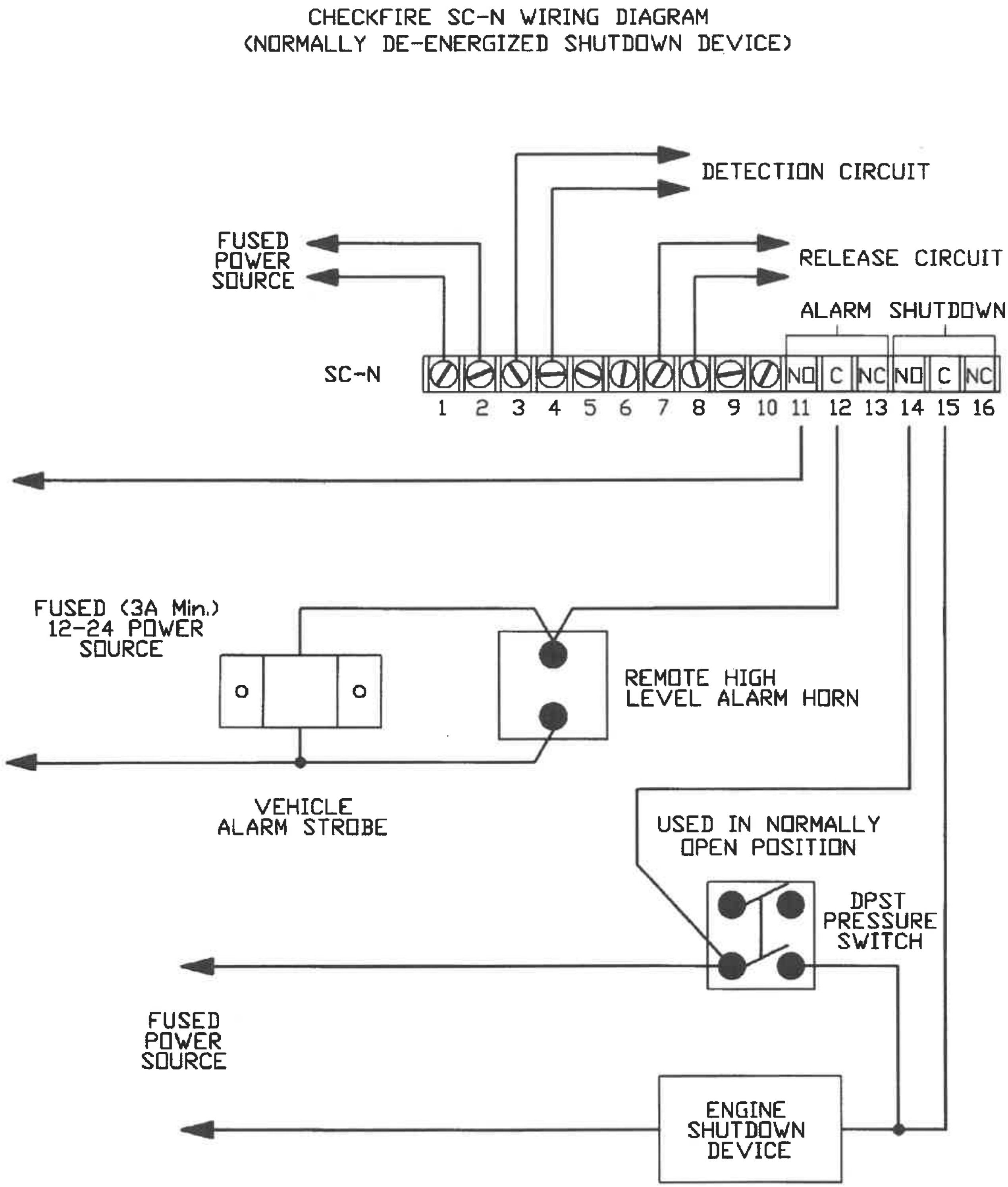


FIGURE 4
006436

EXCAVATOR PROTECTION

Excavators can be classified into three categories, depending on their hydraulic fluid capacity. Ansul has researched the hydraulic fluid capacities in regard to size of equipment (operating weight).

With the introduction of the LVS™ Liquid Agent Suppression System (not FM Approved), we can now offer an enhanced protection scheme for large excavators, as well as other non-road mobile equipment. **The following protection schemes are required for excavator of these specified sizes. They are as follows:**

- **Standard Discharge Application: Small Equipment (Operating Weight: 99,000 to 200,000 lb. (44,906 to 90,720 kg))**

  Standard discharge application of an A-101 dry chemical system can be used for this smallest class of excavators. Design of the suppression system shall be in accordance with the LT-A-101-30 or LT-A-101-125/250 Installation, Recharge, Inspection, and Maintenance Manual.

  Excavators that fall into this class of machine include but are not limited to:

  - Caterpillar: 345BL-VG, 350, 350L, 375, 375L, 5080
  - Hitachi: UH261, UH30
  - Komatsu/DeMag: H65, PC 750-6
  - Liebherr: R982
  - Link-Belt: 5800, 6000
  - O&K: RH 25D, RH 30E
  - Poclain: 300, 400

- **Twin-Agent Application: Mid-Size Equipment [Operating Weight 200,000 to 1,000,000 lb. (90,720 to 453,600 kg)]**

  Use of a twin-agent system consisting of the LVS liquid agent system connected to an A-101 dry chemical (extended or standard discharge) system. The A-101 system can utilize 250 lb., 125 lb. or 30 lb. (nominal) agent containers.

  Note 1: When utilizing a standard discharge design, all hazard areas will require protection using both agents.

  Note 2: When utilizing an extended discharge design, the liquid portion of the twin-agent scheme need only protect the engine(s) and hydraulic devices (i.e., pumps, control valves, valve banks).

  Note 3: Existing systems installed in compliance with Product Service Bulletin No. 77 utilizing an extended discharge design, do not need to be changed to twin-agent systems. However, for new system installations or major changes to an existing hydraulic excavator, the design must follow the guidelines in this manual using a twin-agent system.

  Excavators that fall into this class of machine include but are not limited to:

  - Caterpillar: 5130, 5130B, 5130ME, 5130FS, 5230, 5230ME
  - DeMag: H95, H135S, H185S, H255S, H285S
  - Hitachi: EX1000, EX1100, EX1800, EX 2500, EX3500, EX 3600, UH501, UH80, UH801
  - Komatsu: PC1000-6, PC1100-6, PC1400, PC1500-1, PC1600-1, PC1800-6, PC 3000, 3560 B, PC4000
  - Liebherr: R984, R992, R991, R994, R995
  - NW Engineering: 100-DH
  - O&K: RH 40E, RH 75, RH 90C, RH 120C, RH 170
  - Poclain: 600, 1000
  - P&H: 1200

- **Twin-Agent Application: Large Equipment [Operating Weight: 1,000,000 lb. (453,600 kg) and greater]**

  Use of a twin-agent system consisting of the LVS liquid agent system connected to an A-101-125/250 dry chemical (extended discharge) system.

  Note 1: The liquid portion of the twin-agent scheme, at a minimum, must protect the engine(s) and hydraulic devices (i.e., pumps, control valves, valve banks). Additional LVS liquid agent systems may be added at the designer's discretion to cover other areas.

  Note 2: Existing systems installed in compliance with Product Service Bulletin No. 77 utilizing an extended discharge design, do not need to be changed to twin-agent system. However, for new system installations or major changes to an existing hydraulic excavator, the design must follow the guidelines in this manual using a twin-agent system.

  Excavators that fall into this class of machine include but are not limited to:

  - DeMag: H455S, H485S, H485SP, H655S
  - Hitachi: EX5500, EX7500
  - Komatsu: PC5500, PC8000
  - Liebherr: R996
  - O&K: RH 200, RH 300, RH 400

General Discussion

Special design consideration must be given when protecting large excavators to reduce the potential for reflash and provide additional time. Ansul requires the following as a minimum:

1. Two large size agent tanks are available: a 125 lb. (56.7 kg) tank and a 250 lb. (113.4 kg) tank. The LT-A-101-125 tank can utilize an 8-nozzle extended discharge or 12- or 16-nozzle standard discharge distribution system. The LT-A-101-250 tank can utilize either an 8, 12, or 16 nozzle extended discharge or a 24 nozzle standard discharge system. Both the 125 lb. and 250 lb. tanks can be used where an extended discharge is required. See "Extended Discharge" to determine type of system required.
2. When utilizing 30 lb. agent containers, use four nozzles maximum for each single or two-tank (when used as extended discharge) system to provide additional agent per nozzle and maximum system discharge time. Single tank, two-nozzle systems may also be used for extended discharge.

   NOTE: When protecting the engine, hydraulic devices (i.e. pumps, control valves, valve banks), hoses and connections on large non-road mobile equipment used in surface mining, landfill equipment, or other large specialized machines; only 4-nozzle 30 lb. tank systems, or large capacity (125 lb. and 250 lb.) type systems are to be used.
3. Fully automatic system, including automatic engine shutdown, hydraulic oil/fuel shutoff, and agent discharge.
4. Remote high level alarm and flashing alarm strobe to enhance machine operator warning.
5. A safe means of egress from the operator's compartment without having to exit past fire hazard areas.

EXCAVATOR PROTECTION (Continued)

General Discussion (Continued)

In addition to the LT-A-101 dry chemical system and/or LT-A-101/LVS twin-agent system with CHECKFIRE® Electric Detection and Control equipment, supplemental fire protection should be included when considering protection of large non-road mobile equipment:

1. Cartridge operated hand portable fire extinguishers
2. Secondary means of fire suppression

For any fire protection to be effective, training is critical. As a minimum, comprehensive training for the machine operator and site representatives should include:

1. Fire suppression system operation
2. Fire suppression system performance
3. Fire suppression system capabilities
4. Fire suppression system limitations
5. Response procedures
6. Safe egress procedures

It is important to make sure the site representative understands the LT-A-101/LVS/CHECKFIRE system capabilities as well as limitations. This information needs to be discussed and reviewed with the appropriate end-user personnel.

FUME HOOD PROTECTION (Not FM Approved)

Fume Hood can utilize an Ansul A-101-20 or A-101-30 system with 6 nozzles. See Figure 5.

FUME HOOD

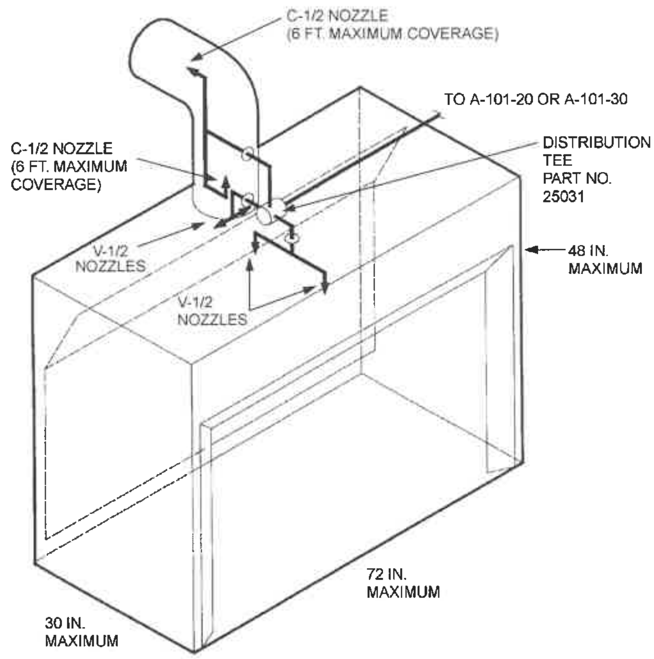


FIGURE 5
003530

The system can utilize a distribution tee and 3/4 in. supply piping and 1/2 in. branch piping.

Standard A-101 nozzles are used for dry chemical discharge. C-1/2 nozzles are used in the duct and V-1/2 nozzles are used in the plenum and hood area.

The pipe length must not exceed the maximum requirement as stated on Page 4-11 and 4-12 of this manual.

When utilizing an Ansul AUTOMAN Release, use an LT-10-R Cartridge to supply the required actuation gas pressure to the tank cartridge.

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Other WV Regulations to Consider

<u>Communications for track equipment:</u>
§22A-2-37. Haulage roads and equipment; shelter holes; prohibited practices; signals; inspection.

(t) (5) All self-propelled track equipment shall be equipped with two-way communications.

<u>Welding tanks:</u>
§22A-2-46. Welding and cutting.

(d) Transportation of oxygen and gas tanks or cylinders shall be permitted on self-propelled machinery or belt conveyors specially equipped for safe holding of the containers in transportation. In no instance shall such transportation be permitted in conjunction with any mantrip, unless such mantrip is especially equipped with a compartment, lined with at least four inches of foam rubber or the equivalent, and capable of tightly securing the tank inside the manufactured frame of the vehicle.

<u>Towing disabled rubber-tired equipment:</u>
§36-45-4. Transportation of Disabled Underground Rubber Tired Mining Equipment.

4.1. Ninety (90) days after the effective date of these rules and regulations a solid triangular tow bar or suitable device approved by the director shall be used to tow disabled underground rubber tired mining equipment in all areas of the mine outby working sections, provided however, other means of towing disabled equipment may be used if it is necessary to transport such disabled equipment short distances to the nearest location where a solid triangular tow bar or other device approved by the director can be safely affixed to the disabled equipment.

4.2. No person shall be permitted to ride in disabled underground rubber tired mining equipment while it is being towed using a solid triangular tow bar unless the towed vehicle is equipped with operative brakes and steering functions and controls and a protective canopy.

4.3. Pushing a disabled vehicle will not be allowed unless it becomes necessary to move such disabled vehicle out of the road of travel or to enable access to the use of a solid triangular tow bar.

4.4. No person shall be allowed to push a disabled vehicle from the operators deck end.

<u>Pre-operation checklist tag on equipment:</u>
§36-18-5. Pre-Operational Equipment Check.

5.1. Each working shift prior to its operation, <u>all self-propelled section equipment</u> to be operated during that shift shall be examined by the equipment operator for safety defects and/or unsafe conditions.

5.2. Pre-Operational equipment examination required under 5.1 of this rule shall include the following items at a minimum. In addition, a <u>list of these items shall be maintained on such equipment</u>.

- 5.2.1. Stop/Start Control
- 5.2.2. Panic Bar
- 5.2.3. Tram Controls
- 5.2.4. Steering
- 5.2.5. Service Brakes
- 5.2.6. Automatic Emergency Brakes
- 5.2.7. Lights
- 5.2.8. Warning Devices
- 5.2.9 Canopies Where Required
- 5.2.10. ATRS System and Boom Controls on Roof Bolting Machines

NOTE: MUST FOLLOW OTHER WV HAULAGE AND HAULAGE EQUIPMENT REGULATIONS (Chapter 22 of Mine Laws)

A. L. LEE
CORPORATION

www.alleecorp.com

UNDERGROUND MINING EQUIPMENT SINCE 1967

Personnel Carriers

Rail Equipment

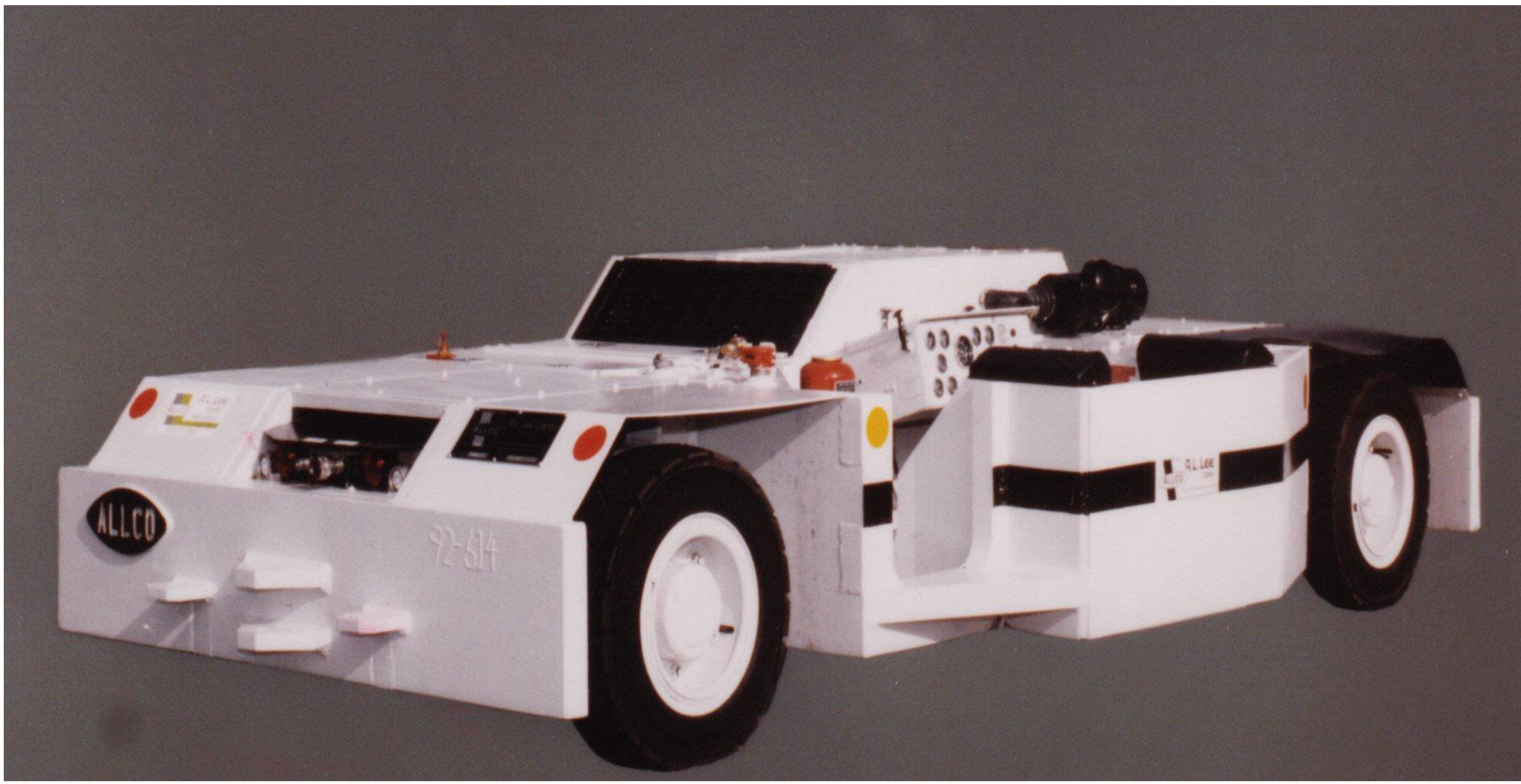
Utility Vehicles

A. L. LEE
CORPORATION
www.alleecorp.com

WV COMPLIANT DIESEL MINI-TRAC

A.L. LEE MODEL 255
4WD PERSONNEL CARRIER

MODEL 2400T
12 TON TRACTOR
“AN INDUSTRY STANDARD”



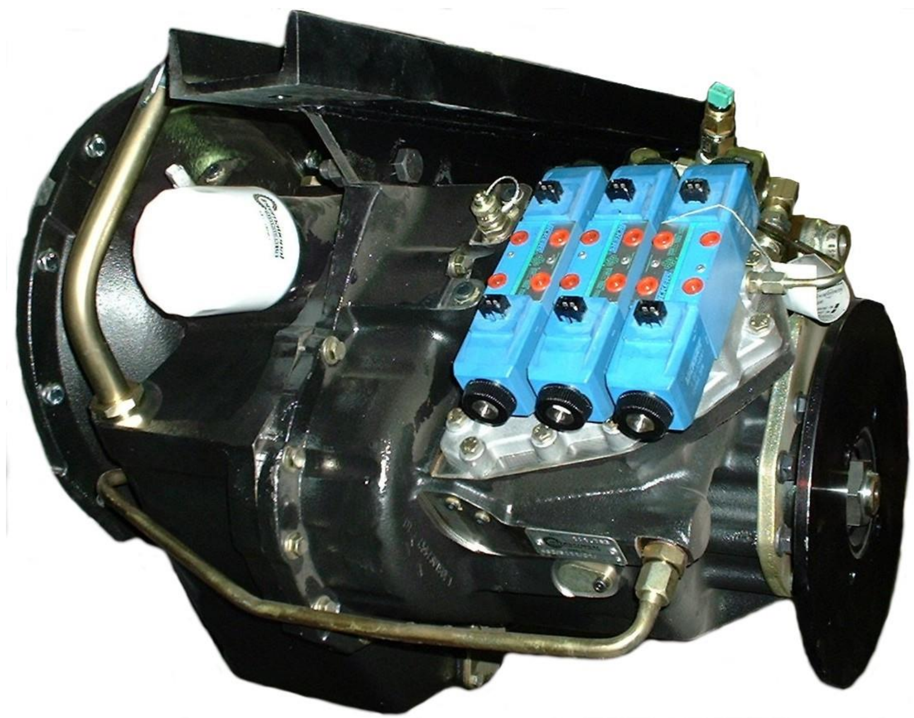
A.L. LEE DIESEL FIFTH WHEEL ROCKDUSTER

DIESEL GENERATOR

A.L. LEE MODEL 255 PERSONNEL CARRIER DRIVE LINE AND SUSPENSION

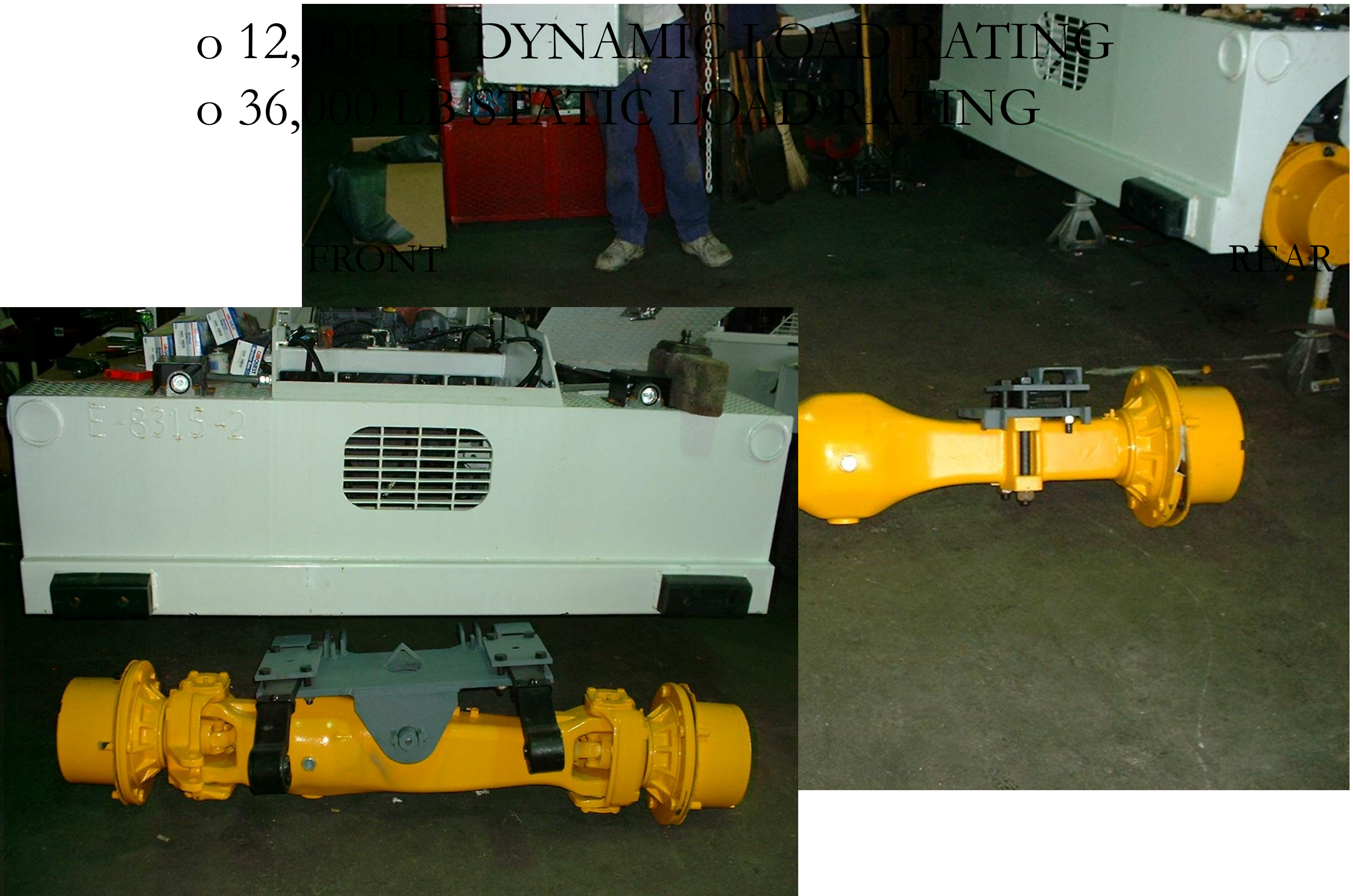
TRANSMISSION

- ITL PS 760 INDUSTRIAL TRANSMISSION WITH 4 SPEED POWER SHIFT
- 120 HP INPUT RATING
- 590 FT-LB INPUT TORQUE RATING
- 14 GPM OIL FLOW RATE



ITL AXLES

- ITL PLANETARY AXLES, FRONT AND REAR
- INTERNAL WET DISC SERVICE BRAKES
- 12,000 LB DYNAMIC LOAD RATING
- 36,000 LB STATIC LOAD RATING



FRONT

REAR

PARK BRAKE

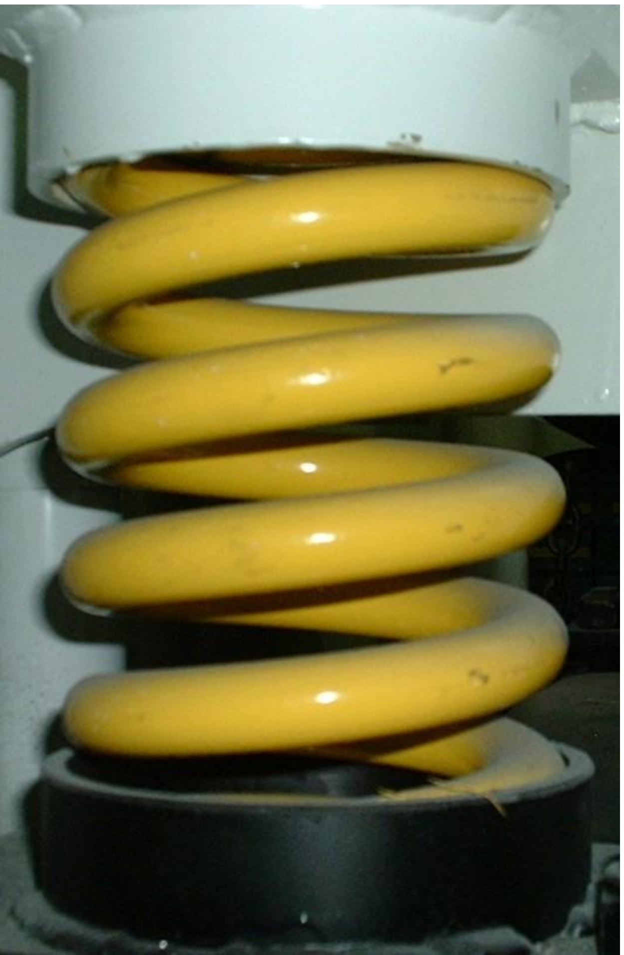
MAINTENANCE FREE AUSCO DRIVE LINE WET PARK BRAKE

WHY IS IT SO IMPORTANT TO USE WET BRAKES ON DIESEL EQUIPMENT?

- INTERNAL WET BRAKES DO NOT HAVE TO BE PROTECTED WITH AUTOMATIC FIRE SUPPRESSIO NOZZLES!
- DRY BRAKES REQUIRE A FIRE SUPPRESSION NOZZLE PER EACH BRAKE HEAD!

TYPES OF SUSPENSION

COIL SPRING

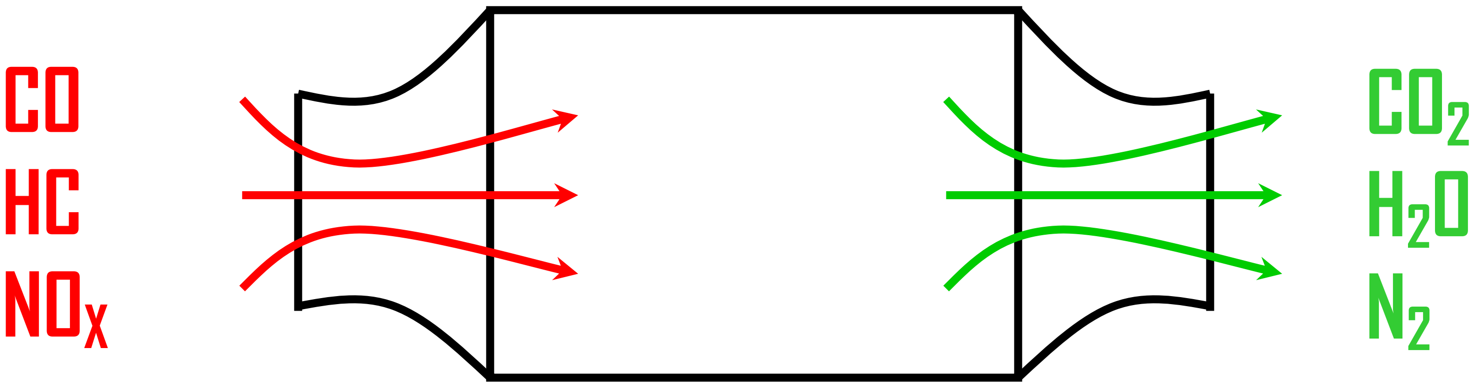


AIR BAG

WHAT COMPONENTS MAKE UP THE EXHAUST TREATMENT SYSTEM

- OXIDATION CATALYST
  - REMOVES CO BY 83% MINIMUM
    - AMBIENT CO CANNOT EXCEED 35 PPM CEILING, ACTION MUST BE TAKEN AT 26 PPM
- DPM FILTER
  - CAPABLE OF REDUCING DPM BELOW .12 MG/M^3
- EXHAUST COOLER
  - REDUCES EXHAUST EXIT TEMPERATURE BELOW 302 DEGREES FAHRENHEIT

OXIDATION CATALYST
REDUCES CO BY 83% MINIMUM



NUMBERS BELOW REPRESENT A DEUTZ 78 HP BF4L2011

Raw Exhaust
150 - 200 PPM CO

Treated Exhaust
15 – 20 PPM CO

Conversion of emissions occurs as hot exhaust **gases** contact the catalyst surface

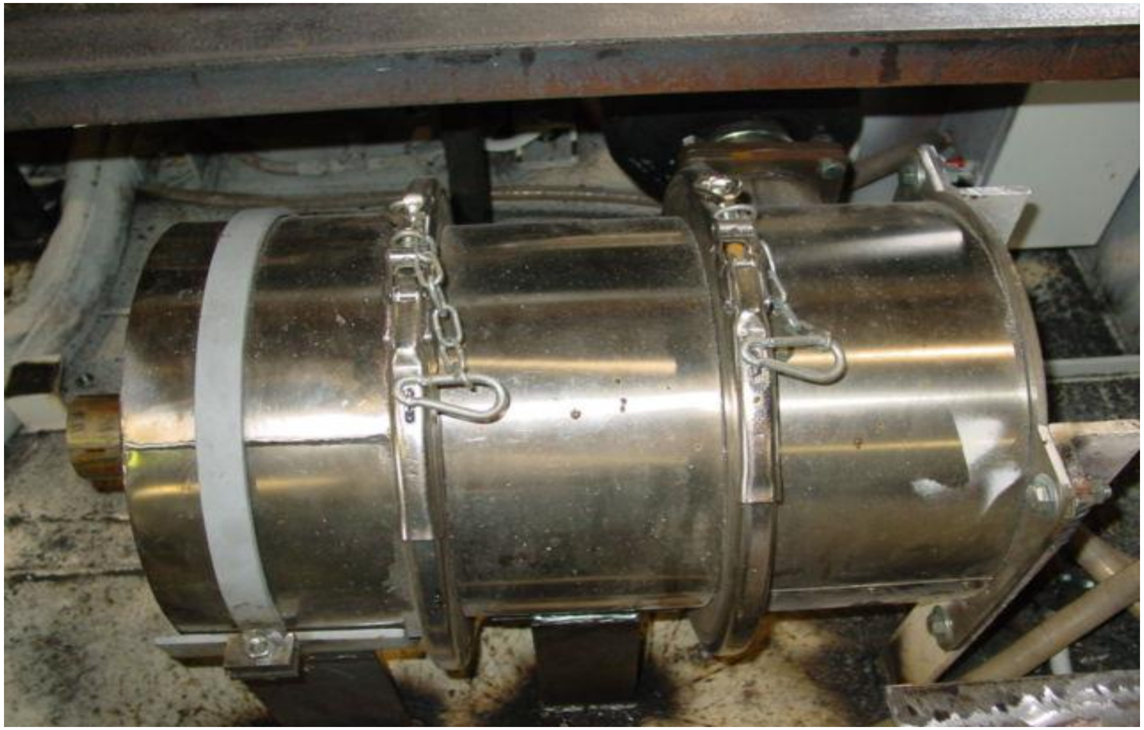
OXIDATION CATALYST MAINTENANCE

- MANUFACTURERS CLAIM THAT A CATALYST SHOULD LAST UP TO 10,000 HOURS
- IF THE DPM FILTER IS ALLOWED TO STOP UP, IT COULD IN TURN PLUG THE OXIDATION CATALYST
- IF THE OXIDATION CATALYST BECOMES CLOGGED IT SHOULD BE REMOVED AND WASHED OUT WITH SOAP AND WATER

DPM FILTER

DEUTZ BF4L2011 TIER 2 HAS A RAW DPM OF 3.7 GRAMS PER HOUR

- REDUCES DPM BY 87%
  - SURFACE TEMPERATUE CANNOT EXCEED 302 DEGREES FAHRENHEIT



DPM SHOWN DISASSEMBLED

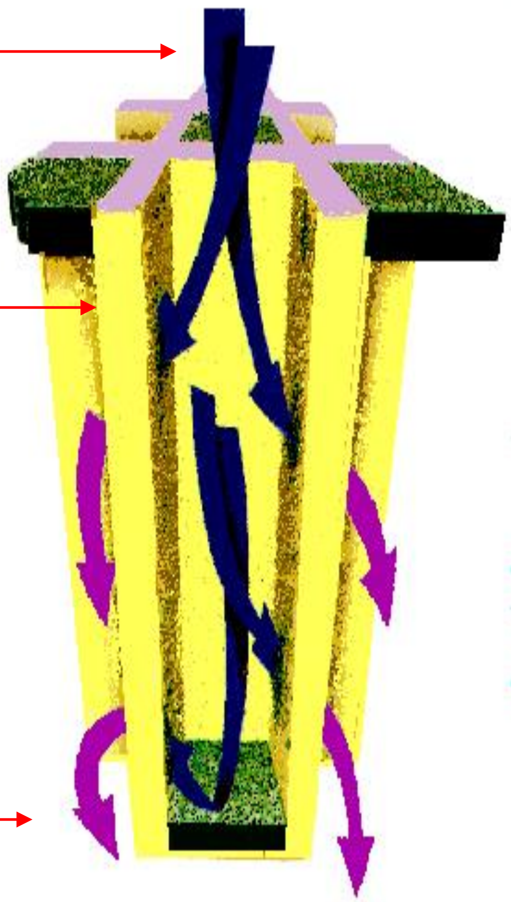
HOW DOES THE DPM FILTER WORK?

DPM COLLECTS ON THE FILTER WALLS

RAW EXHAUST GASES

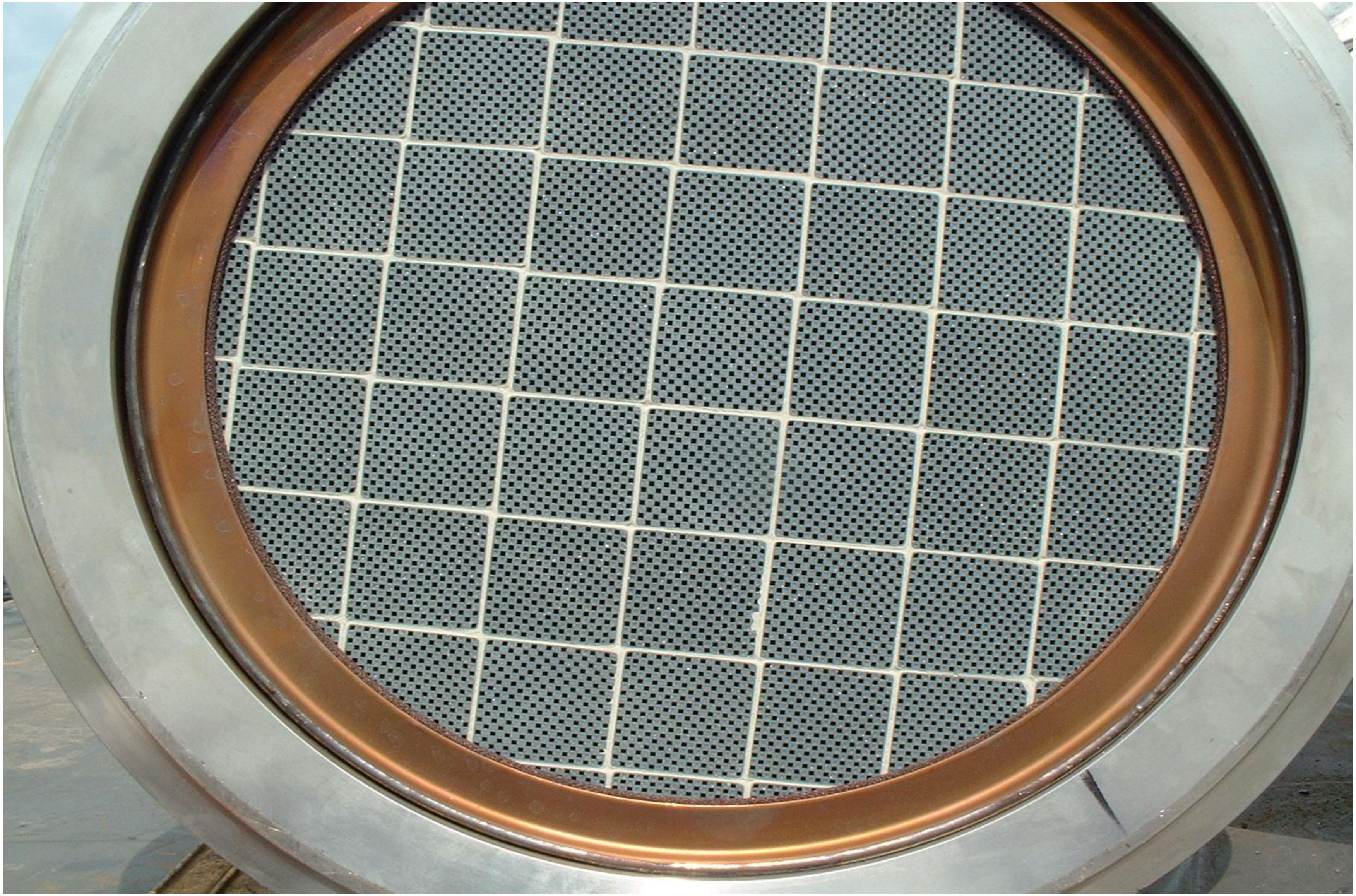
POROUS CERAMIC FILTER WALLS

TREATED EXHAUST GASES



INLET OF FILTER

EXHAUST SIDE OF FILTER



CERAMIC FILTER TYPES

PASSIVE

DPM WILL BURN OFF WHEN EXHAUST TEMPERATURES REACH 800 DEGREES FAHRENHEIT. EQUIPMENT WITH EXHAUST TEMPERTURES OF 800 DEGREES FOR 25% OF THE TIME CAN USE PASSIVE FILTERS. (TRACTORS AND SCOOPS ARE GOOD CANDIDATES)

ASSISTED

FILTER MUST BE TAKEN OFF THE MACHINE AND REGENERATED ON A CLEANING STATION (COOKER).

ACTIVE SYSTEMS ARE THE MOST COMMON

ACTIVE FILTER SYSTEMS ARE THE MOST COMMON AND ARE USED ON ALL A.L. LEE PERSONNEL CARRIERS AND FORK LIFTS. ACTIVE FILTERS SHOULD BE CLEANED EVERY

8 – 10 HOURS

HOW DO YOU KNOW WHEN TO CLEAN THE DPM FILTER?

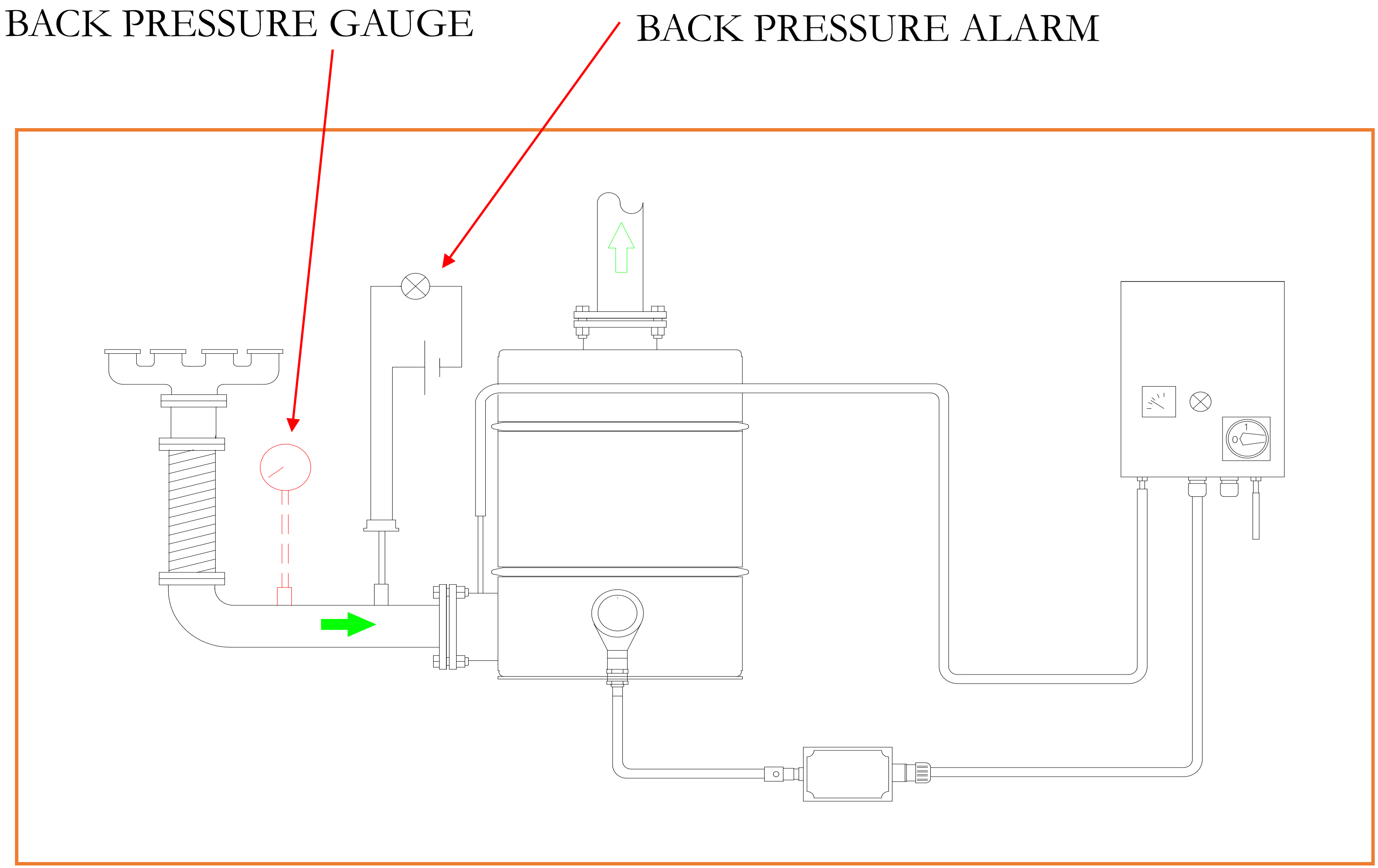
- OBSERVE THE BACK PRESSURE GAUGE. THE DEUTZ BF4L2011 HAS A MAXIXMUM BACKPRESSURE OF 30” OF WATER. CHECK BACKPRESSURE BY SHIFTING TO NEUTRAL WITH ENGINE AT HIGH IDLE.
- THE FILTER SHOULD BE CLEANED WHEN THE BACKPRESSURE EXCEEDS 24”.
- IF THE BACKPRESSURE EXCEEDS 30” THE MACHINE WILL AUTOMATICALLY SHUT DOWN

DPM Filter Backpressure Gauge

Limited to 30 inches H_2O (W.C.) Backpressure.

BACK-PRESSURE IS NOT LINEAR!

WHERE IS THE BACKPRESSURE MEASURED?



A REGENERATION STATION IS USED TO CLEAN THE FILTER

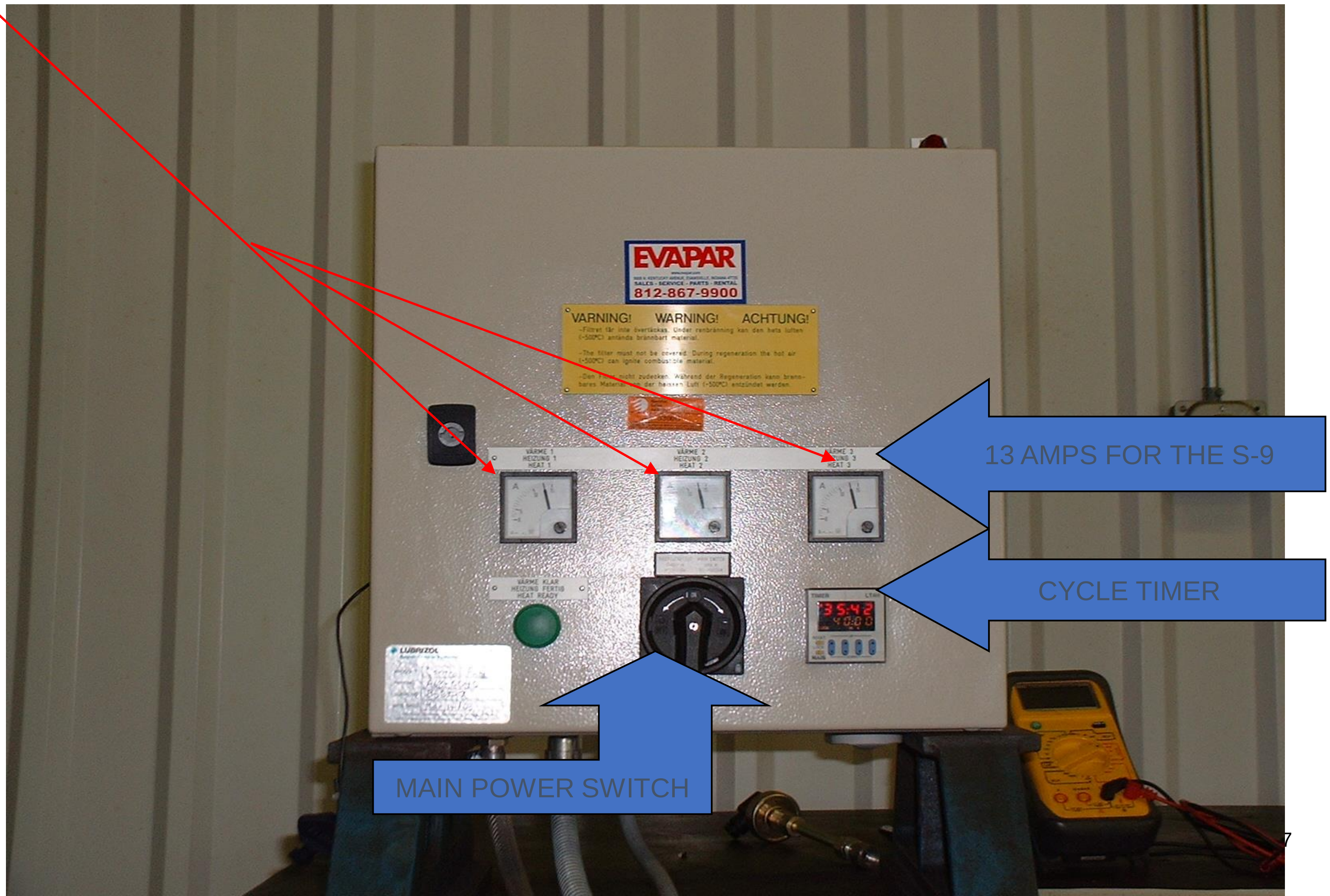
CONTROL PANEL- SUPPLIES POWER TO HEATER BASE

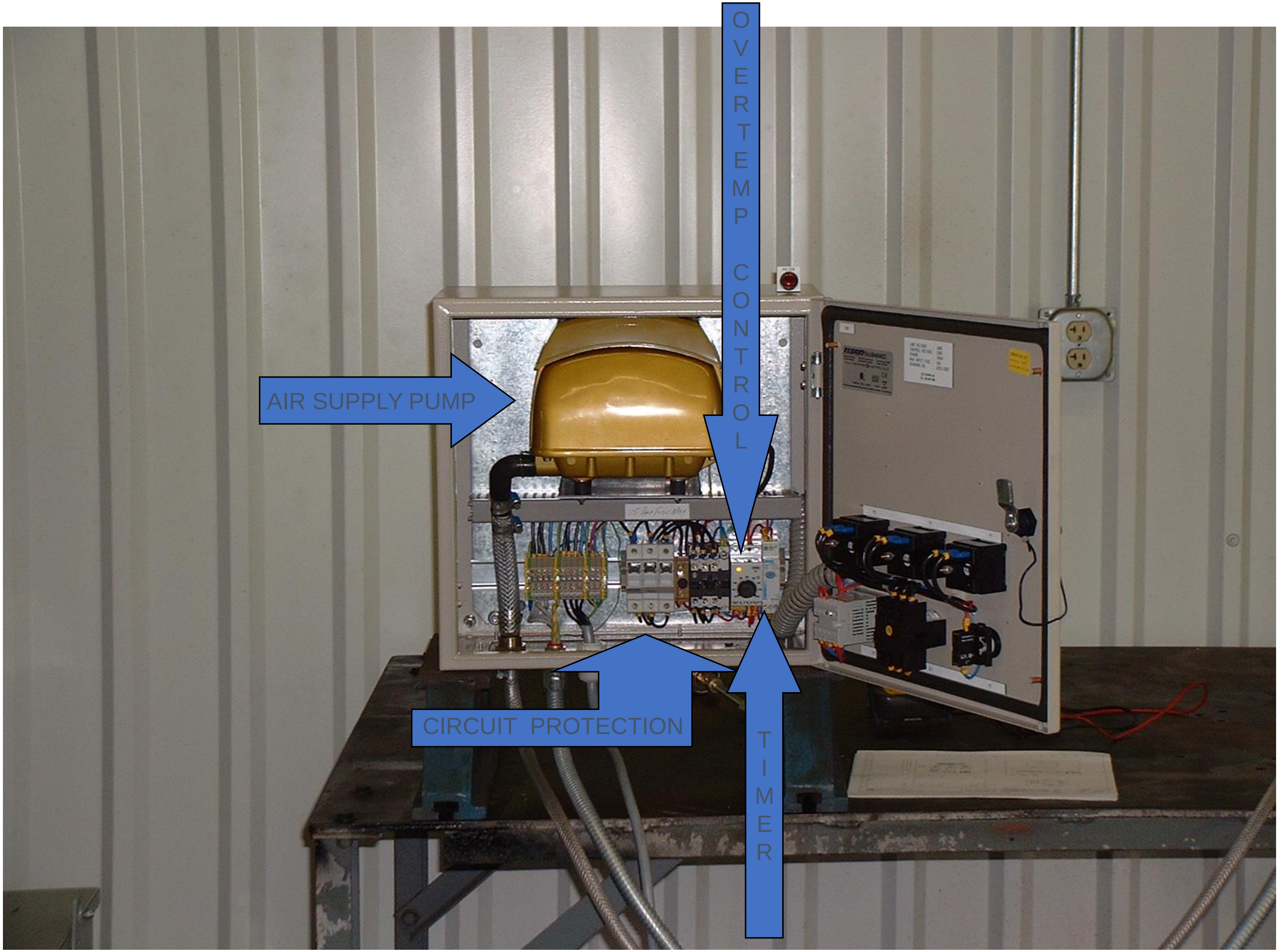
HEATER BASE -
CONSISTS OF 3 HEATER COILS

CONTROL PANEL

REGENERATION TAKES 1 HOUR FOR THE S-9 FILTER SYSTEM

EACH AMP GAUGE REPRESENTS A COIL IN THE HEATER BASE




OVERTEMP CONTROL
AIR SUPPLY PUMP
CIRCUIT PROTECTION
TIMER

COMBICLEAN CLEANING SYSTEM

AFTER REGENERATION FILTERS SHOULD BE BLOWN OUT 100 PSI - 6 INCHES FROM FILTER FACE

BLOW MATERAL INTO BAG!!

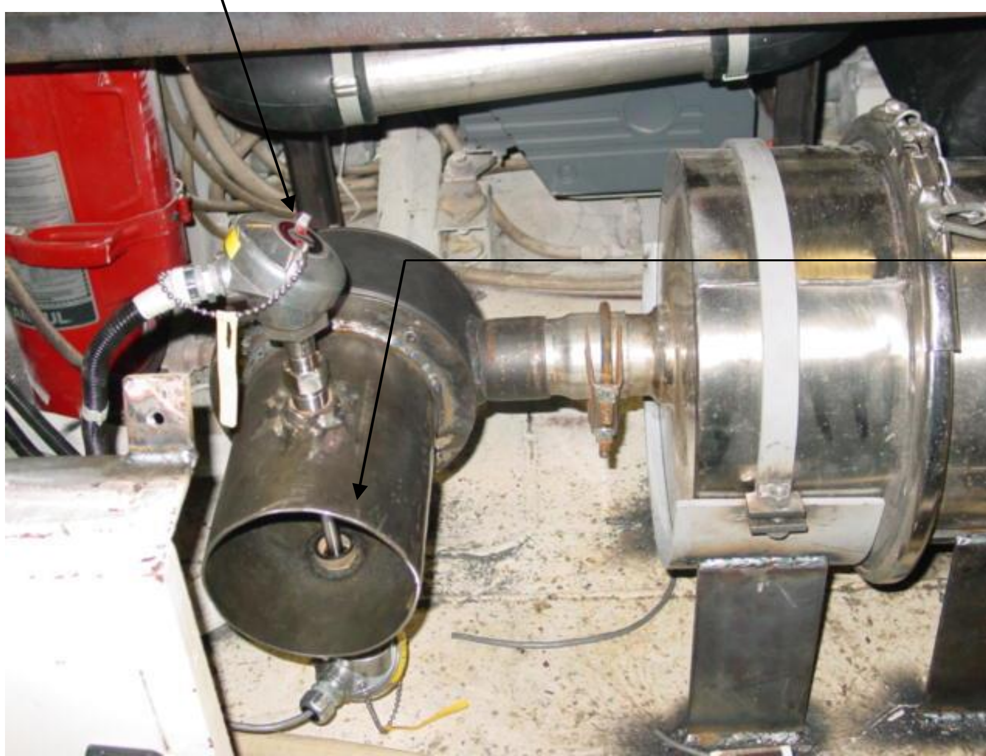
DO NOT USE HIGH PRESSURE WATER!!!!!!!!!

THIS WILL DAMAGE FILTER

Exhaust Coolers

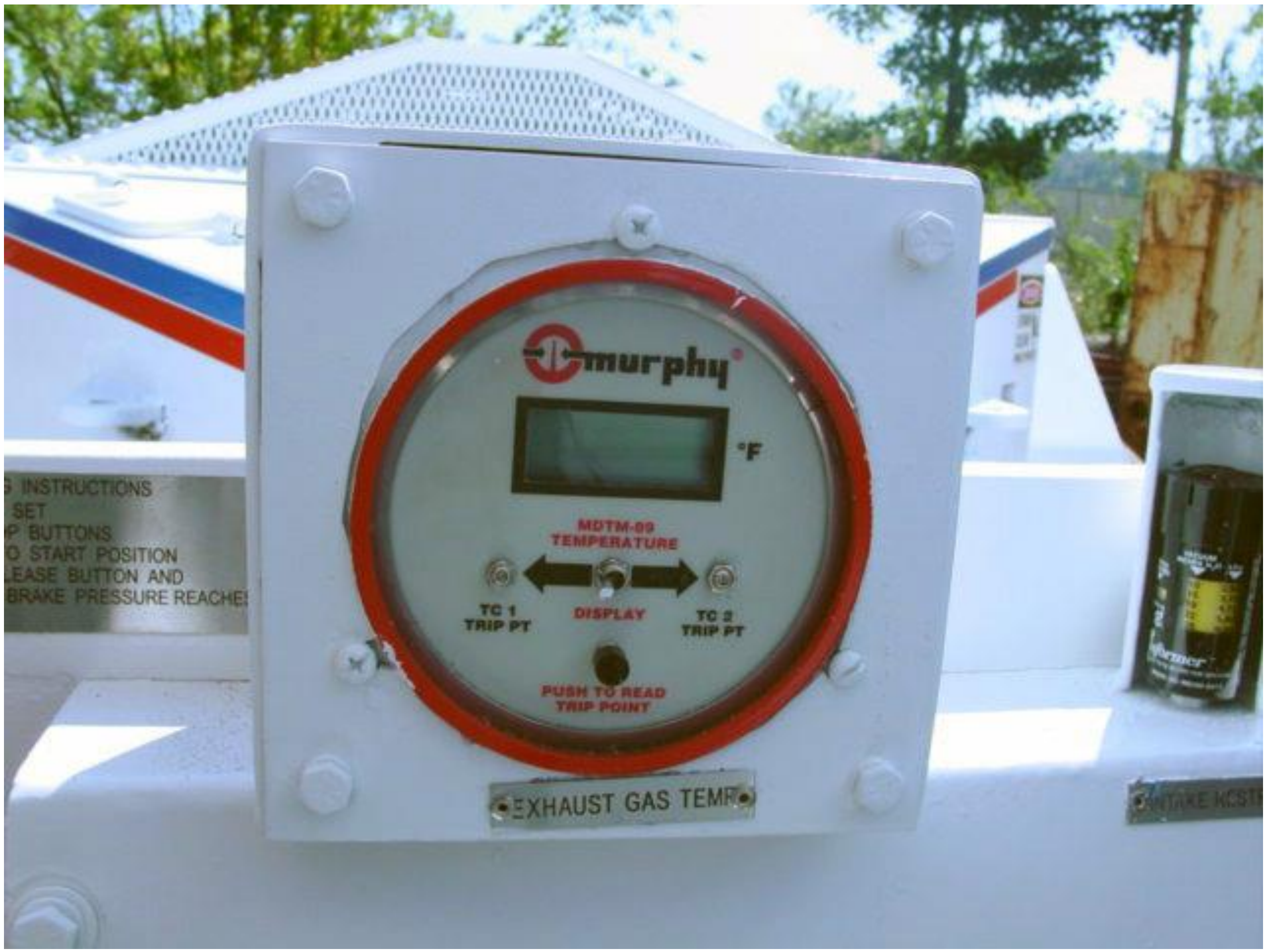
- Exhaust coolers (diffusers) operate off exhaust velocity, combining cool air with hot exhaust. Dirty DPM filters reduce the effectiveness of the cooler and can cause high exhaust temperature.

TEMPERATURE SENSORS



EXHAUST FLOW DIRECTION

EXHAUST TEMPERATURE GAUGE (302 DEGREES MAX.)



EXHAUST COATINGS

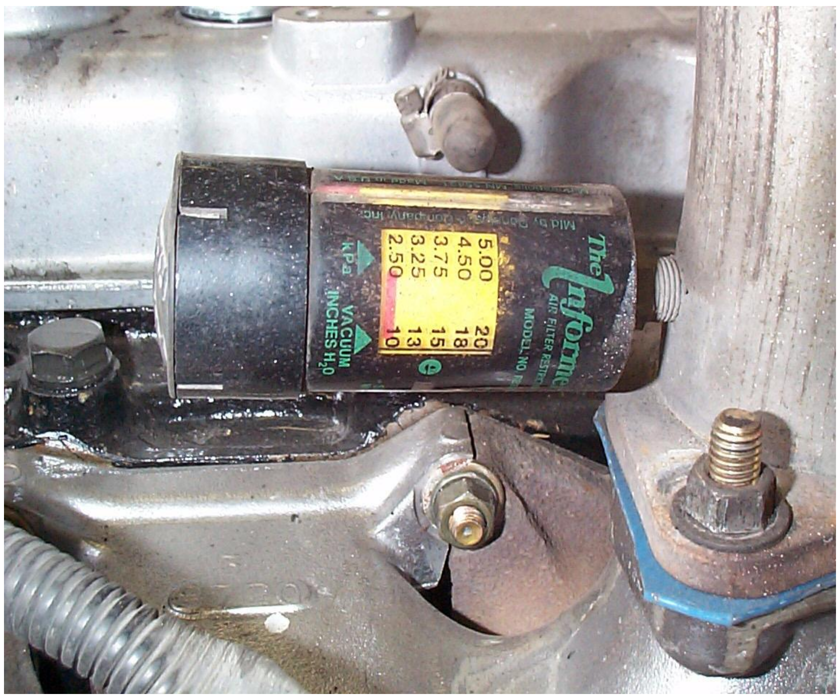
- A MILITARY COATING IS USED ON ALL OF A.L. LEE EXHAUST COMPONENTS TO KEEP THE SURFACE TEMPERATURE BELOW 302 DEGREES FAHRENHEIT.
- PAY CLOSE ATTENTION TO FLANGED AREAS AND BOLT HEADS. SINCE THESE ITEMS ARE NOT COATED HEAT ESCAPES RAPIDLY CAUSING LOOSENING OF BOLTS AND STRESS ON CONNECTIONS AND WELDED AREAS.

INTAKE RESTRICTION AND BACK PRESSURE GAUGES

(DEUTZ BF4L2011 ENGINE, 78 HP)

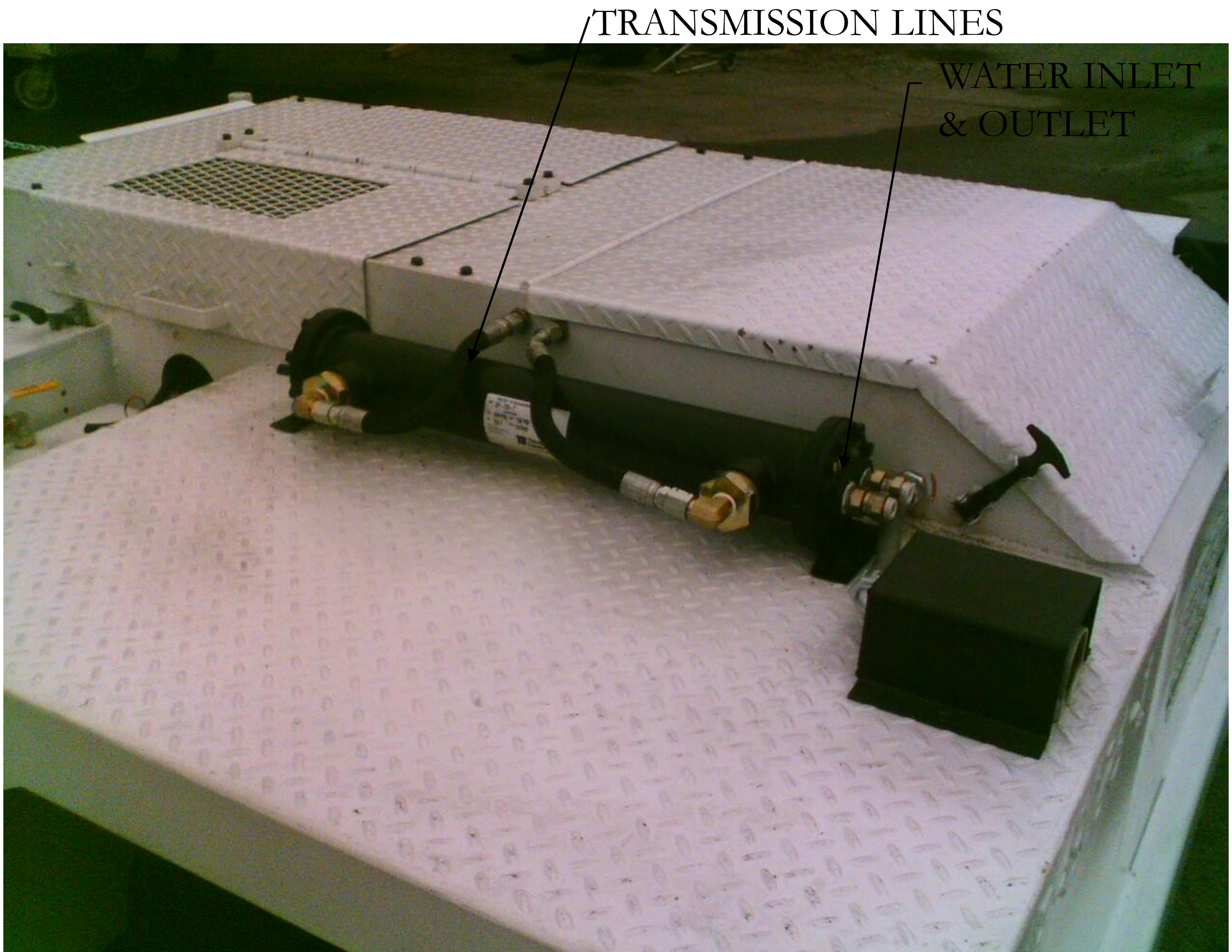
INTAKE RESTRICTION
20" CLEAN
26" DIRTY

BACKPRESSURE GAUGE
30" MAX.
CHANGE DPM FILTER AT 24"



HYDROSTATIC LOAD TESTING

TORQUE CONVERTER LOAD TESTING COOLER



LOAD TEST

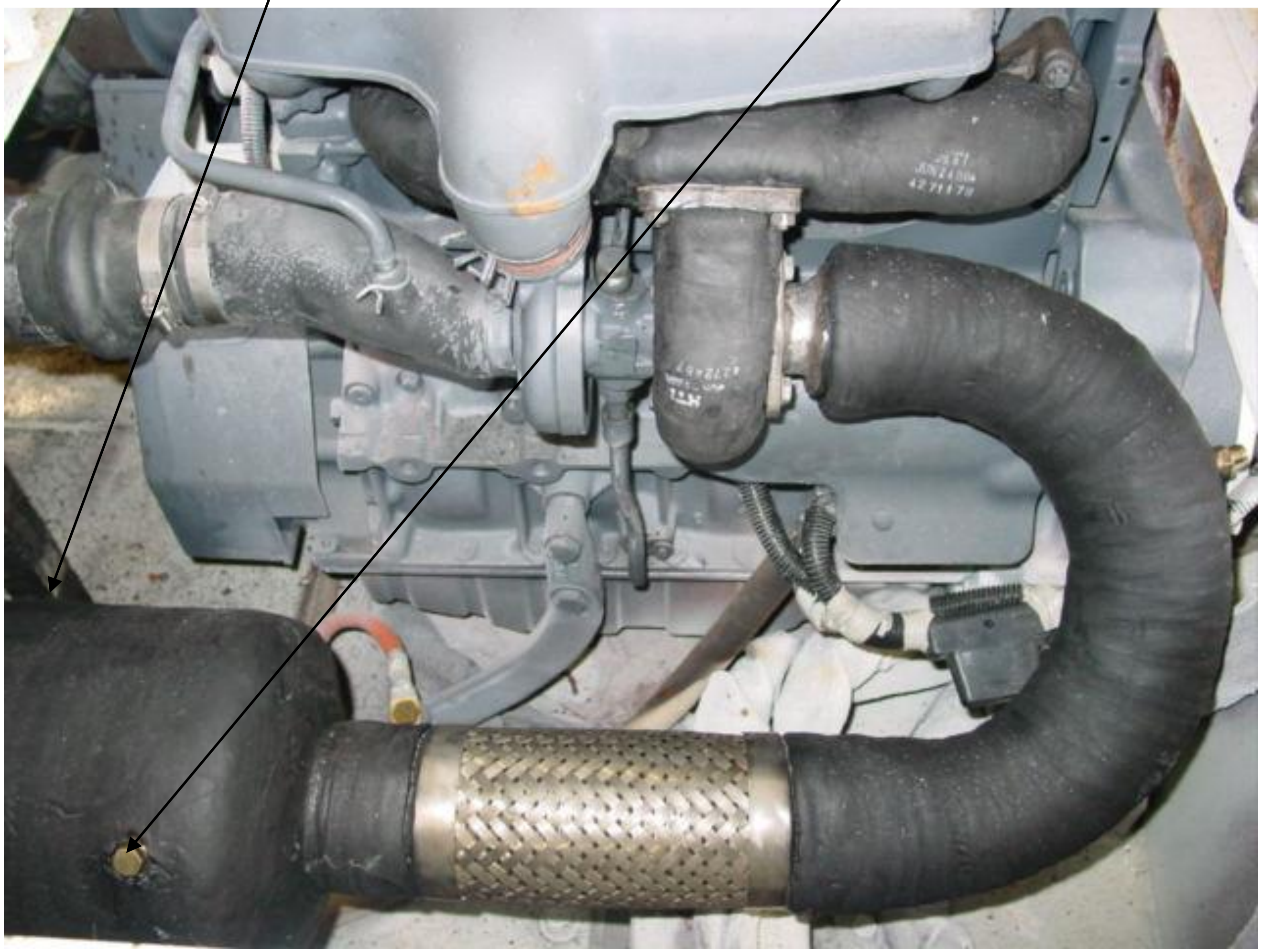
TEST PORTS IN THE OPERATOR DECK

A TREATED & UNTREATED SAMPLING PORT WITH QUICK DISCONNECTS
IS PROVIDED IN THE OPEATOR'S DECK FOR LOAD TESTING CONVENIENCE

UNTREATED PORT

OXIDATION
CATALYST

UNTREATED EXHAUST
PORT



TREATED EXHAUST PORT

LOCATE THE TREATED SAMPLING PORT 3 TO 4 TIMES THE DIAMETER OF THE EXHAUST PIPE FROM THE END OF THE PIPE.

TREATED SAMPLING PORT

AMBIENT EXHAUST READINGS SHOULD NOT EXCEED THE LIMITS LISTED BELOW

- Carbon Monoxide (CO TLV -- 35 ppm Action Level- 75% - 26 ppm
- Nitric Oxide (NO) TLV-- 25 ppm Action Level- 75% - 19 ppm
- Nitrogen Dioxide (NO2) TLV -- 3 ppm Action Level- 75% - 2 ppm

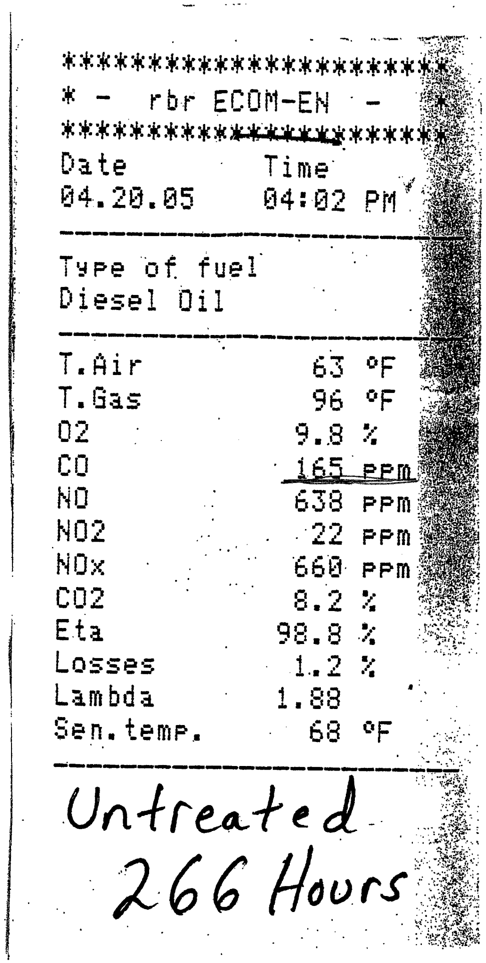
PROBLEMS EXPERIENCED IN THE FIELD

HIGH CO DURING BREAK-IN AND OIL CONSUMPTION

- Higher than normal CO levels can be expected during the first 100 hours of operation.
- Deutz engines CAN take between 500 and 700 hours before normal oil consumption is achieved.
- Normal oil consumption for Deutz engines is between .3% and .75% of the fuel consumption at part load.
- Measure the amount of oil consumed in one full tank of fuel, divide the gallons of fuel into the gallons of oil.

Example: (.25 gallon oil / 20 gallon fuel) x 100 = 1.25%

WHAT WOULD CAUSE THIS HIGH CO READING?



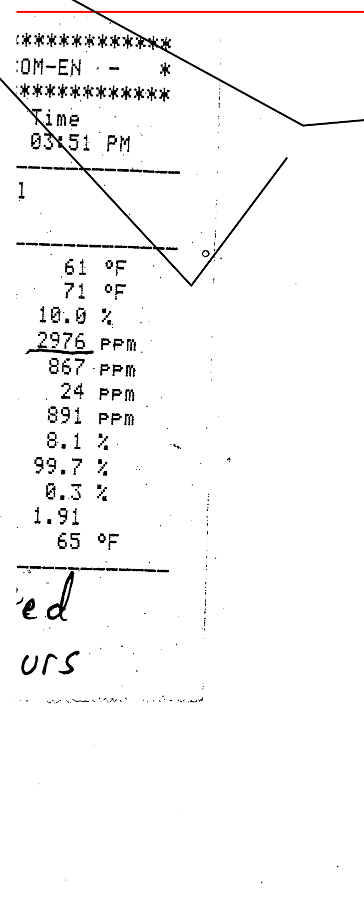
****
* - rbr ECOM-EN - *
****

Date	Time
04.20.05	04:02 PM

Type of fuel
Diesel Oil

T.Air	63	°F
T.Gas	96	°F
O2	9.8	%
CO	165	ppm
NO	638	ppm
NO2	22	ppm
NOx	660	ppm
CO2	8.2	%
Eta	98.8	%
Losses	1.2	%
Lambda	1.88	
Sen.temp.	68	°F

Untreated
266 Hours



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OM-EN - *
****
Time
03:51 PM
l

61	°F
71	°F
10.0	%
2976	ppm
867	ppm
24	ppm
891	ppm
8.1	%
99.7	%
0.3	%
1.91	
65	°F

ed
urs

HIGH CO SHOWN ON TREATED AND UNTREATED (NOTICE TREATED CO EXCEEDS 100 PPM)

****
* - rbr ECOM-EN - *
****

Date 04.27.05
Time 03:51 PM

Type of fuel
Diesel Oil

T.Air	61	°F
T.Gas	71	°F
O2	10.0	%
CO	2976	ppm
NO	867	ppm
NO2	24	ppm
NOx	891	ppm
CO2	8.1	%
Eta	99.7	%
Losses	0.3	%
Lambda	1.91	
Sen.temp.	65	°F

Untreated
280 Hours

****
* - rbr ECOM-EN - *
****

Date 04.28.05
Time 03:22 PM

Type of fuel
Diesel Oil

T.Air	70	°F
T.Gas	702	°F
O2	10.0	%
CO	135	ppm
NO	1155	ppm
NO2	41	ppm
NOx	1196	ppm
CO2	8.1	%
Eta	74.5	%
Losses	25.5	%
Lambda	1.91	
Sen.temp.	70	°F

ECOM America Ltd.
1628 Oakbrook Drive
Gainesville
Georgia 30507
Tel. 770-532.3280
Fax: 770-532.3620
Toll-Free 877-326-6411
www.ecomusa.com

Treated
280 Hours

CHECK AIR FILTER

- HIGH CO INDICATED A RICH FUEL MIXTURE
- THE INTAKE AIR RESTRICTION WAS 15” (26” IS MAXIMUM) WHICH WAS FINE. AIR FILTER WAS CHECKED AND APPEARED CLEAN BUT WAS CHANGED AS A PRECAUTION.
- A 3RD TEST WAS RAN WITHOUT AIR FILTER AND THE CO CAME DOWN FROM 2,976 PPM TO APPROXIMATLEY 2,700 PPM WHICH IS NOT ACCEPTABLE

CHECK 100 HOUR SERVICE, PRE-OP AND WEEKLY SERVICE MANUALS FOR INDICATION OF A PROBLEM

- RECORDS DID NOT INDICATE EXCESSIVE OIL CONSUMPTION
- SERVICE RECORDS INDICTED A 100 HOUR SERVICE AT 200 HOURS.
- THE CO WAS WITHIN RANGE AT 200 HOURS
- ALL FLUIDS WAS CHANGED AT 200 HOURS
- THE AIR FILTER WAS CHANGED AT 200 HOURS
- **<u>THE OIL FILTER WAS NOT CHANGED AT 200 HOURS</u>**
- **<u>THE FUEL FILTER WAS NOT CHANGED AT 200 HOURS</u>**

FUEL FILTER

- A DIRTY FUEL FILTER WOULD ACTUALLY CREATE A LEAN FUEL SITUATION, CAUSING A LOWER THAN NORMAL CO LEVEL.
- THE FUEL FILTER WAS CHANGED AS A PRECAUTION. THE LOAD TEST WAS PERFORMED AGAIN WITH NO CHANGE IN THE CO.

OIL AND OIL FILTER

- THE OIL AND OIL FILTER WAS CHANGED.
- THE LOAD TEST WAS DONE ONCE AGAIN WITH THE FOLLOWING RESULTS.

THE CO CAME DOWN FROM 2,976 PPM TO 112 PPM

BEFORE OIL & FILTER WAS CHANGED

```
**********************
* -  rbr ECOM-EN  -  *
**********************
Date          Time
04.27.05      03:51 PM
--------------------------
Type of fuel
Diesel Oil
--------------------------
T.Air            61  °F
T.Gas            71  °F
O2             10.0  %
CO             2976  ppm
NO              867  ppm
NO2              24  ppm
NOx             891  ppm
CO2             8.1  %
Eta            99.7  %
Losses          0.3  %
Lambda         1.91
Sen.temp.        65  °F
--------------------------
```

Untreated
280 Hours

AFTER OIL & FILTER WAS CHANGED

```
**********************
* -  rbr ECOM-EN  -  *
**********************
Date          Time
04.28.05      04:31 PM
--------------------------
Type of fuel
Diesel Oil
--------------------------
T.Air            68  °F
T.Gas            67  °F
O2             10.1  %
CO              112  ppm
NO             1097  ppm
NO2              42  ppm
NOx            1139  ppm
CO2             8.0  %
Sen.temp.        65  °F
--------------------------
```

Untreated
280 Hours

IT WAS DETERMINED THAT THE DIRTY OIL FILTER CAUSED THE HIGH CO LEVEL. WHY?

- AS THE OIL FILTER BECOMES DIRTY, OIL IS ALLOWED TO BYPASS AROUND THE FILTER TO PROTECT THE ENGINE.
- HYDROCARBONS FROM THE UNFILTERED OIL ESCAPES THROUGH THE RINGS ON THE PISTON AND CREATES AN EXTREMELY HIGH CO CONDITION.

REASONS FOR HIGH CO

- DIRTY AIR FILTER
- DIRTY OIL AND/OR OIL FILTER
- WRONG TYPE OF FUEL
- EXCESSIVE OIL CONSUMPTION
- DPM FILTER INSTALLED BACKWARDS
- DEFECTIVE CATALYST
- INJECTOR PROBLEMS

Who is DST®

Dry Systems Technologies®

DST® is the Leading Manufacturer of Diesel Power Packages for Underground Coal Mines.

DST® exclusively Manufactures and sells the patented "Dry System®" and Low Temperature Exhaust Filtration System.

DST® Offices and Warehouses are located in Woodridge, Illinois and DST® is represented on three Continents.

Dry Systems Technologies®

The Original – and still the Best™

Dry Systems® are designed and manufactured in the USA and available directly from the manufacturer.

More than 300 DST Dry Systems® are in operation at more than 30 mines worldwide with more than 1,000,000 hrs incident free operation.

Dry Systems® have been in continuous service since 1992 and some have accumulated more than 25,000 operating hours.

Dry Systems® are MSHA Approved for Inby and Outby use in underground Mines and Tunnels.

Dry Systems® are available for many older and new Mining Engines from 35 to 350 Hp.

What is the Dry System®

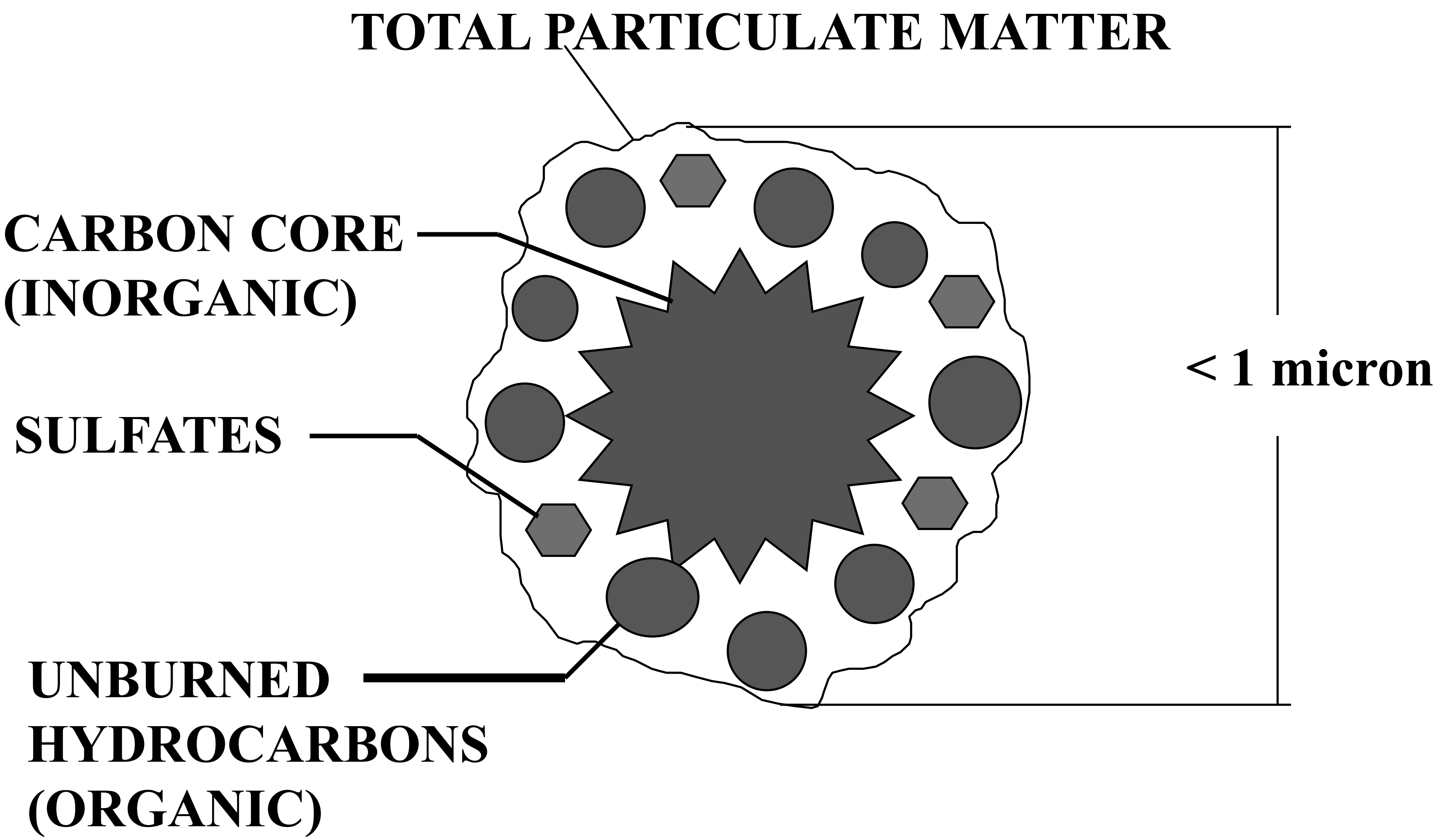
The Dry System® is the most efficient and economical Technology for Mining to reduce DPM from Diesel Engines.

The Dry System® is a safe and maintenance friendly replacement for Water Scrubbers and meets all current and proposed MSHA Regulations.

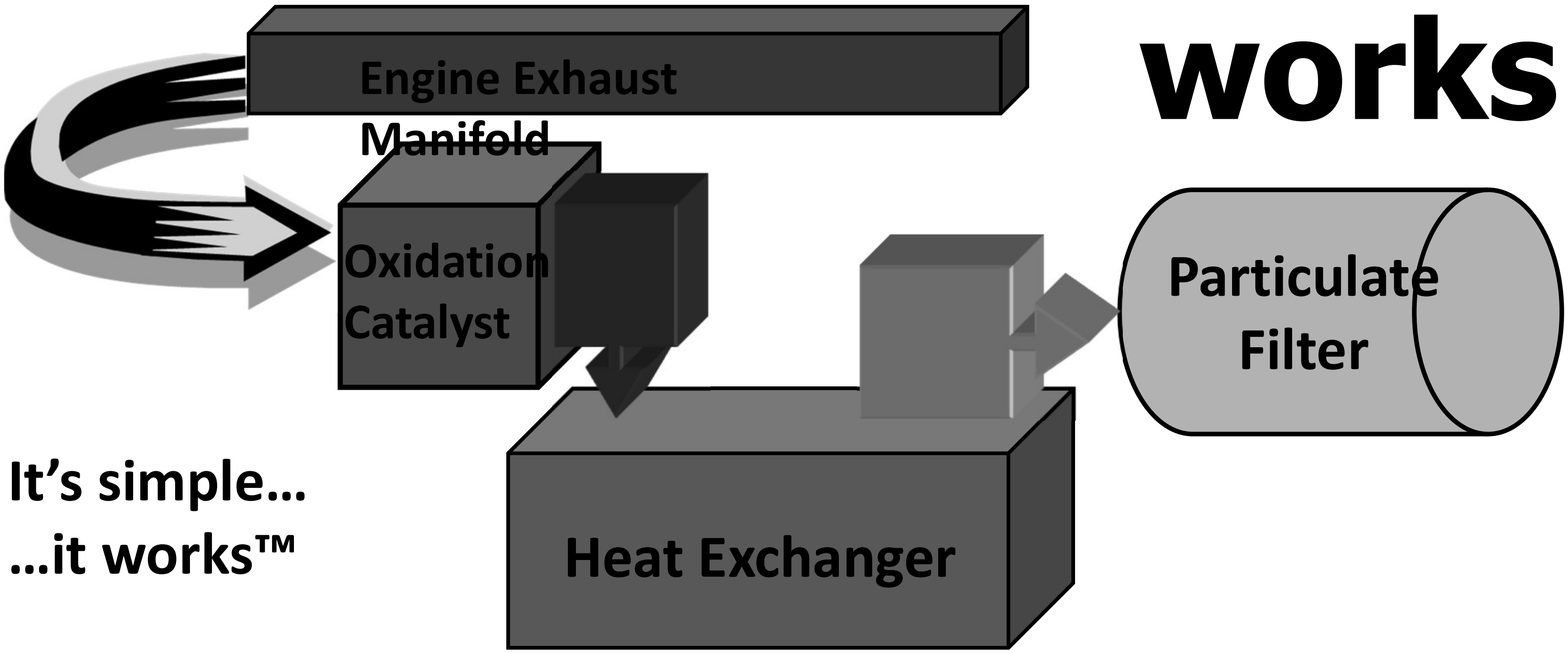
The Dry System® is an economical and proven alternative to Particulate Traps for Outby Equipment in Mining.

The Dry System® is manufactured and marketed exclusively by Dry Systems Technologies®.

DPM COMPOSITION



How the Dry System® works



It's simple…
…it works™

Unmatched Performance

- 96% DPM Removal
- 90% CO Reduction
- 97% SO2 Removal
- No Increase of NOx

APPROVED AND
OPERATING ON
THREE CONTINENTS

Main Components of the Inby (Part 7F) Dry System®

- **Water-cooled Oxidation Catalyst**
- **Water-cooled Heat Exchanger**
- **Mechanical Intake and Exhaust Flame Arrestor**
- **Low Temperature Particulate Filter (DPF)**
- **Integrated Cooling System**
- **Water-cooled Exhaust Manifold**
- **Complete Safety Shut-down System and Gauges**
- **CO Monitoring Port**
- **Onboard Cleaning System**

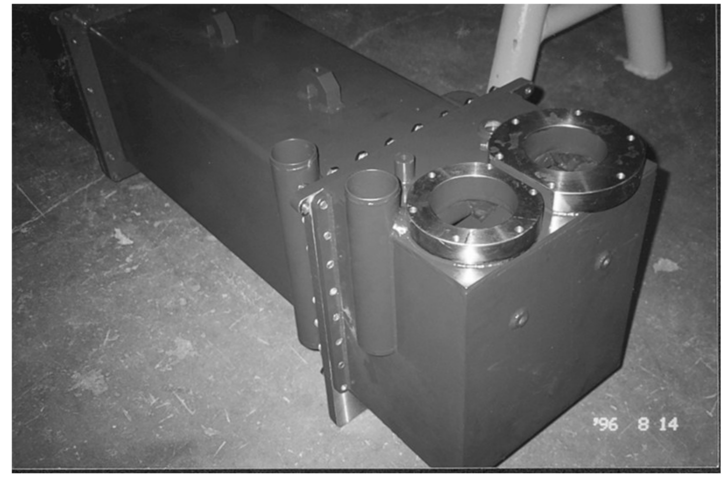
The DST® water-cooled Oxidation Catalyst

The DST water-cooled Catalyst uses a proprietary formulation and heat shielding specially developed for the needs of the Mining Industry.

The DST Catalyst reduces 90% Carbon Monoxide (CO), 80% Unburned Hydrocarbons from Fuel and Oil (HC) and removes Diesel Odors.

The DST Catalyst is formulated that it will not increase in Oxides of Nitrogen.

The DST® Heat Exchanger



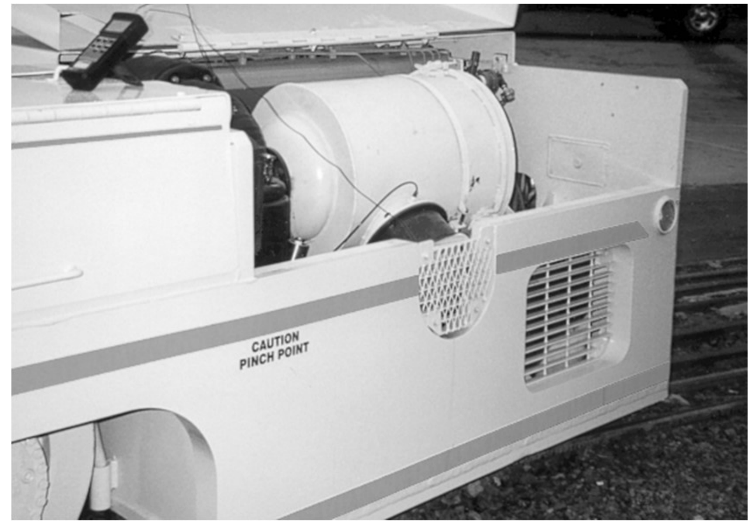
Cools the Exhaust Gas to 260°F before entering the Low Temperature Filter.

Can be sized to fit tight spaces and can be remotely mounted into existing Equipment.

Cooled through the Engine Cooling or a separate Cooling System.

Incorporates an On-Board Cleaning System to prevent fouling.

The DST® Low Temperature Diesel Particulate (DPM) Filter



- **DST® Filters are manufactured and stocked in Illinois.**
- **Three sizes match a wide range of Engines.**
- **Unique construction for superior Filter Life**
- **Filter cost to operate is very competitive**
- **Disposable without special requirements and minimizes exposure during handling.**
- **Will not generate smell from off-gasses.**

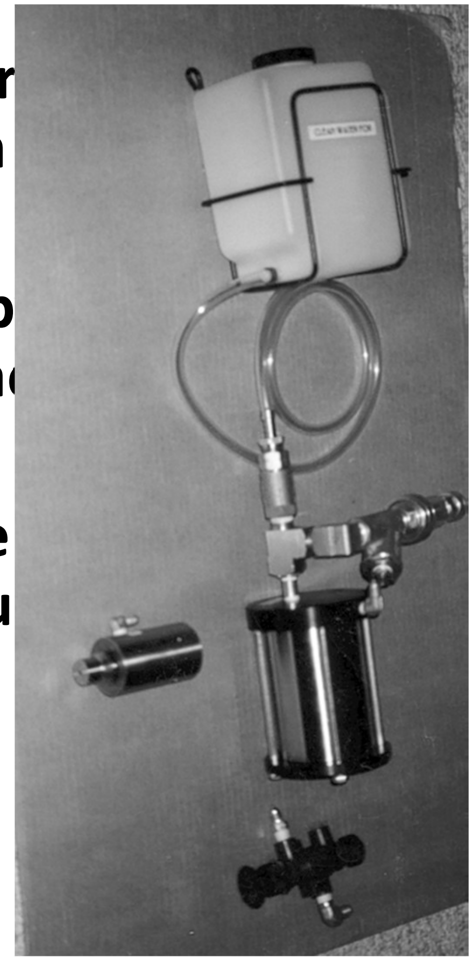
On-board Cleaning System™

The patented On-Board Cleaning System r
Soot build-up inside the Exhaust System
operation.

It is activated with a Cab mounted Knob b
Operator without having to stop the Ma
operation.

It uses compressed air, hydraulic pressure
electric power and uses less than one cu
clean water/day.

The On-Board Cleaning System generates
Emissions and can be used anytime and
anywhere in the Mine

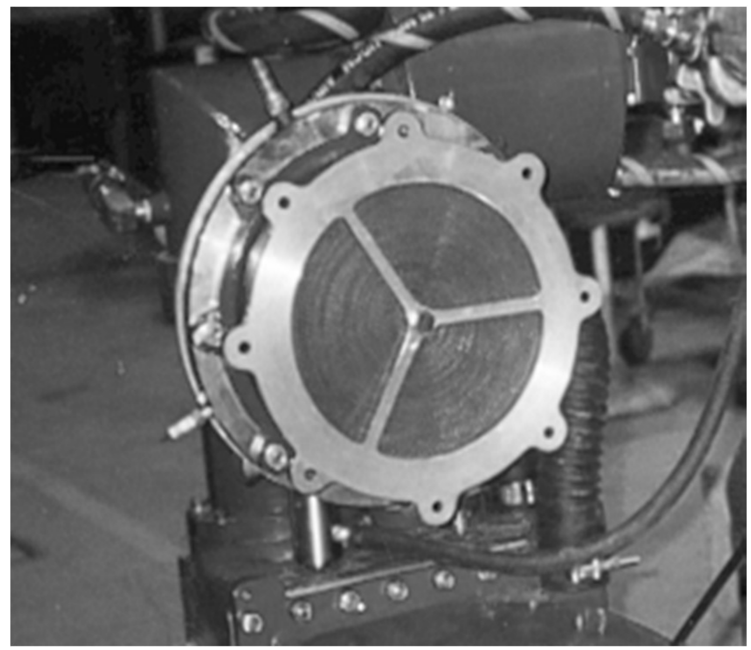


In-Cab CO Monitoring

- **Convenient Location**
- **No second Person needed for Test**
- **No Ports to remove**
- **MSHA Approved to meet Part 75.1914**
- **Uses handheld CO Monitors**

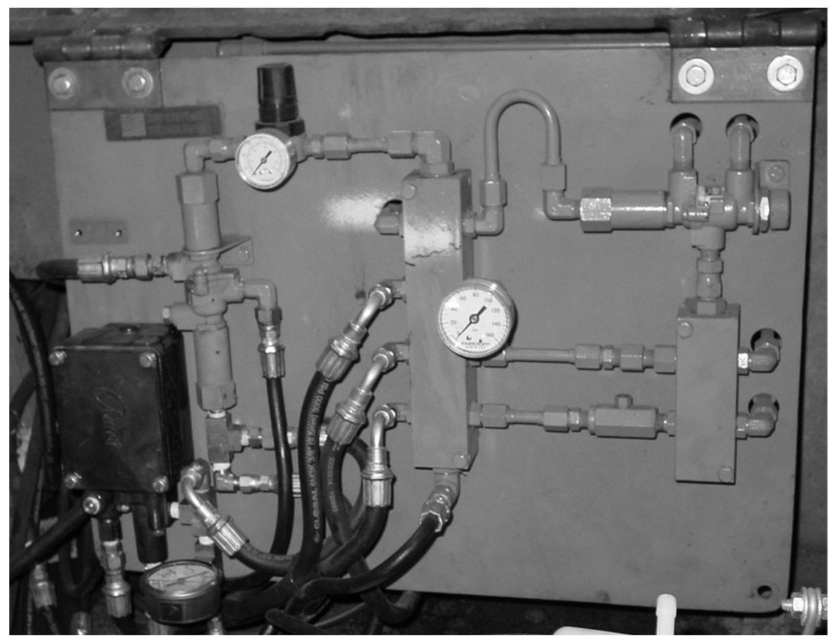
Mechanical Flame Arrestor
for Intake and Exhaust System

- **Mechanical Design with no moving Parts**
- **Large openings limit fouling**
- **MSHA tested and Approved**



The DST® Safety Shut-down System

- **Simple, reliable pneumatic and mechanical components**
- **Modular control Panel**
- **Calibration only every six months**



DST MANAGEMENT SYSTEM™

A DIESEL EMISSIONS CONTROL SYSTEM

- **THE DST MANAGEMENT SYSTEM™ IS A COMPLETE PACKAGE, NOT AN ADD-ON COMPONENT.**
- **AS A COMPLETE PACKAGE, ALL COMPONENTS ARE TUNED TO WORK TOGETHER FOR MAXIMUM REDUCTIONS OF ALL EMISSIONS.**
- **THE DST MANAGEMENT SYSTEM™ WILL PROVIDE SIGNIFICANT REDUCTION OF ALL DIESEL EMISSIONS UNDER ALL OPERATING CONDITIONS.**

DST Management System™

- **A SPECIALLY FORMULATED OXIDATION CATALYST REMOVES UP TO 90% OF THE UNBURNED HYDROCARBONS AND DRIES THE SOOT FOR BETTER FILTER PERFORMANCE. THE CATALYST ALSO REMOVES MOST OF THE DIESEL ODOR**

- **RAPID EXHAUST GAS COOLING INSIDE THE HEAT EXCHANGER ENCOURAGES AGGLOMERATION OF THE SMALL SOOT PARTICLES INTO LARGER PARTICLES THAT ARE EASIER TO CAPTURE IN THE FILTER**

- **THE DISPOSABLE PAPER FILTER CAPTURES MORE THAN 96% OF ALL PARTICULATE MATTER UNDER ALL OPERATING CONDITIONS**

- **SULFATES FROM THE FUEL SULFUR, ADHERE TO THE CARBON CORE OF THE DIESEL PARTICULATES AND ARE CAPTURED IN THE FILTER**

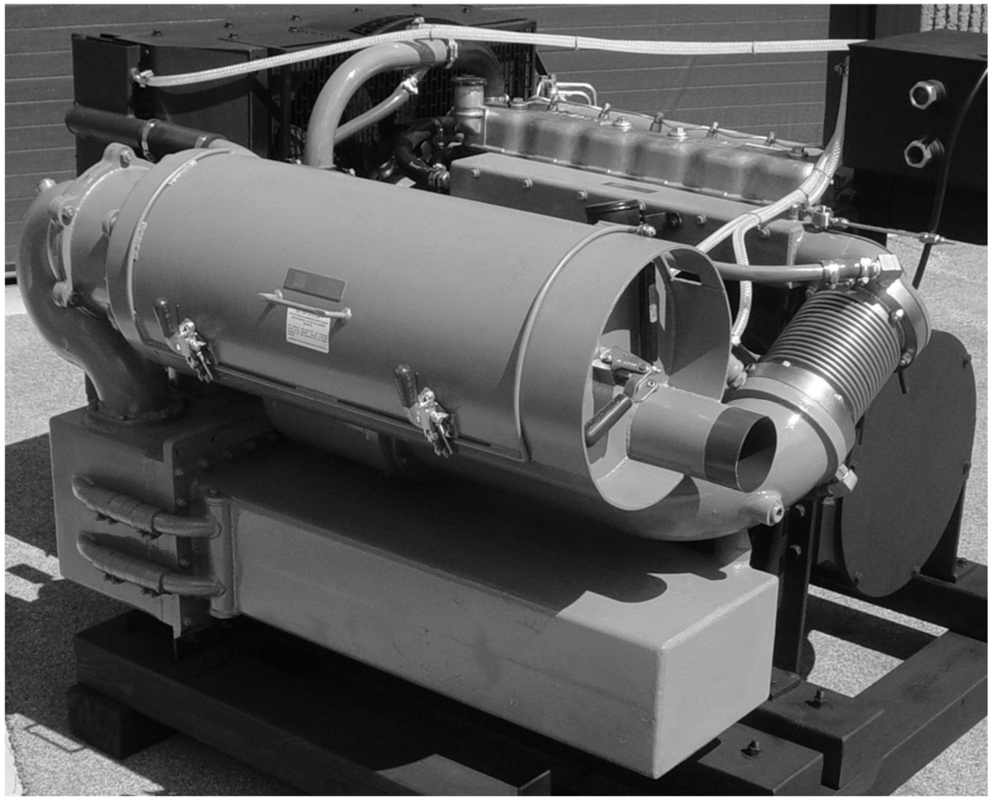
DST Management System™

- **A SPECIALLY FORMULATED OXIDATION CATALYST PROVIDES FOR UP TO 96% REDUCTION IN CARBON MONOXIDE BEFORE DISCHARGE.**
- **RAPID EXHAUST GAS COOLING INSIDE THE HEAT EXCHANGER LIMITS THE FORMATION OF NITROGEN DIOXIDE.**
- **FINAL DILUTION WITH THE AIR FROM THE COOLING FAN AWAY FROM THE OPERATOR PROVIDES FOR LOW AMBIENT LEVELS OF OXIDES OF NITROGEN AND CO NEAR THE MACHINE AND PREVENTS ACCUMULATION OF EMISSIONS AROUND THE OPERATOR.**

DST Maintenance Requirements

- **Manually activate water injection system under engine full load at least once each operating shift**
- **Observe recommended engine exhaust backpressure**
- **Observe recommended engine intake restriction**
- **Change exhaust and intake filters when indications warrant**
- **Manually flush heat exchanger as needed**
- **Weekly permissibility required**

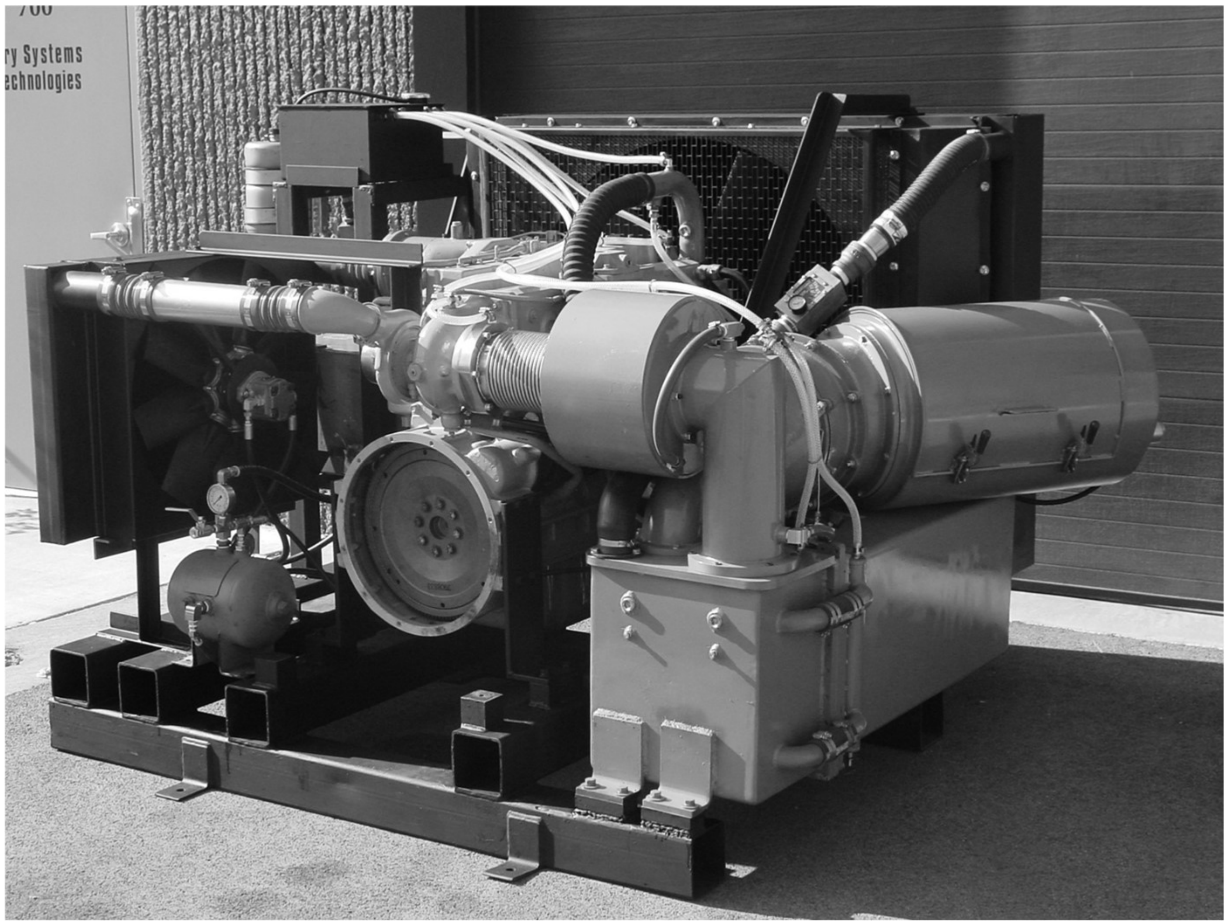
Engine: MSHA Part 7E-A006 Approved
Power Package: MSHA Part 7F -021-0 Approved



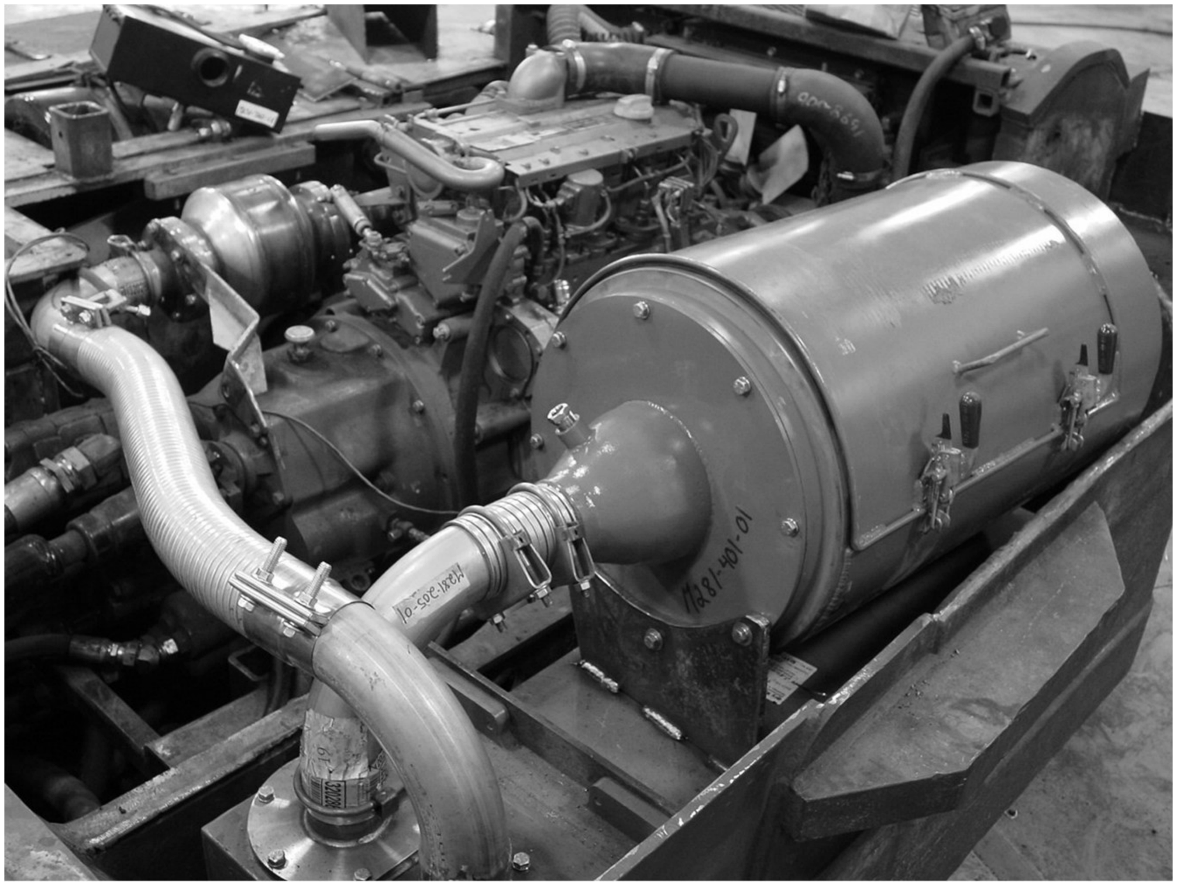
M150 DST Dry System® Diesel Power Package installed on a 116 Hp Isuzu 6BG1 Diesel Engine

Jeffrey 4110 Ramcar re-powered and rebuilt by DST®

185 Hp Cummins C8.3 Engine with Dry System® installed



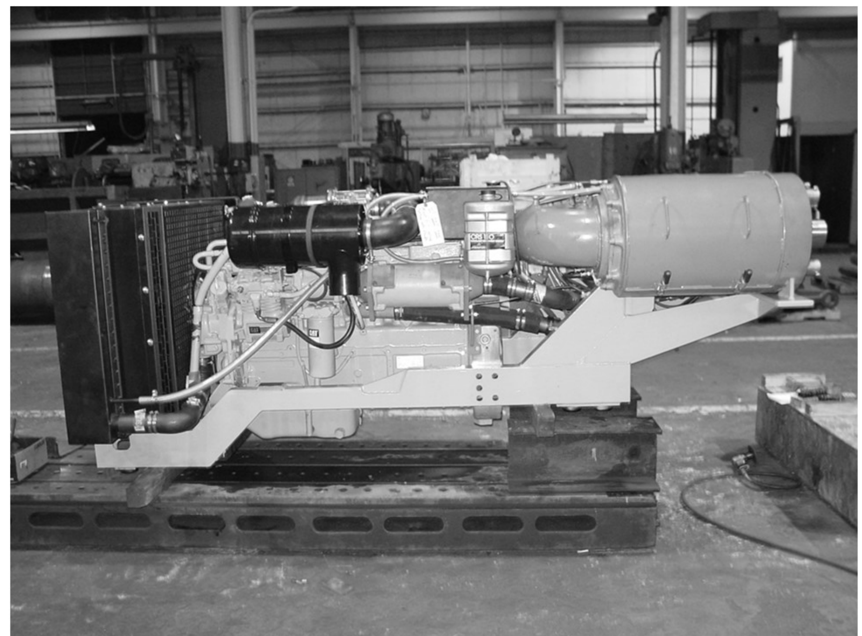
Outby Dry System® installed on a
113 Hp Deutz BF4M 1012 engine



Heavy Duty Outby System operating in Kentucky

DRY SYSTEMS TECHNOLOGIES®

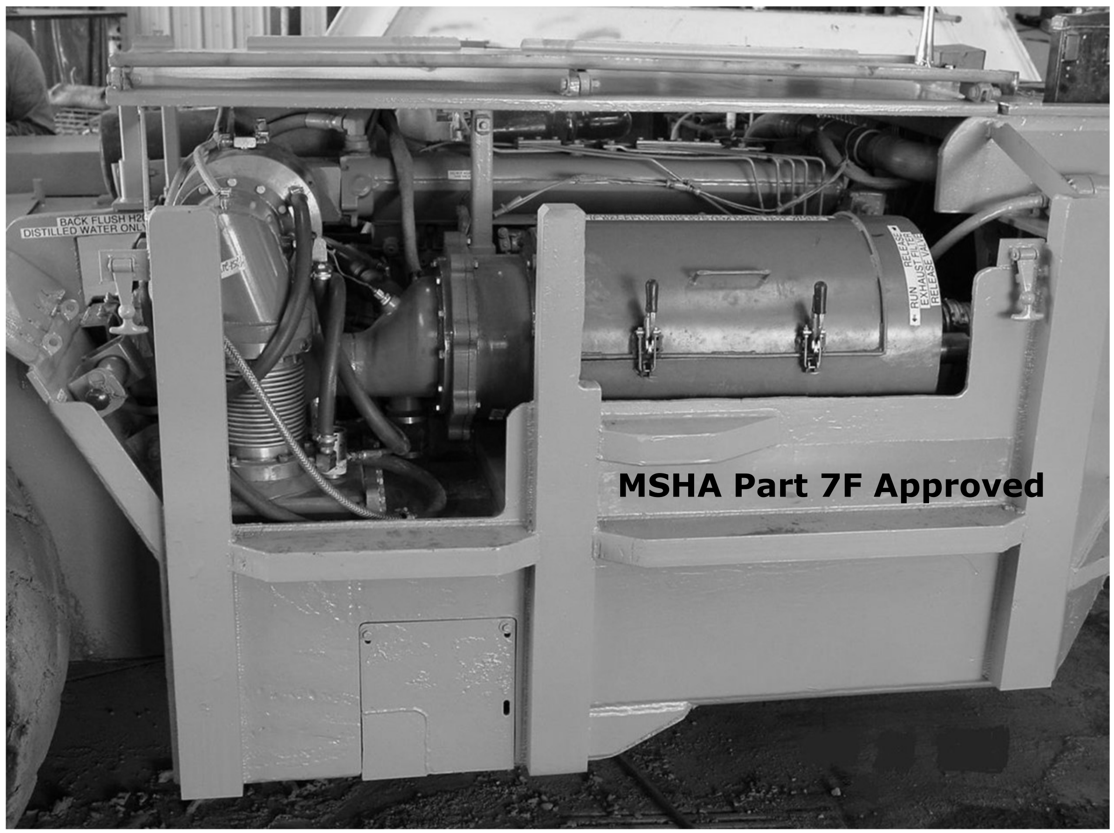
Dry System® installed on a Goodman Locomotive with a 150 Hp Caterpillar 3306 PCNA Engine



MSHA Part 7F Approved

Operating in California since 2001

Dry System® installed on a Wagner LST-5S Scoop with 150 Hp Caterpillar 3306 Engine



Operating in New Mexico, Colorado, Illinois and West Virginia since 2003

WV MINING COMPANY, INC
No.1 Mine

PERMIT NO. U-000-09

DIESEL PLANS AND APPLICATION FOR

1- Damascus Mac-10D WV Personnel Carrier

ENGINE # 1

January 12, 2009

SAMPLE PERMIT

West Virginia Diesel Commission

Application for Underground Diesel Equipment Approval

Instructions:

- **For each piece of Diesel Equipment submitted, a completed Inventory Sheet, DPM Calculation Sheet and 8-Mode Test Sheet shall accompany the submittal.**
- **A Maintenance or Training Plan need not be submitted with each request once the initial Maintenance or Training Plan is approved by the WV Diesel Commission. In cases where an approved Maintenance or Training plan(s) exist, a statement in the submittal stating that the approved plans exists for the specific mine ID and referenced initial approval date of the respective plan(s).**
- **A cover letter addressed to the WV Diesel Commission c/o the Administrator shall accompany the submittal and outline the nature of the request.**
- **A picture (if possible) of the equipment is desired with the submission**
- **The operator will submit the plans to the Administrator, for distribution to the parties responsible for reviewing the package and subsequent recommendation for approval to the WV Diesel Commission.**
- **Upon the recommendation for approval and final review, the Diesel Commission will issue an Order of Approval allowing the equipment to be placed into service.**

NOTE: To obtain Diesel Inventory, Maintenance, and Training forms go to www.wvminesafety.org click on forms (Left side of screen), then click on Diesel Forms (Middle of screen).

WV MINING COMPANY, INC
No.1 Mine
January 12, 2009

PERMIT NO. U-000-09

DIESEL PERMIT APPLICATION

Table of contents

Request Letter

WV MINING COMPANY, INC.

No.1 mine

U-000-09

P.O. Box 100
Oak Hill, WV 29076

January 12, 2009

WV Diesel Commission
Joel Watts, Administrator
1615 Washington Street East,
Charleston, WV 25311

Dear Sirs:

WV Mining Co., INC. wishes to submit a Diesel Inventory, Maintenance and Training plan enclosed in this binder to gain approval to operate one Damascus Corporation diesel powered model Mac 10D WV personnel carrier at our No.1 Mine.

The machine is identified as follows:

Engine No. 1	Mac 10 D WV	Machine Serial# 101

If additional information is required please feel free to contact me at (304) 123-4567.

Sincerely,

Jim Smith

Jim Smith
Safety Director, WV Mining Co., INC.

Diesel Inventory

West Virginia Diesel Commission

Revised 9/2006

Diesel Inventory

Date: January 12, 2009

Name of Company: WV Mining Co., INC. Permit Number: U-000-09

Name of Mine: No.1 Mine

Address: P.O. Box 100
Oak Hill, WV 29076

Person Responsible for Maintenance and Testing of Diesel Equipment at this Location: John Buck (Maintenance Supt.)

Phone Number: (304) 123-4567

I. Engine #1 Damascus Mac-10D WV Personnel Carrier S/N 101

Manufacturer	**Deutz**	**High Idle (RPM)**	**3,100 RPM**
Manufacturer Address	**3883 Steve Reynolds Blvd. Norcross GA. 30093**	**Particulate Index (PI)**	**2,500 CFM**
Engine Model No.	**BF4M2011**	**Gaseous Ventilation Rate (CFM)**	**6,000 CFM**
Engine Serial No.	**10109231**	**Raw DPM (gr/hr)**	**3.7 gr/hr**
HP/RPM	**87 HP @ 2800 RPM**	**MSHA Part 7 Approval No.**	**07-ENA040004-1**
Clean Intake Air Restriction (H^2O)	**5 to 20 inches**	**Est. Ambient Level w/ after-treatment (mg/m^3)**	**.047 mg/m3**
Max. Dirty Intake Air Restriction (H^2O)	**26 inches**	**Type of Aspiration**	**Turbocharged**
Max. Allowed Backpressure H^2O	**30 inches**	**Fuel Delivery System**	**Mechanical Pump**
Turbocharger Boost Pressure (psi)	**20.8 psi**	**Fuel Specifications**	**Meets Latest Over The Road Fuel Standards**
Low Idle (RPM)	**900 RPM**	**Untreated CO**	**142 ppm**

 (The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.)

West Virginia Diesel Commission

II. Filter System

Manufacturer	Engine Control Systems
Manufacturer Address	165 Pony Drive Newmarket, Ontario, Canada L3Y7V1
Model Number	ECS S/9 (Silicon Carbide)
Serial Number	B12345 and (spare filter B54321)
System Type	Electrically-Assisted Off Board Regeneration
System Composition	Silicon Carbide
Efficiency Rating	87%
Type of Regeneration	Electrical- 1 hour

III. Catalyst

Manufacturer	Engine Control Systems
Manufacturer Address	165 Pony Drive Newmarket, Ontario, Canada L3Y7V
System Name	AZ Purifier
Model Number	Model 7 AZ
Serial Number	B98765
Average CO Reduction	83 – 90%
Estimated CO at Tailpipe	14 to 24 ppm

 (The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan

West Virginia Diesel Commission

IV. Regeneration System

Manufacturer	Engine Control Systems
Manufacturer Address	165 Pony Drive Nemarket, Ontario, Canada L3Y7V
System Name	Combiclean
Model Number	S/9
Serial Number	B45678
System Type	Off-Board Electrical

Test data such as ISO 8178 laboratory tests or other third party test data shall be attached to this document as part of the inventory submittal.

 (The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.)

Engine Specifications

BF4M2011 Specification data

General

Cylinders	4	
Cylinder arrangement	Vertical in-line	
Bore	94 mm	3.7 in.
Stroke	112 mm	4.4 in.
Cylinder Displacement	0.777 liter	47.4 $in.^3$
Total displacement	3.108 liter	190 $in.^3$
Compression ratio	17.5:1	
Combustion system	Direct Injection	
Aspiration	Turbocharged	

Fuel system

Lift pump suction head, max	3 m	118.1 in.
Lift pump flow @max rpm	53.1 l/h	14.0 GPH
Max restriction in fuel supply line	300 mbar	120 in. H_2O
Max restriction in fuel return line	200 mbar	80 in. H_2O
Max restriction in fuel pre-filter	200 mbar	80 in. H_2O
Fuel filter type	Replaceable cartridge	
Fuel consumption @ max rating	17.7 l/h	4.7 GPH
Fuel consumption @ peak torque	11.1 l/h	2.9 GPH

Combustion air system

Combustion air flow @ max rating	370.0 m^3/h	217.7 CFM
Max allowable clean restriction	50 mbar	20 in. H_2O
Max allowable dirty restriction	65 mbar	26 in. H_2O

Exhaust system

Exhaust gas flow @ max rating	965.0 m^3/h	567.9 CFM
Exhaust temp @ max rating	550 °C	1022 °F
Max allowable back pressure	75.0 mbar	30 in. H_2O

Cooling system

Type	External oil cooling	
Coolant flow rate @ max rpm	2400.0 l/h	10.6 GPM
Coolant heat rejection % of gross power	60%	
Max coolant temp @ engine outlet	135 °C	275 °F
Max coolant operating pressure	7 bar	101.5 psi
Coolant volume in engine (std. oil sump)	13.0 liter	13.7 qt.

Lubrication system

Lubrication type	Forced-feed lubrication	
Oil flow at max rpm	40.0 l/min	10.6 GPM
Oil pump relief valve setting	7 bar	102 psi
Max oil temperature in oil sump	130 °C	266 °F
Filter volume	0.4 liter	0.423 qt.
Oil change interval	500 hours	

Electrical

Starter motor	12V, 2.3kw	24V, 4.0kw
Max battery CCA	950A	750A
Voltage drop, battery (+), max	1.0V	

Physical data

Length	718 mm	28.3 in.
Width	553 mm	21.8 in.
Height	703 mm	27.7 in.
Weight, dry	247 kg	543.4 lb.
Max bending @ housing:	900 Nm	663.3 lb-ft
Max force @ flywheel:		
Axial:	1500 N	337.8 lb.
Radial:	3700 N	833.3 lb.

Performance data

Peak torque	270 Nm	199.0 lb-ft
@ rpm	1600	
low idle speed	900 rpm	

Gross power		Genset	Variable speed		
Engine RPM		1800	2300	2500	2800
kW, intermittent	(LTP)		56.0	60.0	65.0
Hp, intermittent		0.0	76.2	81.6	88.4
kW , continuous	(COP)	46.4	53.0	57.0	62.0
Hp, continuous		63.1	72.1	77.5	84.3
Fuel consumption					
g/kWhr		204.5	210.5	219.0	230.0
lb/hphr		0.335	0.345	0.359	0.377
Combustion air					
m^3/h		220.0	270.0	300.0	370.0
CFM		129.5	158.9	176.6	217.7
Exhaust gas					
m^3/h		600.0	728.0	815.0	965.0
CFM		353.1	428.4	479.6	567.9
Coolant					
l/h		1860.0	2160.0	2280.0	2400.0
GPM		8.2	9.5	10.0	10.6
Heat rejection to coolant					
kW		29.3	33.6	36	39.0
BTU/min		1666.6	1911.2	2047.7	2218.3

Noise, dB(A)

Avg. @ 1 meter

Certifications

U.S. EPA Non Road Tier 2
European COM 1 (37 - 75 KW)
and COM 2 (18 - 37 KW)

Engine De-rate And Exhaust Cooling info.

Exhaust Cooling Information

Exhaust surface temperature is kept below 302 degrees F. by customized blanketing material that extends through the engine and transmission compartment. Exhaust surface and exhaust gas temperature continues to be cooled within an air-to-air fan driven chiller compartment. Finally, a Nett Model 20 diluter further cools the exhaust gas temperature as it reaches the outside atmosphere. This system is designed to meet the 302 degree F. surface and exhaust gas temperature standard and repeatable five-minute load-testing standard of West Virginia.

Engine De-rate Letter

Fuel Injection Specialists

BLUE RIDGE DIESEL INJECTION, INC.
1016 DELAWARE STREET
P.O. BOX 867
SALEM, VA. 24153
1-540-389-7296
WATTS # 1-800-476-0456 FAX # 1-540-387-2792

ADS ASSOCIATION OF DIESEL SPECIALISTS

Walter Stuart
Damascus Corp.
26864 Watauga Rd.
Abingdon, VA. 24211

Sample

Walter Stuart, Chuck Phibbs

All diesel engines approved after promulgation of the new rule from MSHA (April 2004) need to be de-rated for elevations above 1000 ft.

The maximum operating altitude of 1000 ft. has been established by MSHA at the engine's approved HP and RPM. Operating altitudes of greater than 1000 ft. elevation require that the engine be de-rated 1% per 328 ft. of elevation above the 1000 ft. limit.

The purpose of this letter is to address the MSHA altitude de-rate required for Deutz engine model # BF4M2011, Serial # 101 MSHA Approval # 07-ENA040004 approved with 87 HP @ 2800 RPM to 1000 FT. This engine is currently rated at 82 HP which is a de-rate of 5.3% from the MSHA approved power.

5.3 % x 328 ft = 1738.4 ft over 1000 ft, i.e. engine is good up to 2738.4 ft altitude before additional de-rating is required.

Sincerely,

Sample

Willard "Mulie" Craighead
Sales Manager
Blue Ridge Diesel Injection Inc.
1016 Delaware St. Salem, VA 24153
Phone: (540) 389-7296
FAX: (540) 387-2792
e-mail: sales@blueridgediesel.com

Calculations & 8-Mode

DPM CALCULATION SHEET

Engine Model	Deutz BF4M2011 (87 HP)
MSHA Number	07-ENA040004-1
Ventilation Rate	6,000 CFM
Filter Type	Model ECS S-9 Silicon Carbide
Filter Efficiency	87%

<u>CONVERT DPM FROM (grams/hr) to (mg/min)</u>

(3.7 g/hr) ÷ (1hr/60 min) X (1,000mg/g) = 61.67 mg/min

<u>CONVERT VENTILATION RATE FROM (CFM) TO (m^3/min)</u>

(6,000 ft^3/min) X (.028315 m^3/ 1ft^3) = 169.89 m^3/min

<u>DIVIDE DPM (mg/min) BY VENTILATION RATE (m^3/min.)</u>

(61.67 mg/min) ÷ (169.89 m^3/min) = <u>.363 mg/m^3</u>

<u>SOLVE FOR AMBIENT DPM LEVEL AT 87% FILTER EFFICIENCY</u>

.363 mg/m^3 X (100% - 87% Filter Efficiency) = <u>**.047 mg/m^3**</u>

<u>*ESTIMATED TREATED CO AT TAILPIPE*</u>

Catalyst Efficiency 83% - 90%

Raw CO in PPM 142 PPM (Obtained from Mode 5 of MSHA 8 mode test)

Treated CO = (Raw CO) X (Catalyst Efficiency)

Treated CO = 142 PPM X .10 = <u>**14 PPM CO**</u>

<u>**(14 – 24 PPM CO)**</u>

Treated CO = 142 PPM X .17 = <u>**24 PPM CO**</u>

C1 - Test

Motorhersteller:	Deutz AG
Motortyp:	BF4M2011
Ausführung:	Code CE65
Motorprüfstand:	E12

Datum:	21./26.04.04
Ort:	Köln - Porz

DEUTZ

Ingenieur:	Rauscher
Prüfstandsfahrer:	Schumacher
Test-Nr.:	rau..0 / rau..2

Certification for MSHA, calculation of ventilation rates

		Gross power					
Engine type:	BF4M2011	65,00 kW at	2800	1/min	Eng.No: 882 728	Date:	21./26.04.04
Engine Code:	Code CE65						

Fuel Data:	m.% C:	86,200	m.% H:	13,300	m.% S: 0,033	m% O:	0,000
Stoich Air Demand, kg/kg fuel:		14,4812			Densitiy, kg/dm^3 at 15 °C:		0,8428

Mode			1	2	3	4	5	6	7	8
Speed	n	1/min	2800,0	2800,0	2800,0	2800,0	1680,0	1680,0	1680,0	900,0
Torque		%	100,0	75,0	50,0	10,0	100,0	75,0	50,0	0,0
Torque calculated		Nm	221,7	166,3	110,8	22,2	270,0	202,5	135,0	0,0
Torque observed		Nm	225,0	169,9	115,5	24,2	273,4	208,4	140,4	0,5
Fuel mass flow	B	kg/h	16,8612	12,60	9,03	3,88	10,94	8,14	5,62	0,56
Water content of intake air	ha	g/kg	6,07	6,03	6,01	6,11	5,95	5,78	5,79	5,77
Air mass flow, dry	GAIRD	kg/h	422,456	382,519	339,270	274,217	222,552	200,644	184,154	88,255
Air mass flow, wet	GAIRW	kg/h	425,0	384,6	341,3	275,9	223,9	201,8	185,2	88,8
Temp air intake		°C	26,5	26,9	26,7	26,2	26,7	27,1	27,0	26,7
Lab atmospheric factor	fa		1,0024	1,0042	1,0031	1,0008	1,0031	1,0050	1,0044	1,0029
Exhaust mass flow, wet	GEXH	kg/h	441,9	397,4	350,3	279,8	234,8	209,9	190,8	89,3
Fuel to air ratio	f/a	kg/kg	0,03991	0,03294	0,02661	0,01414	0,04918	0,04058	0,03054	0,00631
Dry to wet correction factor	J		0,9160	0,9291	0,9410	0,9642	0,8989	0,9152	0,9340	0,9793
Humidity correction factor NOx	FHUM		0,936	0,924	0,915	0,901	0,950	0,933	0,917	0,881
HC, wet	HC	ppmC1	68,2	33,7	71,8	223,3	48,1	41,7	70,4	129,8
CO, dry	CO	ppm	159,0	89,3	113,2	435,9	158,0	83,7	97,2	174,5
CO2, dry	CO2	%	8,64	7,19	5,70	2,82	10,73	8,78	6,54	1,33
NOx, dry	NOx	ppm	772,6	594,6	382,6	169,0	1072,6	897,2	550,3	149,2
NO2, dry	NO2	ppm	10,6	9,6	14,6	11,0	20,6	14,2	9,3	11,2
NO, dry	NO	ppm	762,0	585,0	368,0	158,0	1052,0	883,0	541,0	138,0

NO2, corrected	NO2-K	ppm	9,1	8,2	12,6	9,6	17,6	12,1	8,0	9,7
NO, corrected	NO-k	ppm	653,6	502,4	316,8	137,2	898,0	754,2	463,2	119,0
CO, corrected	CO-k	ppm	145,6	83,0	106,5	420,3	142,0	76,6	90,8	170,9
CO2, corrected	CO2-k	Vol-%	7,91	6,68	5,36	2,72	9,64	8,04	6,11	1,30
NO2 emission	mNO2	g/h	6,4	5,2	7,0	4,2	6,6	4,0	2,4	1,4
NO emission	mNO	g/h	299,3	206,9	115,0	39,8	218,5	164,1	91,6	11,0
CO emission	mCO	g/h	62,1	31,8	36,0	113,5	32,2	15,5	16,7	14,7
CO2 emission	mCO2	g/h	53122	40328	28543	11554	34402	25626	17707	1767
Ventilation rate, NO based	cfm NO	cfm	5551	3838	2133	738	4053	3043	1699	204
Ventilation rate, NO2 based	cfm NO2	cfm	386	315	423	257	396	244	146	83
Ventilation rate, CO based	cfm CO	cfm	618	316	358	1128	320	154	166	146
Ventilation rate, CO2 based	cfm CO2	cfm	3359	2550	1805	731	2176	1621	1120	112

Ventilation rate, maximum	**cfm**	**5551**
	cfm, rounded	**6000**
	cfm/HP	**69**

CO emission in C1-Test:	**1,16 g/kWh**	
NOx emission in C1-Test:	**6,69 g/kWh**	
HC emission in C1-Test:	**0,30 g/kWh**	
Particulate emission in C1-Test:	**0,109 g/kWh**	**3,702 g/h**
Particulate index:	**2178 cfm**	
Particulate index, rounded:	**2500 cfm ,**	**29 cfm/HP**

Untertagemotoren
MSHA_C1_BF2011-CE65.xls

MSHA LUG (TORQUE) CURVE CHART for DEUTZ BF4M2011 87 HP @ 2800 RPM

TORQUE CURVE TEST - ALL TESTS AT FULL THROTTLE		
MSHA # :	07-ENA040004	
Engine:	Deutz BF4M/L 2011	
Engine Rating:	87 HP @ 2800 RPM	
Engine Speed, RPM	CO, ppm	CO2, %
1000	526	11.51
1200	322	11.06
1400	246	11.53
1600	158	11
1800	151	10.49
2000	175	10.2
2200	144	9.65
2400	139	9.34
2600	129	8.98
2800	153	8.56

Maintenance Plan

West Virginia Diesel Commission

Diesel Maintenance Plan

Date: January 12, 2009

Name of Company: WV Mining Co. INC. Permit Number: U-000-09

Name of Mine: No.1 Mine

Address: P.O. Box 100
Oak Hill, WV 29076

Person Responsible for Maintenance and Testing of Diesel Equipment at this Location: John Buck (Maintenance Supt.)

Phone Number: (304) 123-4567

Equipment: Engine #1

Manufacturer	Model Number	Serial Number
Damascus Corporation	**Mac 10D WV**	**101**

Statement of Maintenance Plan Requirements

Maintenance Plan will comply fully with all regulations pertaining to the maintenance of the diesel equipment specifically, Title 196-1-16, Maintenance subsections 16.1 thru 16.3(b), 196-1-19, Scheduled Maintenance, subsections 19.1 thru 19.1(u), Emissions Monitoring and Control, subsections 20.1 thru 20.2(o), 196-1-21, Diagnostic Testing, subsections 21.1 thru 21.1(o) and all other pertinent sections in the 196-1-1 Rules for Operating Diesel Equipment in Underground Mines in West Virginia.

The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.

Training Plan

West Virginia Diesel Commission

Diesel Training Plan

Date: January 12, 2009

Name of Company: WV Mining Co. INC.   Permit Number: U-000-09

Name of Mine: No.1 Mine

Address: P.O. Box 100
Oak Hill, WV 29076

Person Responsible for Maintenance and Testing of Diesel Equipment at this Location:
John Buck

Phone Number: (304) 123-4567

The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan

West Virginia Diesel Commission

(Attach proof of attendance and copy of WV Certification of Diesel Instructors Card for each instructor listed.)

Instructors

List instructors used in conducting diesel training

Name	Address	Affiliation
Larry A. Wine Cert. No. QDI-287-08	P.O. Box 100 Oak Hill, WV 29076	WV Mining Co. INC.
Marvin L. Given Cert. No. QDI-289-08	P.O. Box 610 Abingdon, VA. 24212	Damascus Corporation
Edward O. Blake Cert. No. QDI-288-08	P.O. Box 007 Welch, WV 22675	Blake Safety Company

The West Virginia Diesel Commission reserves the right to ask for additional data prior to approving this plan.

I. Diesel Mechanic - §196-1-24 – 16 Hours

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/OR SUPV. OPER.	METHOD OF EVALUATION
24.5.a. Federal and State requirements	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.b. Company policies and rules	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
24.5.c. Emissions control system	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.5 Hours	Questions
24.5.d. On-board engine performance and maintenance diagnostics	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.5 Hours	Questions
24.5.e. Service and maintenance procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	2.0 Hours	Questions
24.5.f. Emissions testing procedures and evaluation	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	2.0 Hours	Questions
24.5.g. Troubleshooting procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.h. Fire protection systems test and maintenance	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions

I. Diesel Mechanic - §196-1-24 – (continued)

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/OR SUPV. OPER.	METHOD OF EVALUATION
24.5.i. Fire and ignition sources	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
24.5.j. Fuel system maintenance and safe fueling procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.5 Hours	Questions
24.5.k. Intake air system design	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.l. Engine shutdown device tests and maintenance	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.m. Special instructions regarding components	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
24.5.n. Instruction on recordkeeping	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions

II. Diesel Operator - §196-1-22 – 8 Hours

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/OR SUPV. OPER.	METHOD OF EVALUATION
22.6.a. Engine fundamentals	Qualified Diesel Instructor	Hand outs; Power Point, Lecture	0.5 Hours	Questions
22.6.b. Diesel regulations	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.c. Diesel emissions	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
22.6.d. Factors that affect diesel emissions	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.e. Emissions control devices	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.f. Diagnostic techniques	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
22.6.g. The preoperational inspection	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
22.6.h. Ventilation	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.25 Hours	Questions
22.6.i. Fire suppression system	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.25 Hours	Questions
22.6.j. Operating rules	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	1.0 Hours	Questions
22.6.k. Emergency procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.75 Hours	Questions

22.6.i Recordkeeping and reporting procedures	Qualified Diesel Instructor	Hand outs, Power Point, Lecture	0.5 Hours	Questions
23.1.e Driving Practice	Qualified Diesel Instructor assisted by Experienced Operator	Underground Driving	0.25 Hours	Observation

Part III. Diesel Mechanic Annual Refresher Plan- §196-1-24.4 (8 Hours)

TASK	CONDUCTED BY	METHODS AND MATERIALS FOR INSTRUCTION IN SAFE OPERATING PROCEDURES	PERIOD OF PRACTICE AND/ OR SUPV. OPER.	METHOD OF EVALUATION
24.5.a. Federal and State requirements	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 120 Min.	Oral and/or Written Question & Answer
24.5.b. Company policies and rules	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
24.5.c. Emissions control system & component technical training	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.d. On-board engine performance and maintenance diagnostics	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.e. Service and maintenance procedures	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.f. Emissions testing procedures and evaluation & evaluation of test results	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.g. Troubleshooting procedures	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer

Part III.	Diesel Mechanic Annual Refresher Plan- §196-1-24.4		(8 Hours - Continued)	
24.5.h. Fire protection systems test and maintenance	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	30 to 60 Min.	Oral and/or Written Question & Answer
24.5.i. Fire and ignition sources, control & elimination	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min.	Oral and/or Written Question & Answer
24.5.j. Fuel system maintenance and safe fueling procedures	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
24.5.k. Intake air system design & maintenance procedure	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min.	Oral and/or Written Question & Answer
24.5.l. Engine shutdown device tests and maintenance	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min.	Oral and/or Written Question & Answer
24.5.m. Special instructions regarding components	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
24.5.n. Instruction on record keeping	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 30 Min.	Oral and/or Written Question & Answer
New Procedures & New Diesel Technologies (As Necessary)	Qualified Diesel Instructor (Assisted by others)	Handouts, Videos, Lecture, Hands On, Discussion, Power Points, Overheads	15 to 60 Min. (If applicable)	Oral and/or Written Question & Answer

QDI
Certification
Cards

QUALIFIED DIESEL INSTRUCTOR CERTIFICATION CARDS

STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY & TRAINING

CLASS 28 QUALIFIED DIESEL INSTRUCTOR

NAME LARRY A. WINE

DATE OF ISSUE	DATE OF EXPIRATION
06/18/2008	
QDI-287-08	XXX-XX
CERTIFICATE NUMBER	SOCIAL SECURITY NUMBER

0714021304

CERTIFYING OFFICIAL VERIFYING OFFICIAL

ENTERED

STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY & TRAINING

CLASS 28 QUALIFIED DIESEL INSTRUCTOR

NAME MARVIN L. GIVEN

DATE OF ISSUE	DATE OF EXPIRATION
06/18/2008	N/A
QDI-289-08	XXX-XX
CERTIFICATE NUMBER	SOCIAL SECURITY NUMBER

0714021306

CERTIFYING OFFICIAL VERIFYING OFFICIAL

ENTERED

STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY & TRAINING

CLASS 28 QUALIFIED DIESEL INSTRUCTOR

NAME EDWARD O. BLAKE

DATE OF ISSUE	DATE OF EXPIRATION
06/18/2008	N/A
QDI-288-08	XXX-XX
CERTIFICATE NUMBER	SOCIAL SECURITY NUMBER

0714021307

CERTIFYING OFFICIAL VERIFYING OFFICIAL

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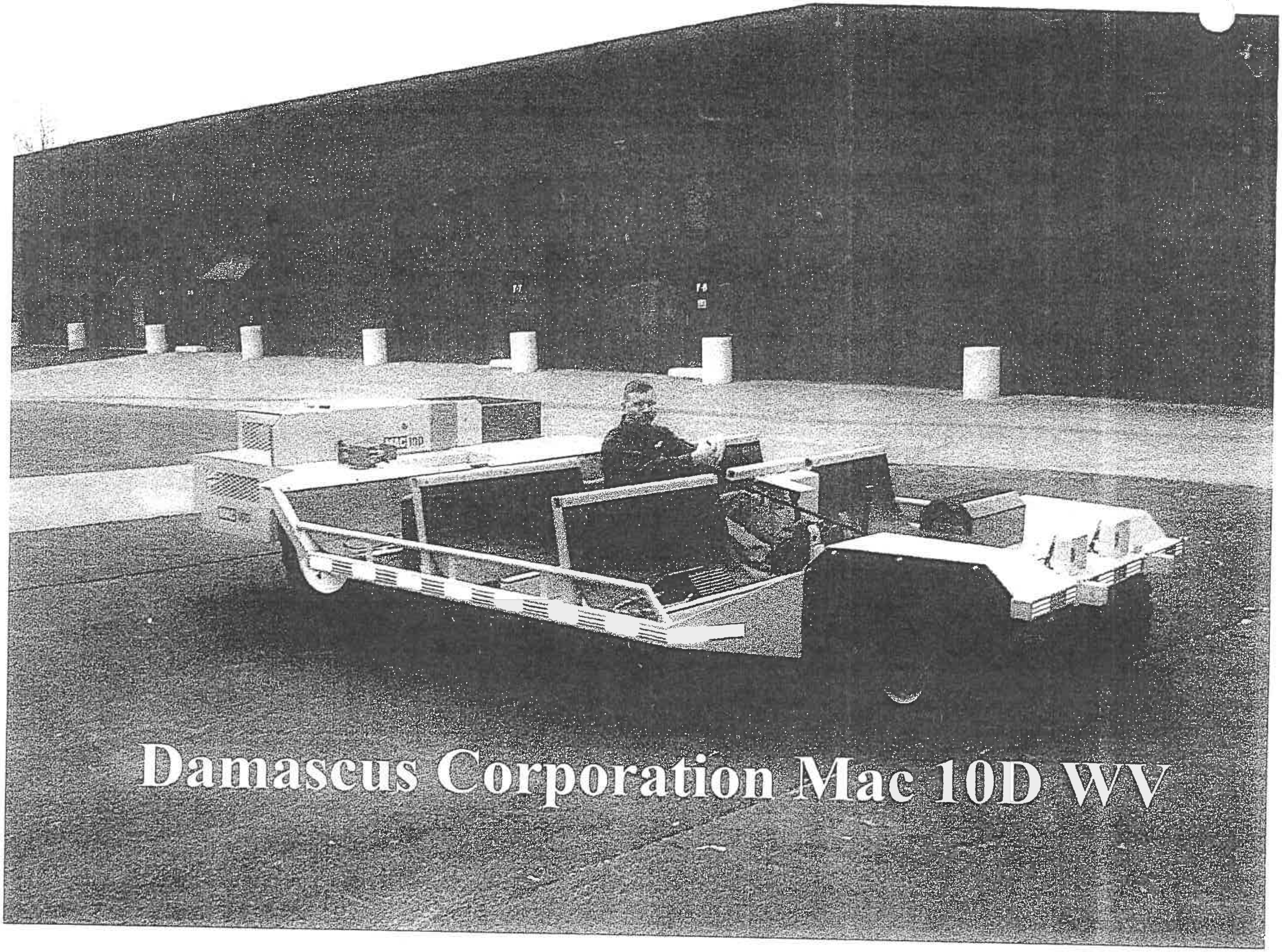
SAMPLE

Photos/
Drawings


Damascus Corporation Mac 10D WV

Outby Machine Checklist

§ 75.1909 Nonpermissible diesel-powered equipment; design and performance requirements.

§ 75.1910 Nonpermissible diesel-powered equipment; electrical system design and performance requirements.

Machine: ______________________________

Model No.: ______________________________

Serial No. ______________________________

Owner: ______________________________

Condition: ______________________________

Date of Inspection: ______________________

Location: ______________________________

Investigators: __________________________

Section	Rule	Comments	Changes Minor	Major
1909	Nonpermissible diesel-powered equipment; design and performance requirements.			
(a)	Nonpermissible diesel-powered equipment, except for the special category of equipment under Sec. 75.1908(d), must be equipped with the following features:			
(a)(1)	An engine approved under subpart E of part 7 of this title	Approval No.______		
(a)(1) cont.	equipped with an air filter sized in accordance with the engine manufacturer's recommendations,	Air filter model no.:____________ CFM rating:__________________		
(a)(1) cont.	an air filter service indicator set in accordance with the engine manufacturer's recommendations;	______"Hg		
(a)(2)	At least one portable multipurpose dry chemical type (ABC) fire extinguisher listed or approved by a nationally recognized independent testing laboratory with a 10A:60B:C or higher rating.	Date of last inspection- UL, FM tag-		
(a)(2) cont.	The fire extinguisher must be located within easy reach of the equipment operator and protected from damage;			

Section	Rule	Comments	Changes Minor	Changes Major
(a)(3)	A fuel system specifically designed for diesel fuel meeting the following requirements:	OEM or aftermarket?		
(a)(3) (i)	A fuel tank and fuel lines that do not leak;			
(a)(3) (ii)	A fuel tank that is substantially constructed and protected against damage by collision;	UL 395 OEM? metal? min-1/16", typ. 1/8" within machine frame, skid plate		
(a)(3) (iii)	A vent opening that maintains atmospheric pressure in the fuel tank, and that is designed to prevent fuel from splashing out of the vent opening;	OEM or aftermarket?		
(a)(3) (iv)	A self-closing filler cap on the fuel tank;	Flap in filler nozzle?		
(a)(3) (v)	The fuel tank, filler and vent must be located so that leaks or spillage during refueling will not contact hot surfaces;			
(a)(3) (vi)	Fuel line piping must be either steel-wire reinforced; synthetic elastomer-covered hose suitable for use with diesel fuel that has been tested	SAE 1527 Type A, SAE 1942 UL 1114 Type A1 type N		

Section	Rule	Comments	Changes Minor	Changes Major
	and has been determined to be fire-resistant by the manufacturer; or metal;			
(a)(3) (vii)	Fuel line piping must be clamped;			
(a)(3) (viii)	Primary fuel lines must be located so that fuel line leaks do not contact hot surfaces;			
(a)(3) (ix)	The fuel lines must be separated from electrical wiring and protected from damage in ordinary use;			
(a)(3) (x)	A manual shutoff valve must be installed in the fuel system as close as practicable to the tank;			
(a)(3) (xi)	A water separator and fuel filter(s) must be provided.			
(a)(4)	A sensor to monitor the temperature and provide a visual warning of an overheated cylinder head on air-cooled engines;			
(a)(5)	Guarding to protect fuel, hydraulic, and electric lines when such lines pass near rotating parts or in the event of shaft failure;			

Section	Rule	Comments	Changes Minor	Changes Major
(a)(6)	Hydraulic tanks, fillers, vents, and lines located to prevent spillage or leaks from contacting hot surfaces;			
(a)(7)	Reflectors or warning lights mounted on the equipment which can be readily seen in all directions;			
(a)(8)	A means to direct exhaust gas away from the equipment operator, persons on board the machine, and combustible machine components;			
(a)(9)	A means to prevent unintentional free and uncontrolled descent of personnel-elevating work platforms;			
(a)(10)	A means to prevent the spray from ruptured hydraulic or lubricating oil lines from being ignited by contact with engine exhaust system component surfaces.			
(b)	Self-propelled nonpermissible diesel-powered equipment must have the following features in addition to those in paragraph (a):			
(b)(1)	A means to ensure that no stored hydraulic energy that will cause machine articulation is available after the engine is shut down;			

Section	Rule	Comments	Changes Minor	Major
(b)(2)	A neutral start feature which ensures that engine cranking torque will not be transmitted through the powertrain and cause machine movement on vehicles utilizing fluid power transmissions;			
(b)(3)	For machines with steering wheels, brake pedals, and accelerator pedals, controls which are of automobile orientation;			
(b)(4)	An audible warning device conveniently located near the equipment operator;			
(b)(5)	Lights provided and maintained on both ends of the equipment.			
(b)(5) cont.	Equipment normally operated in both directions must be equipped with headlights for both directions;			
(b)(6)	Service brakes that act on each wheel of the vehicle and that are designed such that failure of any single component, except the brake actuation pedal or other similar actuation device, must not result in a complete loss of service braking capability;			
(b)(7)	Service brakes that safely bring the fully loaded vehicle to a complete stop on the maximum grade on which it is	Vehicle grade rating-		

Section	Rule	Comments	Changes Minor	Major
	operated;			
(b)(8)	No device that traps a column of fluid to hold the brake in the applied position shall be installed in any brake system, unless the trapped column of fluid is released when the equipment operator is no longer in contact with the brake activation device.			
(c)	Self-propelled nonpermissible heavy-duty diesel-powered equipment under Sec. 75.1908(a), except rail-mounted equipment, shall be provided with a supplemental braking system that:			
(c)(1)	Engages automatically within 5 seconds of the shutdown of the engine;			
(c)(2)	Safely brings the equipment when fully loaded to a complete stop on the maximum grade on which it is operated;	Vehicle grade rating-		
(c)(3)	Holds the equipment stationary, despite any contraction of brake parts, exhaustion of any nonmechanical source of energy, or leakage;			
(c)(4)	Releases only by a manual control that does not operate any other equipment function;			

Section	Rule	Comments	Changes Minor	Major
(c)(5)	Has a means in the equipment operator's compartment to apply the brakes manually without shutting down the engine, and a means to release and reengage the brakes without the engine operating;			
(c)(6)	Has a means to ensure that the supplemental braking system is released before the equipment can be trammed, and is designed to ensure the brake is fully released at all times while the equipment is trammed.			
(d)	Self-propelled nonpermissible light-duty diesel-powered equipment under Sec. 75.1908(b), except rail-mounted equipment, must be provided with a parking brake that holds the fully loaded equipment stationary on the maximum grade on which it is operated despite any contraction of the brake parts, exhaustion of any nonmechanical source of energy, or leakage.			
(e)	The supplemental and park brake systems required by paragraphs (c) and (d) must be applied when the equipment operator is not at the controls of the equipment, except during movement of			

Section	Rule	Comments	Changes Minor	Major
	disabled equipment.			
(f)	Self-propelled personnel-elevating work platforms must be provided with a means to ensure that the parking braking system is released before the equipment can be trammed, and must be designed to ensure the brake is fully released at all times while the equipment is trammed.			
(g)	Any nonpermissible equipment that discharges its exhaust directly into a return air course must be provided with a power package approved under subpart F of part 7 of this title.			
(h)	Self-propelled nonpermissible heavy-duty diesel-powered equipment meeting the requirements of Sec. 75.1908(a) must be provided with an automatic fire suppression system meeting the requirements of Sec. 75.1911.	See attached §75.1911 Checklist		
(i)	Self-propelled nonpermissible light-duty diesel-powered equipment meeting the requirements of Sec. 75.1908(b) must be provided with an automatic or manual fire suppression system meeting the requirements of Sec. 75.1911.	See attached §75.1911 Checklist		

Section	Rule	Comments	Changes Minor	Major
(j)	Nonpermissible equipment that is not self-propelled must have the following features in addition to those listed in paragraph (a):			
(j)(1)	A means to prevent inadvertent movement of the equipment when parked;			
(j)(2)	Safety chains or other suitable secondary connections on equipment thatis being towed;			
(j)(3)	An automatic fire suppression system meeting the requirements of Sec. 75.1911.	See attached §75.1911 Checklist		
1910	Nonpermissible diesel-powered equipment; electrical system design and performance requirements.			
1910 cont.	Electrical circuits and components associated with or connected to electrical systems on nonpermissible diesel-powered equipment utilizing storage batteries and integral charging systems, except for the special category of equipment under Sec. 75.1908(d), must conform to the following requirements:			
(a)	Overload and short circuit protection must be provided for electric circuits	Attach wiring schematics-		

Section	Rule	Comments	Changes Minor	Major
	and components in accordance with Secs. 75.518 and 75.518-1 of this part;			
(b)	Each electric conductor from the battery to the starting motor must be protected against short circuit by fuses or other circuit-interrupting devices placed as near as practicable to the battery terminals;	Fuse rating:__________ Starter motor\kW:__________		
(c)	Each branch circuit conductor connected to the main circuit between the battery and charging generator must be protected against short circuit by fuses or other automatic circuit-interrupting devices;	Attach wiring schematics-		
(d)	The electrical system shall be equipped with a circuit-interrupting device by means of which all power conductors can be deenergized.			
(d) cont.	The device must be located as close as practicable to the battery terminals and be designed to operate within its electrical rating without damage.	Distance from battery:__________ Switch rating:__________		
(d) cont.	The device shall not automatically reset after being actuated.			
(d) cont.	All magnetic circuit-interrupting devices must be mounted in a manner to			

Section	Rule	Comments	Changes Minor	Major
	preclude their closing by force of gravity;			
(e)	Each motor and charging generator must be protected by an automatic overcurrent device. One protective device will be acceptable when two motors of the same rating operate simultaneously and perform virtually the same duty;	Attach wiring schematics-		
(f)	Each ungrounded conductor must have insulation compatible with the impressed voltage.	Wire designation:________________		
(f) cont.	Insulation materials must be resistant to deterioration from engine heat and oil.	Wire designation:________________		
(f) cont.	Electric conductors must meet the applicable requirements of Secs. 75.513 and 75.513-1, except electric conductors for starting motors, which must only meet the requirements of Sec. 75.513;	Wire designation:________________ NEC, ICEA, or SAE standard: _________________________________		
(g)	All wiring must have adequate mechanical protection to prevent damage to the cable that might result in short circuits;			
(h)	Sharp edges and corners must be removed			

Section	Rule	Comments	Changes Minor	Changes Major
	at all points where there is a possibility of damaging wires, cables, or conduits by cutting or abrasion.			
(h) cont.	The insulation of the cables within a battery box must be protected against abrasion;			
(i)	When insulated wires other than cables pass through metal frames, the holes must be substantially bushed with insulated bushings.			
(i) cont.	Cables must enter metal frames of motors, splice boxes, and electric components only through proper fittings.			
(i) cont.	All electrical connections and splices must be mechanically and electrically efficient, and suitable connectors shall be used.			
(i) cont.	All electrical connectors or splices in insulated wire must be reinsulated at least to the same degree of protection as the remainder of the wire;			
(j)	The battery must be secured to prevent movement, and must be protected from external damage by position.			
(j)	Batteries that are not protected from			

Section	Rule	Comments	Changes Minor	Major
cont.	external damage by position must be enclosed in a battery box.			
(j) cont.	Flame-resistant insulation treated to resist chemical reaction to electrolyte must be provided on battery connections to prevent battery terminals from contacting conducting surfaces;	Mfg's spec.:____________		
(k)	A battery box, including the cover, must be constructed of steel with a minimum thickness of \1/8\ inch, or of a material other than steel that provides equivalent strength;			
(l)	Battery-box covers must be lined with a flame-resistant insulating material permanently attached to the underside of the cover, unless equivalent protection is provided.	Mfg.'s spec.____________		
(l) cont.	Battery-box covers must be provided with a means for securing them in closed position. At least \1/2\ inch of air space must be provided between the underside of the cover and the top of the battery, including terminals;			
(m)	Battery boxes must be provided with ventilation openings to prevent the accumulation of flammable or toxic gases or vapors within the battery box.			

Section	Rule	Comments	Changes Minor	Changes Major
(m) cont.	The size and locations of openings for ventilation must prevent direct access to battery terminals;			
(n)	The battery must be insulated from the battery-box walls and supported on insulating materials.			
(n) cont.	Insulating materials that may be subject to chemical reaction with electrolyte must be treated to resist such action;	Mfg.'s spec.____________		
(o)	Drainage holes must be provided in the bottom of each battery box.			

OUTBY MACHINE CHECKLIST

§ 75.1911 Fire suppression systems for diesel-powered equipment and fuel transportation units.

Machine: ______________________________

Model No.: ______________________________

Serial No. ______________________________

Owner: ______________________________

Condition: ______________________________

Date of Inspection: ______________________

Location: ______________________________

Investigators: __________________________

Warning: Determine "*....the hazards inherent to the operation* *of the fire suppression systems and, where appropriate, the safeguards available for each system."*

Section	Rule	Comments	Changes Minor	Major
1911	Fire suppression systems for diesel-powered equipment and fuel transportation units.			
(a)	The fire suppression system required by Secs. 75.1907 and 75.1909 shall be a multipurpose dry chemical type (ABC) fire suppression system listed or approved by a nationally recognized independent testing laboratory and appropriate for installation on diesel-powered equipment and fuel transportation units.	UL-______ FM-______		
(a)(1)	The system shall be installed in accordance with the manufacturer's specifications and the limitations of the listing or approval.	No. of tanks\qty.:______________ No. of nozzles:________________ Drawing No.:___________________		
(a)(2)	The system shall be installed in a protected location or guarded to minimize physical damage from routine vehicle operations.			
(a)(3)	Suppressant agent distribution tubing or piping shall be secured and protected against damage, including			

Section	Rule	Comments	Changes Minor	Major
	pinching, crimping, stretching, abrasion, and corrosion.			
(a)(4)	Discharge nozzles shall be positioned and aimed for maximum fire suppression effectiveness.			
(a)(4) cont.	Nozzles shall also be protected against the entrance of foreign materials such as mud, coal dust, or rock dust.			
(b)	The fire suppression system shall provide fire suppression and, if automatic, fire detection for the engine................................ including the starter,................ transmission,.......................... hydraulic pumps and tanks,............. fuel tanks,............................ exposed brake units,................... air compressors........................ and battery areas...................... on diesel-powered equipment and electric panels or controls............ used on fuel transportation units and other areas as necessary...............			

Section	Rule	Comments	Changes Minor	Major
(c)	If automatic, the fire suppression system shall include audible and visual alarms to warn of fires or system faults.			
(d)	The fire suppression system shall provide for automatic engine shutdown. If the fire suppression system is automatic, engine shutdown and discharge of suppressant agent may be delayed for a maximum of 15 seconds after the fire is detected by the system.	Delay time:_______		
(e)	The fire suppression-system shall be operable by at least two manual actuators. One actuator shall be located on each side of the equipment. If the equipment is provided with an operator's compartment, one of the manual actuators shall be located in the compartment within reach of the operator.			
(f)	The fire suppression system shall remain operative in the event of engine shutdown, equipment electrical system failure, or failure of any other equipment system.			

Section	Rule	Comments	Changes Minor	Major
(g)	The electrical components of each fire suppression system installed on equipment used where permissible electric equipment is required shall be permissible or intrinsically safe and such components shall be maintained in permissible or intrinsically safe condition.	IS-_____		
(h)	Electrically operated detection and actuation circuits shall be monitored and provided with status indicators showing power and circuit continuity.			
(h) cont.	If the system is not electrically operated, a means shall be provided to indicate the functional readiness status of the detection system.			
(i)	Each fire suppression system shall be tested and maintained in accordance with the manufacturer's recommended inspection and maintenance program and as required by the nationally recognized independent testing laboratory listing or approval, and be visually inspected at least once each week by a person trained to make such inspections.	NRITL\Mfg's test\maintenance scedule-		
(j)	*Recordkeeping* Persons performing inspections and tests of fire	Note defects\repairs-		

Section	Rule	Comments	Changes Minor	Major
	suppression systems under paragraph (i) shall record when a fire suppression system does not meet the installation or maintenance requirements of this section.			
(j)(1)	The record shall include the equipment on which the fire suppression system did not meet the installation or maintenance requirements of this section, the defect found, and the corrective action taken.			
(j)(2)	Records are to be kept manually in a secure manner not susceptible to alteration or recorded electronically in a secured computer system that is not susceptible to alteration.			
(j)(3)	Records shall be maintained at a surface location at the mine for one year and made available for inspection by an authorized representative of the Secretary and miners' representatives.			
(k)	All miners normally assigned to the active workings of the mine shall be instructed about the hazards inherent to the operation of the fire suppression systems and, where appropriate, the safeguards available for each system.			

Section	Rule	Comments	Changes Minor	Major
(l)	For purposes of Sec. 75.380(f), a fire suppression system installed on diesel-powered equipment and meeting the requirements of this section is equivalent to a fire suppression system meeting the requirements of Secs. 75.1107-3 through 75.1107-16.			

WEST VIRGINIA STATE MINE INSPECTOR'S DIESEL INSPECTION CHECKLIST

Date__________________ **Company**____

Mine _______________________ **Equipment Type**_______________________________

WV Approval #(*see Approval Letter*)_____________ **Machine serial#**________________

RECORDS REQUIRED

56-23-22.3	1. Diesel operator training records. (MSHA 5000-23 FORMS)
56-23-24.3	2. Diesel mechanic training records. (MSHA 5000-23 FORMS)
56-23-4.3	3. Diesel inventory on file at mine.
56-23-16.2	4. Diesel maintenance plan on file at mine.
56-23-22.1	5. Diesel training plan on file at mine.
56-23-8.2	6. Latest fuel delivery receipt (*ultra-low sulfur fuel* **ONLY !**)
56-23-17.1	7. Preoperational check records.
56-23-17.1	8. Weekly ambient emissions records.
56-23-17.1	9. 200 hour service records.(*note:* can not be more than 200 hr from last service). *Last 200hr service done at*__________*Hours.*
56-23-11.2	10. Semi-annual fire suppression check records. *Last check*_________

MACHINE INSPECTION

56-23-5.5	11. Check all gauges and controls (properly labeled)
56-23-16.1	12. Sounding device (*must be **horn***).
56-23-16.1	13. A means to prevent the spray from ruptured hoses from coming in Contact with a hot surface
56-23-10.4.2	14. Filler caps provided for fuel tanks must be "self closing caps".
56-23-10.4.5	15. Manual fuel shut off valve provided for tank.(*should be labeled).*
56-23-14.2	16. Check machine for fuel leaks.
56-23-16.1	17. Fuel system must be provided with a water separator and fuel filter(s).
56-23-16.1	18. Fuel lines must be fire resistant or metal.
56-23-16.1	19. Fuel line piping must be clamped.
56-23-16.1	20. Guarding to protect fuel, hydraulic, and electrical lines when such lines pass near rotating parts.
56-23-14.2.	21. Accumulations of diesel fuel and other combustible materials on machine.
56-23-16.1	22. Reflectors or warning lights mounted on the machine that can be readily seen in all directions.
56-23-16.1	23. Neutral start feature. *(machine must not start if transmission is in gear).*
56-23-16.1	24. Check headlights on each end of machine.
56-23-25.8.	25. Check service brake and park brake.
56-23-19.1.15	26. Check portable fire extinguisher. *(must be near operator and be10A:60B. Or higher rating.*
56-23-7.5.3	27. Proper installation and maintenance of intake air filters.

<u>**56-23-16.1**</u>	28. Battery must be secured and maintained properly.
<u>**56-23-16.1**</u>	29. Battery dis-connecting device installed as close to battery as practicable.
<u>**56-23-16.1**</u>	30. Battery boxes lined with insulating material and drainage holes (unclogged) provided.
<u>**56-23-16.1**</u>	31. Sharp edges and corners must be removed at all points where there is a possibility of damaging wires, cables, or conduits by cutting or abrasion.
<u>**56-23-16.1**</u>	32. Battery boxes must be provided ventilation openings.
<u>**56-23-5.4.3.**</u>	33. Check surface temperature of engine and exhaust components. (note: surface temperature can be no more than **302 degrees**). **Surface Temperature is**____________________
<u>**56-23-5.4.5.**</u>	34. Automatic engine shutdown that will shut the engine down before exhaust gas temperature reaches **302 degrees**. Also, must give operator warning before engine shutdown.

<u>***FIRE SUPPRESSION SYSTEM***</u>

<u>**56-23-11.2.**</u>	35. Fire suppression system must be able to be automatically activated in the event of a fire on the machine.
<u>**56-23-11.2.1.**</u>	36. Fire suppression system must be installed according to manufacturer's specifications.
<u>**56-23-11.2.2.**</u>	37. System must be installed in a protected location or guarded to minimize physical damage from routine operations.
<u>**56-23-11.2.3.**</u>	38. Hoses provided for the system must be secured and protected against damage, including pinching, crimping, stretching, abrasion and corrosion.
<u>**56-23-11.2.4.**</u>	39. Discharge (spray) nozzles shall be aimed for maximum effectiveness. Also, check all nozzles to make sure the end of the nozzle is not clogged with mud or coal dust. (NOTE: The nozzles must be provided with a protective cap to prevent the entrance of foreign material).
<u>**56-23-11.3.1.**</u>	40. The following areas must be covered by the fire suppression system – **1.** engine , **2.** transmission , **3.** hydraulic pumps and tanks, **4.** fuel tanks, **5.** exposed (open) brake units, **6.** air compressors, **7.** battery areas. <u>(b.) Fuel containers and elect. Controls on fuel cars.</u>
<u>**56-23-11.4.**</u>	41. System must be provided with a fire detection unit (unit will be located in the operator cab) to warn the operator of a fire or system malfunction. (Note: To check this operator warning un-plug the squib from the unit).
<u>**56-23-11.5.**</u>	42. When system is activated the engine must automatically shutdown within 15 seconds after the fire alarm alerts the operator. (Note: To check this system manually flip the shutdown switch).
<u>**56-23-11.6.**</u>	43. Must be provided with at least 2 manual actuators. 1 actuator near the operator and 1 on the other end and opposite side of machine.

EMISSIONS CHECK

56-23-5.4.2.

44. **Catalyst Inspection-** 1) Visually inspect catalyst (make sure catalyst is not damaged). 2) TAILPIPE TEST- Under all conditions of operation at **normal engine operating temperature** ***(at least 170 degrees)*** the carbon monoxide exiting the tailpipe can be no More than **100 ppm**. (NOTE: To perform this test use the iTx detector with the pump and probe. Insert the probe into the tailpipe of the machine). If CO is greater than 100ppm the machine must be taken out of service. ***THE FILTERED CO IS*** __________

56-23-5.4.1.

45. **DPM Filter Inspection-** 1) Visually inspect filter (make sure filter is not damaged and is installed correctly). 2) SMOKE DOT TEST- Filter must capable of at least **75%** reduction of diesel particulate matter (DPM). Smoke dot shall be a **#3** or less. (NOTE: To perform this test use the Bacharach Smoke Dot Tester. Insert tester into tailpipe pull 10 pumps *(take 4 seconds to pull each pump)* remove test paper from tester and compare to the scale provided). If the smoke dot number is greater than 3 the machine must be taken out of service. ***THE SMOKE DOT # IS*** ____________________

56-23-18.1.1.

46. **Exhaust Leak Test-** Check the exhaust system from the manifold to the DPM filter for exhaust leaks. (NOTE: To perform this test use the iTx detector with the pump and probe. Follow the exhaust with the probe. Any exhaust leaks will be detected with the iTx.

56-23-7.1,2,3,4.

LOCATION OF AMBIENT TEST IS

____
____
____

47. **Ambient Emissions Test-** Have machine moved underground and placed in proper airflow *(find minimum amount of airflow on MSHA approval tag provided on engine)* (NOTE: To perform this test take air reading then measure 8 feet downwind of the **exhaust pipe**. Using the iTx detector travel from rib to rib in the exhaust flow. Also, measure the emissions at the operator's cab. ***CFM MEASURED FOR THIS TEST IS*** ____________________

TEST AT 8 FEET DOWNWIND OF EXHAUST -

CO ________ ppm **NO** ________ ppm **NO2** ________ ppm

TEST AT OPERATOR'S CAB-

CO ________ ppm **NO** ________ ppm **NO2** ________ ppm

VIOLATION
CO – 26 to 35 ppm
NO – 19 to 25 ppm
NO2- 2 to 3 ppm

OTHER REGULATIONS TO CONSIDER

56-23-10.14.	48. Safety cans shall be used for emergency fueling only. Safety cans may not be used to do regular fueling of equipment.
56-23-10.15.	49. Safety cans shall be clearly marked, have a maximum capacity of five gallons, and be constructed of metal, and equipped with a nozzle.
56-23-6.3.	50. Ventilation not adequate to operate the diesel machine.
56-23-25.4.	51. Roadways not maintained properly.
22A-2-37(z)	52. E-stop switch **rail equipment only.**
36-18-5.2	53. Pre-operational checklist provided on machine.
22A-2-37t(5)	54. Track equipment provided with two-way communications Or handheld Operator Radio (*personal communication*)
22A-2-37(o)	55. Provided with lifting jack and bar.
22A-2-49(b)	56. Fenders provided for machine.
22A-2-49(e)	57. Sanders on Rail Equipment.
56-23-16.1	58. Manual park brake release.(*A means to release the park brake With the Engine of the Machine Off*).
56-23-25.8.	***(Catch All)*** – ALL DIESEL POWERED EQUIPMENT **SHALL** BE MAINTAINED IN A SAFE AND HEALTHFUL OPERATING CONDITION. EQUIPMENT IN AN UNSAFE OR UNHEALTHFUL CONDITION OR NOT MAINTAINED IN ACCORDANCE WITH THE ENGINE OR EMISSIONS CONTROL OPERATING SPECIFICATIONS SHALL BE ROMOVED FROM SERVICE IMMEDIATELY AND SHALL NOT BE RETURNED TO SERVICE UNTIL ALL NECESSARY CORRECTIVE ACTIONS HAVE BEEN TAKEN.

INSPECTOR'S NOTES

REVISED 2/2021

DO NOT WRITE IN THIS SPACE

Registration No: ______________________

Date Issued: ______________________

Approved by: ______________________

Date of Class: ______________________

Location of Class: ______________________

STATE OF WEST VIRGINIA
OFFICE OF MINERS' HEALTH, SAFETY AND TRAINING

#7 Players Club Drive – Suite 2
Charleston, West Virginia 25311-1626
https://minesafety.wv.gov

Qualified Diesel Instructor Application

(Print:

Name ____
Last First Middle

Address ____
Street or Box City State Zip

Telephone No.: ______________________ Date of Birth: _________ / _________ / _________

Social Security No. (Last 4 Digits) ______________ West Virginia Certificate No. ______________________

Currently Employed by:

____
Coal Company

____
Mine Name

______________________________ ______________________________
Signature of Applicant **Date**

22A-1-21(d) Whoever knowingly makes any false statement, representation, or certification in any application, record, report, plan or other document filed or required to be maintained pursuant to this law or any order or decision issued under this law shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined not more than $5,000.00 or imprisoned in the county jail not more than six months, or both fined and imprisoned.