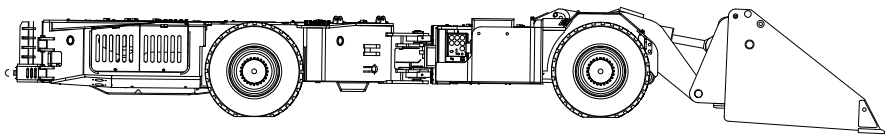
Operation and Maintenance Manual

BUCYRUS UN-A-TRAC®
Model 488D-XP

Doc. No.: A6474X334



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About this manual

This chapter provides important information making it easier for you to use this manual. You will also be given information on the structure of the manual and the symbols and characters used.

Before starting to work

applicable operating manual

Take care to ensure that the operating manual available to you is applicable for the type of equipment or machine used.

machine type

This operating manual is intended for:

BUCYRUS Model 488 Diesel-XP UN-A-TRAC®
Serial No.: N/A

and is only permitted to be used for equipment of this type.

new operation manual

The operating manual must be accessible at all times to all persons working on or with the machine. It should, if possible, always be available at the place of operation.

Send for a new operation manual immediately if the present manual is no longer complete or has become illegible.

Who is this operating manual intended for?

This operating manual is intended for those persons who work with or on the machine. Every person working on the face or in the intersection between face and entry or in the entry must read this operating manual.

This includes persons who:

- are in charge of transport
- perform assembly / disassembly work
- operate the machine
- eliminate faults
- perform daily routine work on the face or in the entry
- perform maintenance work
- perform repair work

and supervisory personnel who:

- initiate and/or
- supervise the activities just indicated.

Safety instructions

General rules

general

Always work with full concentration.

Familiarize yourself with your working environment.

noise emissions

Always wear your personal protective equipment. This includes ear protection, as the noise emitted by other equipment in the area may at times exceed 85 db(A).

Inform your colleagues of:

- your exact location,
- the work you are performing, and
- the time that you will require.

safety equipment

Start the machine only when it is in a good and safe operating condition and all protective devices, cover plates, etc. are correctly installed.

Observe the acoustic and optical start-up warnings of the machine.

symbol plates

Observe the symbol plates on the machine.

cordon off working area

Cordon off your working area widely for the machine.

moving parts

Never allow parts of your body to come between parts which could move, such as:

- bucket
- pivot points
- ejector blade

steering lockout

Connect the steering lockout device before performing maintenance or repairs on the machine.

Overview of the safety instructions

This is a summary of all the safety instructions which have to be observed in the following chapters. This summary is intended only to give you an overview of all the instructions. In some cases, there is no logical relationship between the individual instructions.

Chapter 2: Safety Instructions

NOTICE!
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

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 to be replaced

A mostly blocked intake system can lead to carbon monoxide increases of 50-250% and increases in smoke

Chapter 3: Storage and transport

Instructions on the storage of concentrates for hydraulic fluids can be found, if required, in chapter 6 in this operating manual.

IMPORTANT!
Take care to insure that new supplies are stored separately from existing stock and that removal takes place on the “first in, first out” principle.

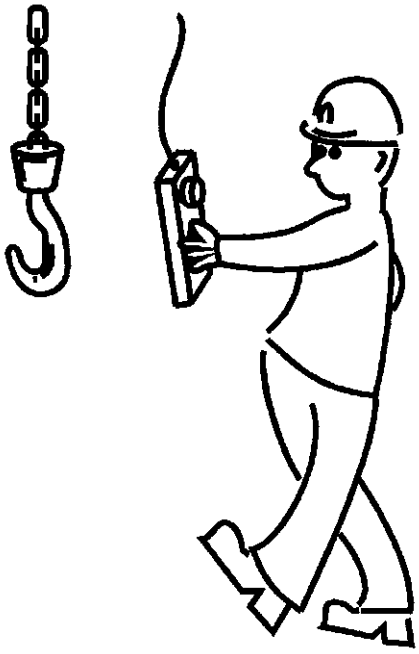
Additional information on the dimensions and weights can be found in chapter 6 in this operating manual.

WARNING!
Use only load handling devices complying with the technical and legal regulations for the transport of loads.
You could be seriously injured or even killed by falling loads.
Use only suitable load handling devices.

Chapter 4: Installation

CAUTION!
Serious damage can be caused to the UN-A-TRAC ® as a result of incorrect installation.
The unit should therefore only be installed under the instruction of specialists from Bucyrus America, Inc.

3 Storage and transport



Pre-installation check list

NOTICE!
The machine was inspected prior to shipment from the factory to ensure proper functioning and installation of all components. However, to ensure that no transit damage has occurred, the following pre-startup checks should be performed:

- perform daily maintenance
- visually inspect all hydraulic hoses and electrical cables for damage
- clean any foreign material from the operator's compartment
- if equipped with bucket, clean any foreign material from behind the ejector blade
- check safety provisions for operational condition on fire suppression system
- check that all covers and guards are in place and secure
- check that all tags and instruction labels are in place and secure
- check that operator's canopy is secure and in place
- start the machine and allow the hydraulic system to warm up for five (5) to ten (10) minutes
- check hydraulic system pressures (refer to the hydraulic schematic supplied for your particular machine for pressure settings)
- check all engine gauges in the operator's comportment to ensure all systems are functioning properly
- check the air system pressure (refer to air system schematic for your particular machine for pressure setting)

WARNING!
Before operating any levers or pedals on the UN-A-TRAC ® always make sure no one is in the hazard zone (see Hazard zone in this chapter). Do not operate any levers or pedals from outside the operator's compartment.

fire suppression

The machine is equipped with a fire suppression system (Fig. 10) that can be actuated either automatically or manually.

A wire circuit is routed throughout the machine. When exposed to fire, the circuit will initiate a fire detection condition and the fire suppression will discharge.

The machine is also equipped with two (2) fire suppression (remote) actuators. One is located to the operator's left inside the operator's compartment and the other is located on opposite side of the machine on the rear frame in the fuel filter compartment. This particular suppression system is pneumatically actuated and extinguishes with dry chemicals. To actuate the system from either of the two (2) actuators, pull the safety pin and strike downward on the plunger. Immediately after the plunger is struck, dry chemical will be dispensed throughout the machine. The engine will shut down when the fire suppression system is activated. The fire suppression system must be completely recharged with dry chemicals and expellants after it has been actuated.
Refer to the Ansul fire suppression users manual for complete operating instructions.

WARNING!
If either of the fire suppression actuator are actuated, the system must be completely recharged with dry chemicals and expellants.

Fig. 10: Fire suppression locator (typical)

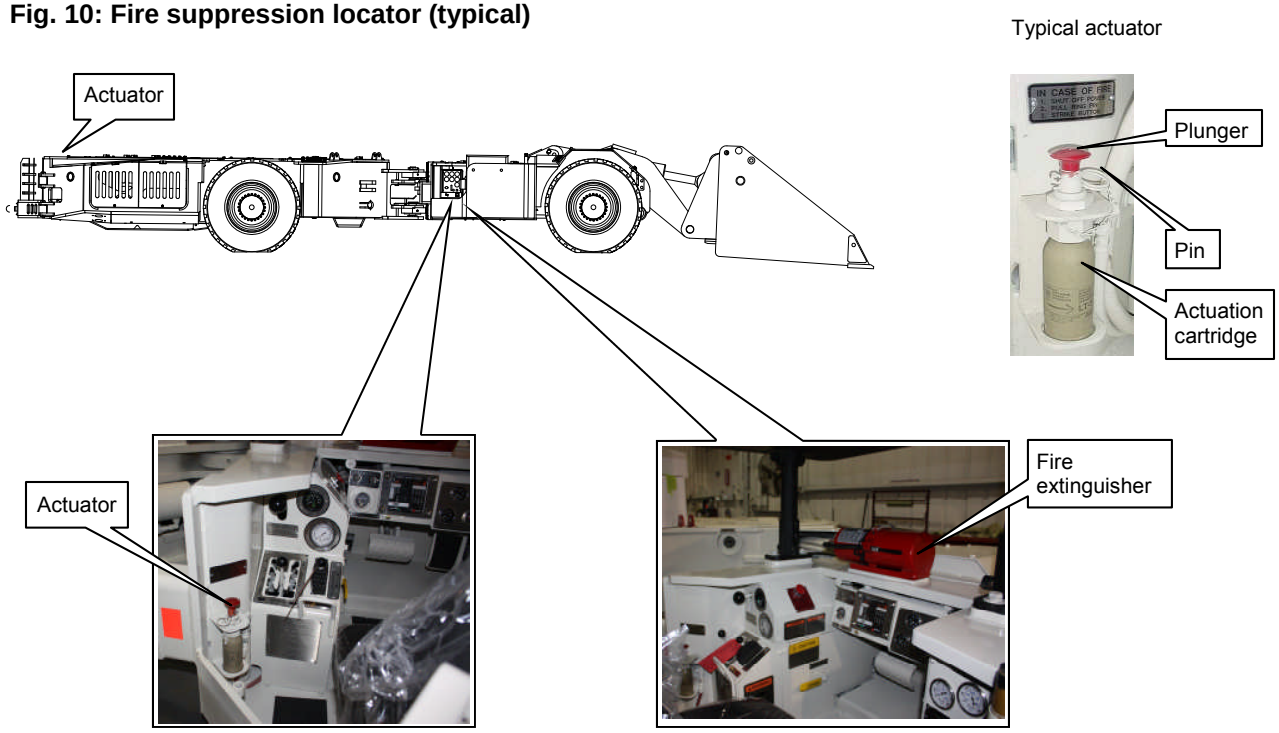
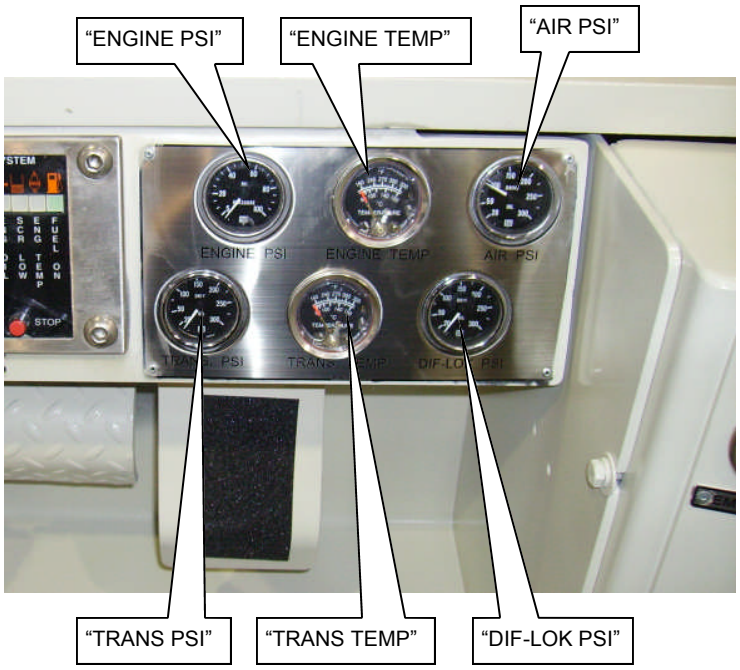


Fig. 20: Gauge panel



“AIR SHUTOFF VALVE”

The “AIR SHUTOFF VALVE” (Fig. 21) is used to shut off air supply to the main control valve for servicing purposes.

“RAW” exhaust

The “RAW” exhaust (Fig. 21) is a port where a meter can be connected to analyze the composition of the untreated exhaust.

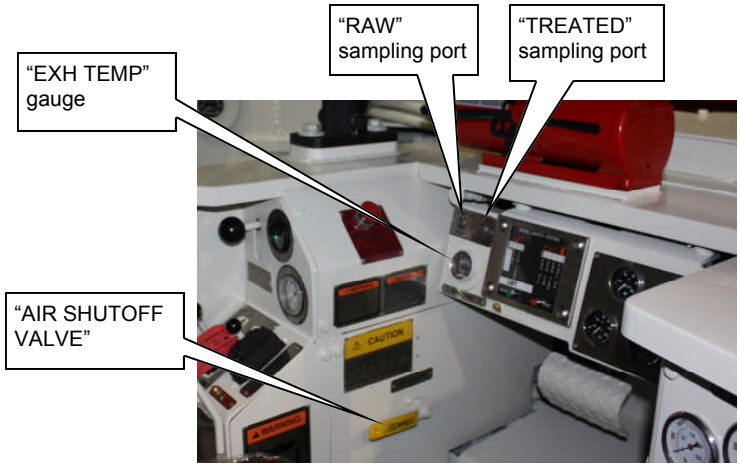
“TREATED” exhaust

The “TREATED” exhaust (Fig. 21) is a port where a meter can be connected to analyze the composition of treated exhaust.

“EXH TEMP” gauge (optional)

The optional “EXH TEMP” gauge (Fig. 21) is used to monitor the exhaust temperature. If the exhaust temperature exceeds 300° F, the machine must be shut down immediately.

Fig. 21: “AIR SHUTOFF VALVE” and sampling ports



Instructions on the maintenance

Maintenance at regular intervals increases the operational safety and prolongs the service life of the machine. In particular, observe the safety instructions in chapter 2 “Your safety”.

Important notes

Please observe the following:

- In order to avoid individual components not being serviced or being inadequately serviced during maintenance work on the machine , we recommend that a general maintenance plan be drawn up. You can, for example, draw up a checklist using this operation manual and the manuals of the other components.
- Inadequate maintenance can result in machine damage which leads to considerable costs.
- Use only suitable and approved tools for maintenance work.
- Use only original Bucyrus America, Inc. spare parts when replacing components.
- All electrical work must be supervised and inspected by a certified electrician.
- Anyone performing maintenance on this equipment must be trained to operate it and be familiar with this Bucyrus America, Inc. guide.

Before maintenance

Please observe the following:

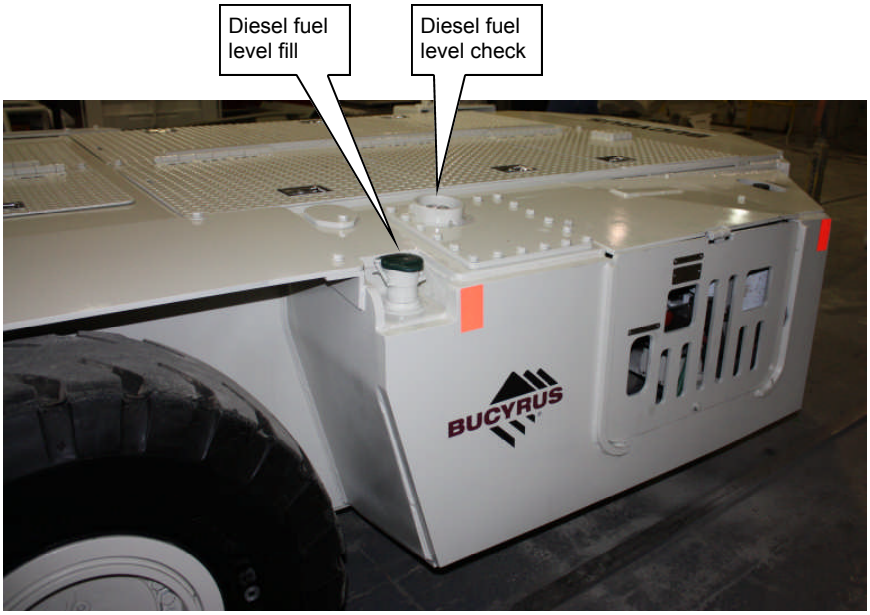
- Shutdown the machine on level ground.
- Test the controls to ensure that the unit will not move.
- Chock all four (4) wheels in each direction.
- Connect steering lockout device.

WARNING!
Do not move any hydraulic control lever unless you are certain that everyone is completely clear of any machine movement. Accidental machine movement can cause serious injuries or even death to you or the maintenance person.

WARNING!
Disconnect the battery before welding on the machine. Failure to do so may result in equipment damage.

Check the fuel level (Fig. 33) before each shift. Add fuel (low sulfur diesel fuel) as required.

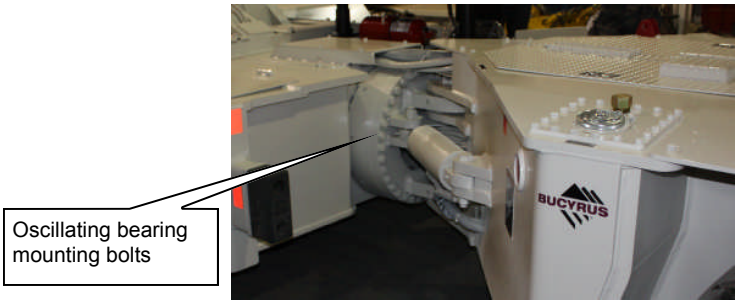
Fig. 33: Diesel fuel check



oscillating bearing mounting bolts

Check the oscillating bearing mounting bolts (Fig. 46). The mounting bolts should be torqued to 1340 - 1360 ft-lbs lubricated. Use Loctite 242 on mounting bolts.

Fig. 46: Oscillating bearing mounting bolts



return filter

Inspect the return filter dirt alarm (Fig. 47) located on the head of the filter. If the alarm indicates the filter element is dirty, replace element.

auxiliary pump pressure filter

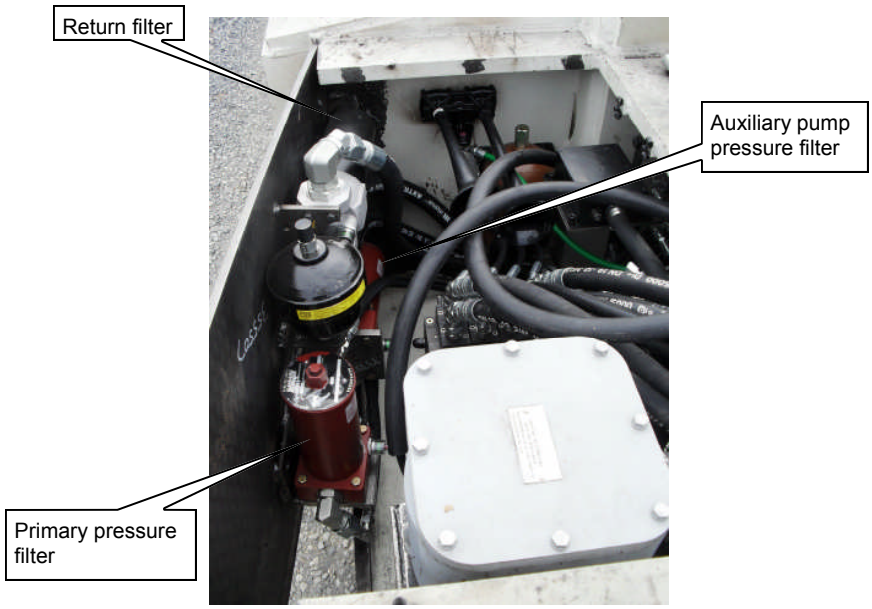
Inspect the pilot filter dirt alarm (Fig. 47) located on the head of the filter. If the alarm indicates the filter element is dirty, replace element.

WARNING!
Due to the auxiliary pump pressure filter being under high pressure, do not attempt to replace element until pressure has been released. To release pressure, operate any control selector handle until accumulator pressure has been depleted or switch the accumulator dump valve (Fig. 47).

primary pressure filter

Inspect the pressure filters dirt alarm (Fig. 47) located on the head of the filter. If the alarm indicates the filter element is dirty, replace element.

Fig. 47: Filter location



fuel pre-filter

To change the fuel pre-filter (Fig. 57):

- ☞ Close fuel stopcock and place the fuel pan beneath the fuel pre-filter.
- ☞ Remove drain plug and drain off fuel.
- ☞ Unscrew clamping screw and remove filter housing with filter insert.
- ☞ Clean sealing surface of the filter bracket and filter insert housing of any dirt.
- ☞ Insert new sealing ring and filter insert. Push the filter insert up to approximately 3 cm over the edge of the housing onto the guide in the filter housing. Press filter housing with filter insert and sealing ring against the filter console and screw into place with clamping screw. It must be possible to push the upper seal on filter insert over the guide bracket on filter console.
- ☞ Tighten drain plug and open fuel stopcock.
- ☞ Check for leaks after the engine has been started.

WARNING!
Avoid naked flames when working on the fuel system. Do not smoke. Dispose of waste fuel in an environmentally friendly way.

final fuel filter

To change the fuel filter (Fig. 57):

- ☞ Close the fuel stopcock.
- ☞ Undo the fuel filter cartridge with commercial tool and spin off.
- ☞ Catch any fuel.
- ☞ Clean any dirt from the filter carrier rim.
- ☞ Apply light film of oil or diesel fuel to the rubber gasket of the new fuel filter cartridge.
- ☞ Screw in the new cartridge finger tight against the gasket.
- ☞ Check that the cartridge is sealed correctly against the gasket and tighten with a final half-turn.
- ☞ Open the fuel stopcock.
- ☞ Check for leaks.

WARNING!
Avoid naked flames when working on the fuel system. Do not smoke. Dispose of waste fuel in an environmentally friendly way.

Diesel emissions

In situations where it is necessary to verify gaseous emissions of the UN-A-TRAC® , the following procedure is recommended.

- Insure all covers surrounding the engine and fan are in place.
- Insure the vehicle is in a safe location - free of pedestrian traffic.
- Place bucket against immovable object - such as berm or etc.
- Place transmission in neutral.
- Release parking brake.
- Remove emission test ports and install vent tubes.
  - Insure vent tubes divert exhaust from operator.
- Bring vehicle to high idle for 1 minute - allow tubes to vent.
- Bring engine to 190 °F operating temperature.
- Verify transmission temperature is less than 180 °F.
  - For optimum results transmission should not be above 120 °F before beginning the test.
- Engage service brake by depressing pedal fully.
  - Verify service brake gage is 0 psi.
- Place transmission into 3rd gear.
- Bring engine RPM to stall and assume test protocol specified by Local or State Authority.
  - Stall RPM is determined by Converter and will occur approximately 2,100 rpm.
- Monitor engine and transmission temperatures during test:
  - Engine temperature should not exceed 215 °F.
  - Transmission/Converter temperature should not exceed 280 °F for intervals exceeding 1 minute.
  - Transmission fluid and filter elements should be changed after the test.
  - If engine temperature exceeds 215 °F, with 68 °F ambient temperatures, the cooling system integrity should be verified.

particulate matter (PM)

These include all substances (with the exception of water) which under normal conditions are present as small solid or liquid particles in exhaust gases. PM is usually defined as "any material, other than water, in the exhaust of a diesel engine which can be filtered after dilution with ambient air". These particulates normally consist of a mixture of carbon (soot), hydrocarbons and sulfuric acid. Therefore we can assume that conditions, which affect the formation of soot, hydrocarbons and oxides of sulfur, will affect the particulate emission.

oxides of sulfur (SOx)

The SOx formation is caused by the oxidation of the sulfur contained in the fuel with the 02 available in the combustion air. The SOx concentrations depend on the sulfur content of the diesel fuel and the fuel consumption of the engine. SOx reductions in the diesel exhaust gas can only be achieved through the use of low sulfur fuels.

smoke

Smoke is usually defined as solid and liquid particles suspended in diesel exhaust gases, which obstruct, reflect or refract light. Smoke from diesel exhaust can be placed into 3 groups depending on the appearance under direct illumination:

- **Grey/black smoke** consisting of solid particles of carbon, i.e. soot.
- **White smoke** usually caused by the presence of vaporized and unburned diesel fuel in the exhaust gas, example, a misfiring cylinder.
- **Blue smoke** is usually caused by high concentrations of unburned or partially oxidized fuel or lubricating oil in the exhaust gas. This situation is typical of a diesel engine operating at low temperatures or suffering high oil consumption.

The visual appearance of the exhaust gas will depend on, the type of illumination and the background against which the exhaust gas is observed. In general, the "color" of the exhaust gas will appear as white/bluish, or grey/black.

The diesel exhaust gas odor is a result of a combination of aromatic hydrocarbons and other substances such as aldehydes. Since "odor" cannot be described objectively, conditions affecting the formation of odor-causing compounds are not easily well defined. However, for a given diesel engine, conditions which may affect the concentrations of unburned HC will tend to affect the odor of the diesel exhaust gas.

The air cleaner on diesel engines is designed to remove moisture, dirt, and dust from the air before it reaches the engine. It must do this over a reasonable time period before servicing is required. The air cleaner also acts as a silencer to reduce intake air noise. On a turbocharged engine, additional air is supplied by means of a turbocharger, which is exhaust gas driven On a supercharged engine (Detroit 2 cycle) a mechanically driven blower is used to supply additional air. The filter sizing should take into consideration these two additional features.

NOTICE!
Always refer to the manufacturer's recommended filter sizes for any given engine application.

Fig. 69: Typical intake system

dry type air cleaners

Modern dry-type air cleaners may have one or more replaceable filter elements and may include primary and secondary or safety filtering elements. Most dry-type air cleaners also include vanes, which act as a type of pre-cleaning device. The vanes may be part of the filter element or they may be part of the air cleaner housing. As air enters the air cleaner, it passes over the vanes, which impart a swirling action to the air. The swirling action causes the heavier dust and dirt to be thrown outward by centrifugal force against the air cleaner housing, where it goes to the dust collector.

The air intake system on modern electronically controlled diesel engines is equipped with one or more of the following sensors: ambient air pressure sensor for altitude compensation, intake manifold temperature sensor, and turbocharger boost pressure sensor. Any of these sensors can quickly detect a problem and cause the engine ECM (Electronic Control Module) to compensate by reducing the amount of fuel that is available thereby reducing speed and power. These sensors are normally located on the intake manifold.

Fig. 70: Typical intake system with TBS

Job aid checklist for exhaust system

Before any maintenance activities are undertaken a set of emissions tests should be performed, taken upstream and downstream of the purifier. This provides a set of values from which to compare the impact of the maintenance activities throughout the day. In addition to the emissions the exhaust backpressure is also measured with a standard mechanical gauge.

Checkpoints

- Emissions tests (Fig. 79) before and after exhaust purifier.
- Check exhaust backpressure.
- Visual inspection of complete system for leaks, cracks, etc.
- Check operation and setting of Jake Brakes (if applicable).

Fig. 79: Performing an emissions test

NOTICE!
Use a copy of the Job Aid Checklist at the end of this manual to record measurements and procedures.

Intake testing

The intake system can easily be considered the most critical with respect to maintenance and emissions. Ironically the intake system has the least known tools for servicing. In the past ether spray was used for detecting intake leaks by listening for engine acceleration where ether would leak by into the intake and combustion chamber.

Problems with ether including extreme flammability and potential catastrophic engine failure when improperly used have led to the discontinuation of its use. This situation left a huge gap where the only activity associated with intake systems was the regular replacement of air filter elements and blind faith that this practice alone was sufficient.

A system for methodically testing intake systems with no risks to either the person doing the test or the engine can be prepared by any mechanic. The system is simply a used intake filter element sealed externally with duct tape, an air pressure regulator and hose assembly, and a spray bottle containing a mixture of soap and water (Fig. 86 and Fig. 87). During service the plugged filter element(s) is installed in the intake housing and the air pressure regulator is connected to a fitting on the intake. Compressed air is regulated inside the intake system to no more than 5 psi for safety reasons. Even with the leakage across valves and turbocharger, enough static pressure remains in the system to produce bubbles when the soap and water solution is sprayed on all hoses and connections.

Fig. 86: Intake testing system

Fig. 87: Mechanic testing an intake system

Fuel injection system recommendations

- The fuel injection system is the most complex of all engine systems to maintain. The components are precision engineered with extremely close tolerances. For this reason the basics of maintenance and especially cleanliness are the most important considerations here.
- Check the primary fuel pressure on a scheduled basis. The entire fuel injection system relies on primary pressure for supply and lubrication as well as some cooling functions.
- Examine the filters that are being used and the criteria used for selecting them. Price is absolutely NOT the criteria by which filters should be selected for underground diesel engines. Performance and protection are all that matters here. Filters should be OEM (Original Equipment Manufacturers) whenever possible and should not pass particles larger than 5 microns. There should also be a guarantee that they will not permit the passage of water.
- Verify the proper operation of the air/fuel ratio.
- Inspect the fuel lines for proper size, condition and length. Fuel lines should be replaced when required but NEVER repaired.
- Inspect the system for correct match of engine to pump, injectors, lines, etc. Often parts are replaced that are incorrectly matched with the original equipment.
- Fuel temperature should be checked regularly to make sure that it is not becoming overheated. This must be done with the vehicle at maximum operating temperature after several hours of continuous operation. The temperature of the fuel in the tanks should never exceed 60°C.
- Use a filtered vent on the fuel tank. An open vent draws dirt continuously while the engine is drawing fuel. This puts unnecessary reliance on the fuel filters to catch this dirt. The tank breather element should be finer than 5 microns.
- As part of the scheduled maintenance the mechanic should check for air in the fuel in the form of champagne bubbles. Using a plastic hose in-line on the return side of the fuel system can do this. Air bubbles cause problems with injection pressures.
- Adjustments and/or replacements of any component such as injectors or pumps should be done only after the need to do so has been verified by testing engine performance and emissions. A systematic diagnostic approach must be taken before any fuel injection component is adjusted or changed. Failure to do so often leads to worse performance than the original condition. A good example of this would be the pop testing of mechanical injectors. Suspicion of an injector problem does not warrant replacement. Testing for chatter, spray pattern, holding and opening pressure, and leaking verifies the need for replacement.

Lubrication

Lubrication recommendations

Engine lubrication requires more attention to handling than most people give it. It is not merely a matter of topping up oil levels or replacing oil and filters. Mechanics and operators both need to recognize lubrication as an important factor in engine maintenance. Maintaining a proper oil level in the crankcase is essential to minimizing emissions. The practice of overfilling a crankcase at the start of a shift to compensate for leaks or oil consumption creates more problems than it solves, especially with respect to emissions. While low level problems will obviously cause wear and eventual failure problems, overfilled oil will cause problems with excessive emissions.

- As with the fuel filters, price should not determine which engine oil filters are purchased. Whenever possible OEM filters should be purchased for each type of engine.
- Inspect and evaluate the system for selection, storage, handling and dispersing of lube oils, from the bulk storage system right through to the use of portable containers in the field. Fill cans and nozzles should be checked regularly for cleanliness.
- Evaluate the system in place for monitoring oil contamination. Ensure that the information from the oil is being used effectively by the right people. Periodically the oils should be checked for reserve alkalinity and soot level to verify the interval baseline.
- When possible install warning systems for engine oil lube temperature. Excessively high temperatures have a direct negative effect on lubricity and viscosity.
- Educate both operators and mechanics on the importance of maintaining and verifying CORRECT ENGINE OIL LEVELS in engines. Operators should be checking the oil at the beginning of their shift. Mechanics should ensure that the right dipstick is in use on each piece of equipment on their beat.
- Oil and fuel filters should NOT be pre-filled on a workbench before installation due to the possibility of unnecessary contamination.

Axle removal/installation

axle removal

To remove either axle from the machine (reference Fig. 114):

- ☞ Park the machine on level ground.
- ☞ Properly crib the machine using standard mine practices and following all applicable mine safety rules.

WARNING!
Make sure the machine is properly cribbed before removing the axle. Serious injury or death can occur from falling loads.

- ☞ Disconnect the battery.

WARNING!
Before performing maintenance on the machine, the disconnect the battery. Electrical shock or accidental machine movement can cause serious injury or death.

- ☞ Test the controls to ensure that the unit will not move.

WARNING!
Do not test any control unless you are sure that everyone is completely clear of all machine movement. Accidental machine movement can cause serious injury or death.

- ☞ Remove wheels from each end of the axle by removing the wheel mounting nuts.
- ☞ Disconnect, tag, and cap the service brake lines.
- ☞ Disconnect the drive shaft from the axle.
- ☞ Support the axle so that it will not fall when the axle mounting bolts are removed.

WARNING!
Before removing axle mounting bolts, make sure the axle is properly supported. Serious injury can resulting from falling loads.

- ☞ Remove the axle mounting bolts.

Instructions on the adjustment procedures

It is essential that adjustments be made periodically, as otherwise damage can be caused to other parts of the machine. Inspect the adjustments at regular intervals.

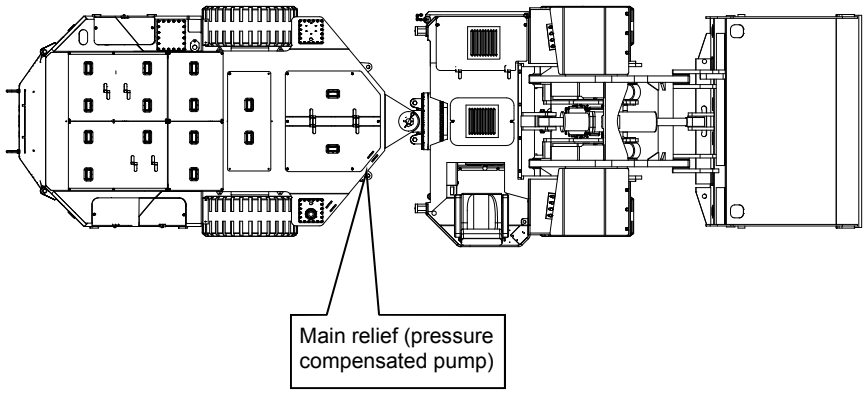
WARNING!
Failure to follow applicable guidelines described in Chapter 2, "Your Safety" before performing maintenance or service on this machine could result in severe personal injury or potential death.

Main relief - pressure compensated variable pump

The relief valve (Fig. 19) is in-line with the outlet port of the pressure compensated variable pump and is to be adjusted to a maximum of 3,000 psi for normal operation.

- ☞ Adjust the relief (turn in, cw) to a point to a point where the compensator setting of the pump may be raised to 3,200 - 3,300 psi.
- ☞ Adjust the compensator setting of the pump to 3,200 to 3,300 psi by turning the adjustment stem in (cw).
- ☞ Adjust the relief by turning its adjustment stem out (ccw) until the system pressure is 3,000 psi and secure.
- ☞ Adjust the compensator to 2,800 psi and secure in place.

Fig. 119: Main relief - pressure compensated variable pump



DRAWING NO. 607214	SHEET NO. 5	BUCYRUS	4041 WURNO ROAD PULASKI, VA 24301

DRAWN J.COE DATE 5/17/07	DIRECTED J. COE	PART 36 MACHINE APPROVAL NUMBERS THAT USE THIS CHECKLIST	
CHECKED J. COE DATE 5/17/07	APPROVED J. COE		

REVISIONS:	REV A 1015939	REV B	REV C	REV D	MINE SAFETY & HEALTH ADMINISTRATION APPROVED PRINT. NO DEVIATION IS LEGAL UNTIL APPROVED BY MSHA

** REFERENCED ITEMS SHOWN ON MACHINE LAYOUT DIAGRAM.

*** (WEEKLY) DESIGNATES THOSE INSPECTION CHECKS THAT MUST BE PERFORMED DURING THE WEEKLY MAINTENANCE EXAMINATION IN ACCORDANCE WITH 30 CFR, SECTION 75.1914.**

*2. ( ) CHECK THE BRAKE PAD DRAGGING BY OBSERVING THE BRAKE SYSTEM GAUGE MENTIONED ABOVE WHILE THE CAR IS IN OPERATION AND THE BRAKE IS NOT APPLIED. IF THE PRESSURE IS LESS THAN 1450 PSI , THE BRAKE CIRCUIT SHOULD BE REVIEWED AND THE SOURCE OF INADEQUATE RELEASE PRESSURE DETERMINED.

3. ( ) THE BRAKE STATUS IN REGARD TO WEAR, CAN BE DETERMINED BY A WEAR INDICATOR LOCATED ON THE INBOARD FACE OF EACH BRAKE. THE INDICATOR IS PROTECTED BY AN ACORN NUT. REMOVE THE NUT AND DEPRESS THE PLUNGER PROTRUDING FROM THE INDICATOR WEAR FACE. IF THE PLUGER CAN BE DEPRESSED PAST THE INDICATOR FACE, THE BRAKES ARE WORN AND SHOULD BE SERVICED.

*4. ( ) PARKING BRAKE TEST

A. WITH THE ENGINE OPERATING AND THE MACHINE STATIONARY, APPLY THE PARKING BRAKE (6) **.

B. PLACE THE TRANSMISSION GEAR SELECTOR IN FSECOND GEAR AND THE DIRECTIONAL CONTROL SELECTOR IN FORWARD OR REVERSE.

C. ACTUATE THE DECLUTH BYPASS VALVE LOCATED ON THE LEFT SIDE WALL OF THE OPERATOR'S COMPARTMENT AND HOLD DURING THE TEST.

WARNING: RELEASING THE DECLUTCH BYPASS VALVE DURING THE TEST MAY CAUSE THE MACHINE TO LURCH IN FORWARD OR REVERSE DIRECTION AS SELECTED.

NOTE: IF THE DECLUTCH BYPASS VALVE IS RELEASED DURING THE TEST, THE TEST PROCEDURE MUST BE STARTED AGAIN BEGINNING WITH "A" ABOVE.

D. DEPRESS THE ACCELERATOR TO FULL THROTTLE, ALLOWING THE ENGINE TO PUT THE TRANSMISSION TORQUE CONVERTOR INTO A STALL CONDITION.

E. AFTER THE TEST, RETURN THE ENGINE TO LOW IDLE, RELEASE THE DECLUTCH BYPASS VALVE AND RETURN THE PARK BRAKE LEVER TO THE "ON" OR "SET" POSITION.

NOTE: IF THE PARKING BRAKE IS OPERATING SATISFACTORILY, THE UNIT WILL NOT MOVE WHEN THE ABOVE PROCEDURE IS FOLLOWED. IF MOVEMENT IS DETECTED, THE PARKING BRAKE MUST BE REPAIRED OR ADJUSTED.

** REFERENCED ITEMS SHOWN ON MACHINE LAYOUT DIAGRAM.

TITLE	DRAWING NUMBER	SHEET NO.	OF
MACHINE / ELECTRICAL CHECKLIST	607214	5	10 SHEETS

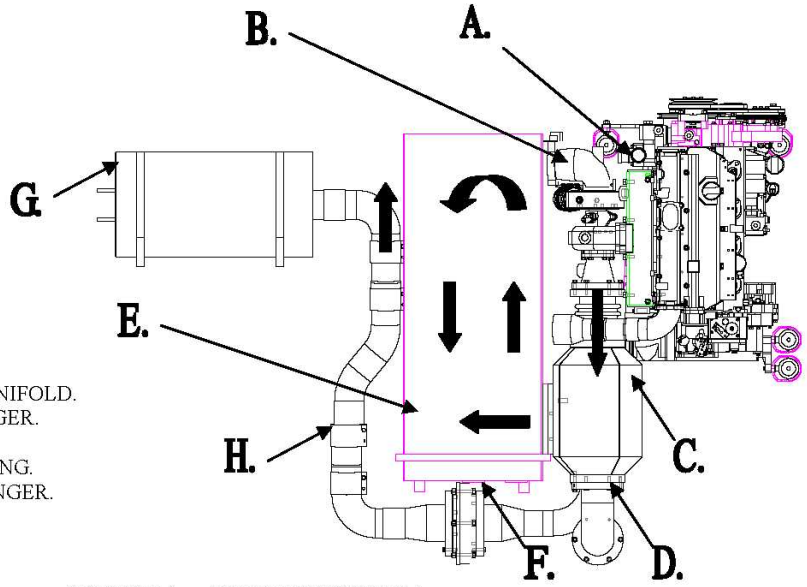
DRAWING NO. 606348	SHEET NO. 5	BUCYRUS	4041 Wurno Road Pulaski, VA 24301

REDRAWN J. Coe	DATE 8/07/07	DIRECTED J. Coe
CHECKED M. MEYERS	DATE 7/29/09	APPROVED J. Coe

REVISIONS:	REV A 1015564 10/29/07	REV B 11994 7/29/09	REV C	REV D	MINE SAFETY & HEALTH ADMINISTRATION APPROVED PRINT. NO DEVIATION IS LEGAL UNTIL APPROVED BY MSHA

EXHAUST SYSTEM

THE EXHAUST SYSTEM OF THE ENGINE INCLUDES A WATER-COOLED EXHAUST MANIFOLD, A WATER COOLED TURBO CHARGER, WATER-COOLED EXHAUST PIPE, WATER COOLED CO REACTOR, WATER COOLED HEAT EXCHANGER, A FLAME ARRESTOR, A SERIES OF EXHAUST PIPES, A DRY PARTICULATE FILTER HOUSING,AND A DISPOSABLE PARTICULATE FILTER ELEMENT. SKETCH 4a AND 4b DEPICTS THIS SYSTEM.



A. WATER COOLED EXHAUST MANIFOLD.
B. WATER COOLED TURBO CHARGER.
C. WATER COOLED CO REACTOR
D. WATER COOLED EXHAUST PIPING.
E. WATER COOLED HEAT EXCHANGER.
F. FLAME ARRESTOR.
G. DPM FILTER HOUSING.
H. EXHAUST PIPES.

SKETCH 4a: EXHAUST SYSTEM

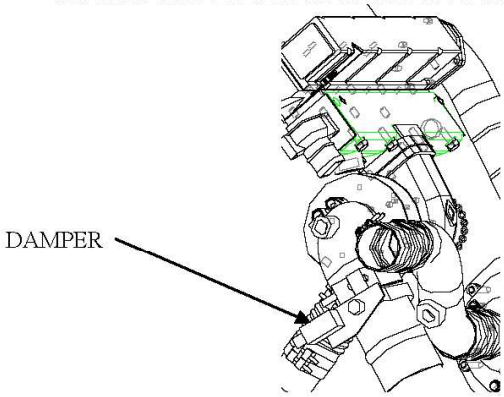
TEST SHEET TITLE: POWER SYSTEM CHECKLIST					MINE SAFETY & HEALTH ADMINISTRATION APPROVED PRINT. NO DEVIATION OR REVISION IS LEGAL UNTIL APPROVED BY MSHA		
DISTR. CODE SEE DRG.	STD: B	SPECIAL:	ENG. SEC L.	PRINT LOCATION:	DRAWING NUMBER 606348	SHEET NO. 5	OF 22 SHEETS

DRAWING NO. 606348	SHEET NO. 15	BUCYRUS	4041 Wurno Road Pulaski, VA 24301
REDRAWN J. Coe DATE 8/07/07	DIRECTED J. Coe		
CHECKED M. MEYERS DATE 7/29/09	APPROVED J. Coe		

REVISIONS:	REV A 1015564 10/29/07	REV B 11994 7/29/09	REV C	REV D	MINE SAFETY & HEALTH ADMINISTRATION APPROVED PRINT. NO DEVIATION IS LEGAL UNTIL APPROVED BY MSHA

*3. ( ) WITH THE ENGINE RUNNING AT IDLE, PULL THE EMERGENCY ENGINE STOP CABLE HANDLE IN THE OPERATORS COMPARTMENT. THE BUTTERFLY VALVE IN THE AIR SHUT DOWN DAMPER (SEE SKETCH 12) SHOULD CLOSE IMMEDIATLY AND THE ENGINE SHOULD STOP COMPLETELY WITHIN 15 SECONDS.

SKETCH 12: INTAKE AIR EMERGENCY SHUT-DOWN DAMPER

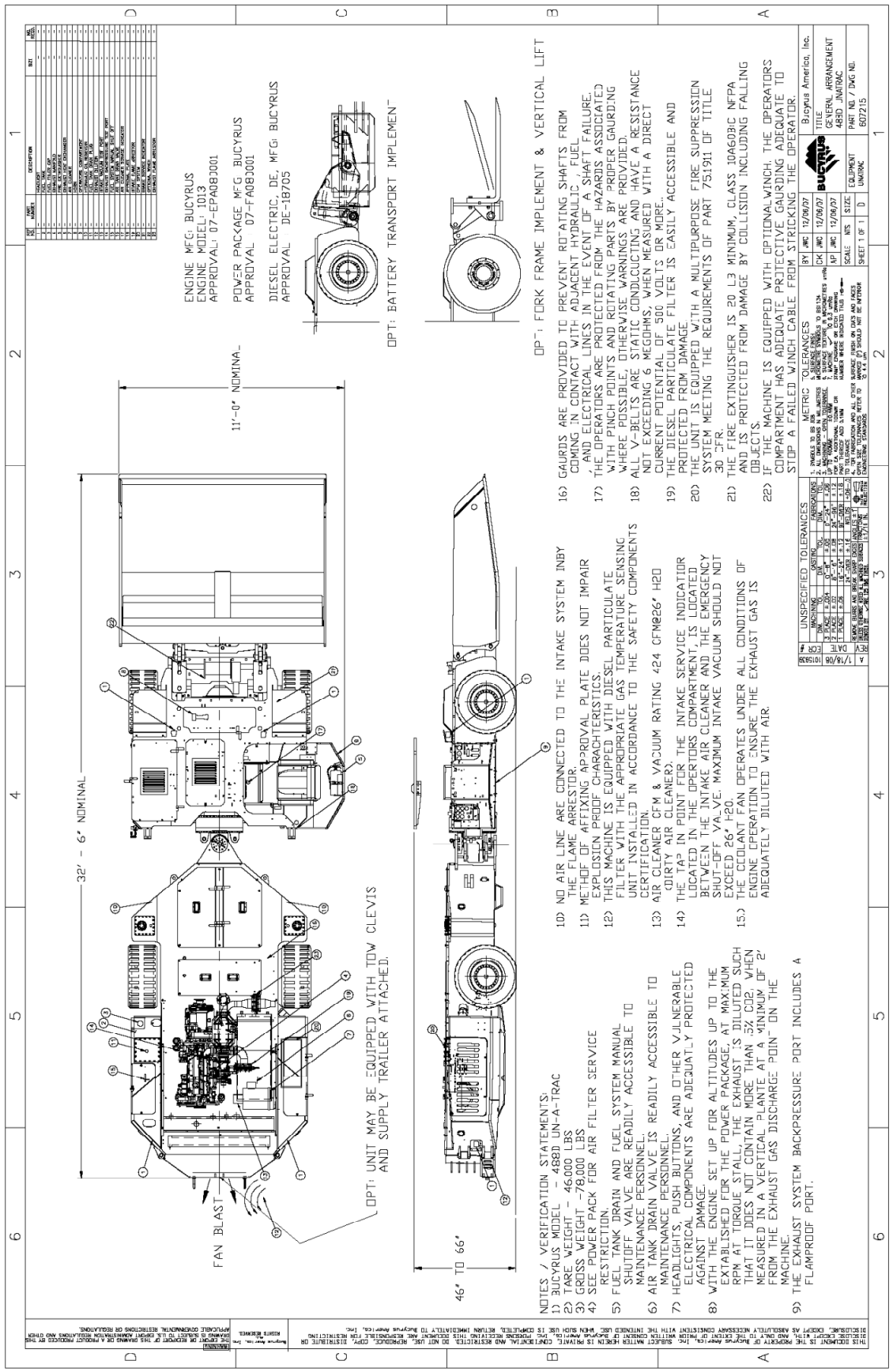


*4. ( ) WITH THE ENGINE RUNNING AT HIGH IDLE, PULL THE EMERGENCY ENGINE STOP CABLE HANDLE IN THE OPERATORS COMPARTMENT. THE BUTTERFLY VALVE IN THE AIR SHUT DOWN DAMPER SHOULD CLOSE IMMEDIATLY AND THE ENGINE SHOULD STOP COMPLETELY WITHIN 15 SECONDS.

RESET DAMPER WITH THE MANUAL LEVER, CABLE RETRACTED, ON THE AIR SHUT OFF ASSEMBLY AT THE ENGINE AIR INTAKE.

*(WEEKLY) DESIGNATES THOSE INSPECTION CHECKS THAT MUST BE PERFORMED DURING THE WEEKLY MAINTENANCE EXAMINATION IN ACCORDANCE WITH 30 CFR, SECTION 75.1914.

TEST SHEET TITLE: POWER SYSTEM CHECKLIST					MINE SAFETY & HEALTH ADMINISTRATION APPROVED PRINT. NO DEVIATION OR REVISION IS LEGAL UNTIL APPROVED BY MSHA		
DISTR. CODE SEE DRG.	STD: B	SPECIAL:	ENG. SEC L.	PRINT LOCATION:	DRAWING NUMBER 606348	SHEET NO. 15	OF 22 SHEETS



Brakes

Table 8: Brakes troubleshooting

Problem or symptom	Probable cause	Test, check and/or remedy
brakes slow to apply	☞ Defective brakes.	☞ Check brakes.
	☞ Pedal linkage out of adjustment.	☞ Adjust linkage.
	☞ Damaged hydraulic brake lines.	☞ Check lines for dents that restrict flow of oil.
	☞ Defective brake pedal valve.	☞ Test individual valve performance and replace brake valve (s) as required.
brakes won't release	☞ Pedal linkage out of adjustment or binding.	☞ Check for proper adjustment and binding.
	☞ Brake release controls not functioning properly.	☞ Inspect brake release solenoid, pilot valves and brake release hand pump.
	☞ Defective brakes.	☞ Check brakes.
	☞ Defective brake pedal valve.	☞ Test individual valve performance and replace brake valve (s) as required.
insufficient brakes	☞ No oil or low level in tank.	☞ Check oil level in tank.
	☞ Pedal linkage out of adjustment.	☞ Adjust linkage.
	☞ Brake line mashed.	☞ Check lines and replace.
	☞ No gas charge in accumulator.	☞ Check gas charge.
	☞ Defective brakes.	☞ Repair or replace as required.
	☞ Brake valve defective.	☞ Test valves performance and replace valve as required.
brakes will not release completely	☞ Defective brakes.	☞ Check brakes.
	☞ Oil Level.	☞ Check oil level and fill as required.
	☞ Pedal linkage out of adjustment.	☞ Adjust pedal linkage.
	☞ Air in brakes.	☞ Bleed brakes.
	☞ Defective brake valve.	☞ Replace brake valve.
	☞ Brake release controls not functioning properly.	☞ Inspect brake release solenoid, pilot valves and brake release hand pump.

Table 12 (continues): Engine troubleshooting

Problem or symptom	Probable cause	Test, check and/or remedy
loud noise (clicking) from valve compartment	☞ Damage to valve spring(s) or lock(s).	☞ Call Bucyrus.
	☞ Not enough lubrication.	☞ Check lubrication in valve compartment. There must be a strong flow of oil at engine high rpm, but only a small flow of oil at low rpm. Oil passages must be clean, especially those sending oil to the cylinder head.
	☞ Too much valve clearance.	☞ Call Bucyrus.
	☞ Damage to valves.	☞ Call Bucyrus.
oil in cooling system	☞ Leaking head gasket.	☞ Install a new head gasket.
mechanical noise (knock) in engine	☞ Connecting rod bearing failure.	☞ Call Bucyrus.
	☞ Timing gear damage.	☞ Call Bucyrus.
	☞ Crankshaft damage.	☞ Call Bucyrus.
fuel consumption too high	☞ Fuel system leaks.	☞ Inspect the fuel system for leaks and make repairs as necessary.
	☞ Fuel and combustion noise.	☞ Small increases in fuel consumption may be the result of fuel nozzles with defects, rough running, or factors causing loss of power (see previous sections).
	☞ Fuel injection timing wrong.	☞ Call Bucyrus.
loud noise from valves or valve drive components	☞ Valve spring damage.	☞ Call Bucyrus.
	☞ Camshaft damage.	☞ Call Bucyrus.
	☞ Valve lifter damage.	☞ Call Bucyrus.
	☞ Valve(s) damage.	☞ Call Bucyrus.

Table 16 (continued): Compressor troubleshooting

Problem or symptom	Probable cause	Test, check and/or remedy
compressor passes excessive oil	☞ Excessive wear.	☞ See “noisy operation”.
	☞ Dirty air strainer.	☞ See “insufficient compressor pressure”.
	☞ High inlet vacuum.	☞ Check valve operation.
	☞ Small oil return line.	☞ Replace with larger line.
	☞ Excessive oil pressure.	☞ Check level, pump, lines.
	☞ Oil supply or return lines flooded.	☞ See “insufficient compressor pressure” section.
	☞ Defective or worn oil seal rings in end cover.	☞ Replace oil rings.
	☞ Piston rings not properly installed.	☞ Disassemble and reinstall.
	☞ Back pressure from engine crankcase.	☞ Check lines, oil level.

Tightening torques

IMPORTANT!
Due to the application of fasteners being subject to great stresses and heavy or extreme vibration, it is imperative that all bolts be applied with an adequate amount of torque. For this reason this list of recommended torque settings for different types and sizes of fasteners used has been compiled.
The tightening torques stated in the spare parts lists have to be observed, as well, for installation and maintenance.

Set screws

Table 16: Set screws (Socket long-lok)

Nominal diameter	Recommended torque setting
#6	6 in-lbs
#8	9 in-lbs
#10	13 in-lbs
¼”	30 in-lbs
5/16”	5 ft-lbs
3/8”	8 ft-lbs
7/16”	11 ft-lbs
½”	16.7 ft-lbs

Table 17: Set screws (Socket standard steel)

Nominal diameter	Recommended torque setting
#6	9 in-lbs
#8	16 in-lbs
#10	30 in-lbs
¼”	6 ft-lbs
5/16”	12 ft-lbs
3/8”	18 ft-lbs
7/16”	29 ft-lbs
½”	43 ft-lbs
5/8”	100 ft-lbs
¾”	146 ft-lbs
7/8”	199 ft-lbs
1”	262 ft-lbs

Table 36: Invert emulsion hydraulic fluid (Spec. 100-5)

	Supplier	Brand name
1	Unocal 76	FR Fluid
2	Conoco Inc.	FR Hydraulic Fluid
3	Atlantic Richfield Company	Duro FR-HD
4	Brooks Oil Company	Brooks Fire Resistant Hydraulic Fluid B
5	Cincinnati – Vulcon Company	Vulcon FR Fluid #1
6	Cities Service Oil Company	Citgo Pacemaker Invert FR Fluid
7	Century Oils Limited	Aquacent Light
8	Fiske Bros. Refining Co.	Lubriplate HO-Retard
9	Getty Oil Company (Veedol, Tidewater)	Veedol Auburn FRH
10	Gulf Oil Company	FR Fluid
11	E.F. Houghton	Houghto-Safe 5046 Houghto-Safe 5046W
12	Century Lubricating Oils	Hulsafe 600
13	Imperial Oil and Grease	Astrol 587
14	Mobil Oil Corporation	Pyrogard D
15	National Oil and Chemical Co.	Erifon 1, 2, and 3
16	Pennzoil	Maxmul FRP/G
17	Quaker Chemical Company	Quintolubric 958 Series Quintolubric 958 Series
18	Henery E. Sanson and Sons MFGE Company	Hydra-Mul Premium Emulsion Fluid
19	Southwest Grease and Oil Company, Inc.	Invert Emulsion Fire Resistant Hydraulic Fluid
20	Southwest Petroleum Corp.	Swepco Fire Resistant Hydraulic Oil #718
21	Standard Oil Company of Ohio (Boron Sohio)	Staysol FR
22	Sun Oil Company	Sunsafe F
23	Tower Oil Company	Safoil Anti-Wear Hydraulic Fluid
24	Wynn Oil Company	Hydra-Safe Heavy Medium
25	Lubrication Engineers	6455 Monolec Fire Resistant Hydraulic Fluid
26	Hydrotex	HY-Guard