


ODECS

Diesel Exhaust Cleaning System

OPERATOR'S MANUAL

Marine Generators | Marine Diesel Engines | Land-Based Generators

NORTHERN LIGHTS




— CALIFORNIA —
Proposition 65 Warning:

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

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NORTHERN LIGHTS

OPERATOR'S MANUAL

DECS Diesel Exhaust Cleaning System

Read this operator's manual thoroughly before starting to operate your equipment.
This manual contains information you will need to run and service your new unit.

Table of Contents

A. Warranty

A warranty registration certificate is supplied with your set. It entitles the original purchaser of our equipment to a warranty covering material or assembly faults. The extent of coverage is described in the Limited Warranty Statement. We recommend that you study the statement carefully.

NOTE: If the warranty is to apply, the servicing instructions outlined in this manual must be followed. If further information is needed, please contact an authorized dealer or the factory.

B. Safety Instructions

NOTICE: ***Accident reports show that careless use of engines causes a high percentage of accidents. You can avoid accidents by observing these safety rules. Study these rules carefully and enforce them on the job.***

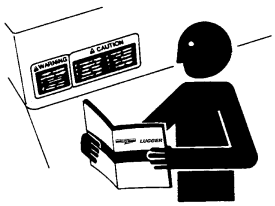
IMPORTANT SAFETY INSTRUCTIONS. Electromagnetic equipment, including generator sets and their accessories, can cause bodily harm and life threatening injuries when improperly installed, operated or maintained. To prevent accidents be aware of potential dangers and act safely.

READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN THIS MANUAL, PRIOR TO THE INSTALLATION OF ANY GENERATOR SET OR ACCESSORY. KEEP THESE INSTRUCTIONS FOR FUTURE REFERENCE.

Recognize Safety Symbols and Instructions
In addition to the information found in this section, this operator's manual uses three different signal words to outline potential dangers of a specific nature.

DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Follow All Safety Instructions



Carefully read and understand all safety messages in this manual and on your machine's safety signs. Keep signs in good and clean condition. Replace missing or damaged signs. Be sure new equipment components and repair parts include the current safety signs. For replacement signs, proper placement of safety signs or clarification on any safety issue, consult your Northern Lights dealer or the factory.

There can be additional safety information contained on parts and components from outside suppliers that is not reproduced in this manual. Consult the suppliers for additional safety information.

Learn how to operate the machine and how to use the controls properly. Only trained personnel should operate machines, or work on or around them.

Keep you machine in proper working condition. UNAUTHORIZED MODIFICATIONS TO THE MACHINERY MAY IMPAIR ITS FUNCTION AND SAFETY PARAMETERS.

Prevent Bypass and Accidental Starting

WARNING

Do not start engine by shorting across start terminal. Engine will start if normal circuitry is bypassed, creating a hazard by runaway machinery.

Start engine only from operator's station.

Handle Fuel Safely - Avoid Flames

WARNING

Diesel is highly flammable and should be treated with care at all times. Do not refuel while smoking or when near sparks or open flame.

ALWAYS STOP ENGINE BEFORE FUELING MACHINE. Always fill portable fuel tank outdoors. Never fuel a hot engine.

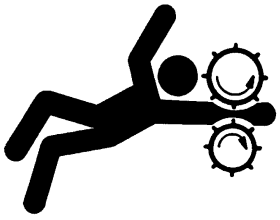
Prevent accidental discharge of starting fluids by storing all cans in a cool, safe place, away from sparks or open flame. Store with cap securely on container. Never incinerate or puncture a fuel container.

Prevent fires by keeping machine clean of accumulated trash, grease and debris. Always clean any spilled fuel as swiftly as possible. Do not store oily rags, which can ignite and burn spontaneously.

Be prepared if a fire starts. Keep a first aid kit and fire extinguisher handy. Keep emergency contact numbers for fire department, doctors, ambulance and hospital near the telephone.

Service Machines Safely

⚠DANGER



Do not wear a necktie, scarf, necklace, rings or other jewelry, or any loose clothing when working near moving parts. Tie long hair behind your head. If any of these items get caught in moving machinery, severe injury or death could result.

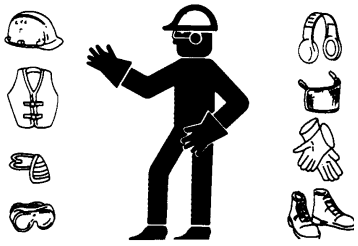
Check for any loose electrical connections or faulty wiring.

Look completely around engine to make sure that everything is clear before starting.

Wear Protective Clothing

⚠WARNING

To prevent catching anything in moving machinery, always wear close fitting clothes and safety equipment appropriate to the job.
Prolonged exposure to loud noise can cause hearing loss or impairment.
Wear suitable authorized hearing protection, such as earmuffs or plugs to protect against loud noises.



Operating equipment requires the full attention of the operator. Do not use radio or music headphones while operating machinery.

Practice Safe Maintenance

⚠CAUTION

Understand all service procedures before starting work. Keep area clean and dry. Never lubricate, service, or adjust machine while it is in operation.

Keep hands, feet and clothing away from power-driven equipment. When shutting down an engine, disengage all power and operator controls. Allow the engine to cool completely before beginning any service work.

Securely support any machinery elements that must be raised for service work with support or lifting machinery specifically intended for that purpose.

Keep all parts in good conditions and properly installed. Fix damage immediately. Replace any worn or broken parts. Remove any build up of grease, oil or debris.

Disconnect battery ground cable (-) before making any adjustments or service work.

Stay Clear of Rotating Drivelines

⚠DANGER

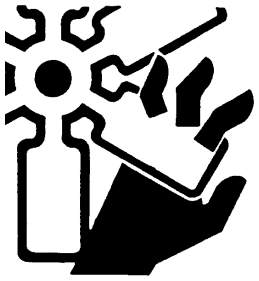
Entanglement in rotating drivelines can cause serious injury or death. Keep shields in place at all times. Make sure that rotating shields turn freely in pace with the drivelines.

Do not wear loose fitting equipment around rotating drivelines. Stop the engine and make sure that all moving parts have stopped before making any adjustments, connections, or performing any other type of service to the engine or other driven equipment.

B. Safety Instructions

Install all Safety Guards

⚠ WARNING



Direct contact with rotating fans, belts, pulley and drives can cause serious injury.

Keep all guards in place at all times during engine operation.

Wear close-fitting clothes. Stop the engine and be sure all fans, belts, pulleys and drives are stopped before making adjustments, connections, or cleaning near fans and their components.

Do not allow anything on your person to dangle into or come in contact with a moving fan, belt, pulley or drive. Fans can act as vacuums and pull materials up from below, so avoid that area as well while in service.

Safe Battery Handling

⚠ WARNING

Prevent Battery Explosions

Battery gas is highly flammable. Battery explosions can cause severe injury or death. To help prevent battery explosions, keep sparks, lighted matches and open flame away from the top of battery. When checking battery electrolyte level, use a flashlight.

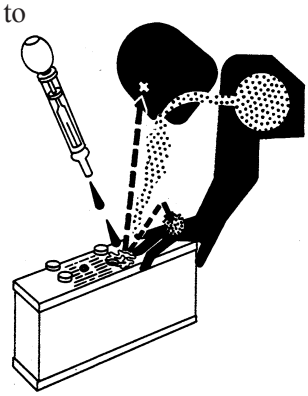
Never check battery charge by contacting the posts with a metal object. Use a volt-meter or hydrometer.

Frozen batteries may explode if charged. Never charge a battery that has not been allowed to warm to at least 16^{o}C (60^{o}F).
Always remove grounded (-) battery clamp first and replace ground clamp last.

Sulfuric acid in battery electrolyte is poisonous and strong enough to burn skin, eat holes into clothing and other materials, and cause blindness if splashed into eyes.

To Avoid Hazards:
- Fill batteries only in well-ventilated areas.
- Wear appropriate eye protection and rubber gloves.
- Never use air pressure to clean batteries.
- Wear appropriate ventilation equipment to avoid inhaling fumes when adding electrolyte.
- Do not spill or drip electrolyte.
- Use correct jump-start procedure if required.

If acid is spilled on skin or in eyes:
1. Flush skin with water.
2. Apply baking soda or lime to help neutralize acid.
3. Flush eyes with water for 15-30 minutes.
4. Get medical attention immediately.



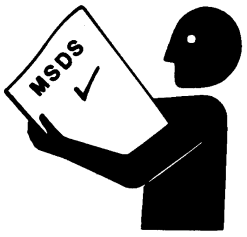
If acid is swallowed:
1. DO NOT induce vomiting.
2. Drink large amounts of water or milk, without exceeding 2 liters (2 quarts)
3. Get medical attention immediately

⚠ WARNING

Battery posts, terminals, and related accessories can contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

Handle Chemical Products Safely

⚠ WARNING



Direct exposure to hazardous chemicals can cause serious inju
Among the potentially hazardou
chemicals that may be used with Northern Lights products are lubricants, coolants, paints and adhesives.

All potentially hazardous chemicals come with a Material Data Safety Sheet (MSDS). The MSDS provides specific details on chemical products, including physical hazards, safety procedures and emergency response techniques

Read and understand the MSDS for each chemical before you start any job that includes it. Follow the procedures and use appropriate equipment exactly as recommended.

Contact your Northern Lights dealer or Northern Lights factory for MSDS's used on Northern Lights products.

Work in Well Ventilated Areas

⚠ CAUTION

Exhaust fumes from engines contain carbon monoxide and can cause sickness or death. Work in well ventilated areas to avoid prolonged exposure to engine fumes. If it is necessary to run an engine in an enclosed area, route the exhaust fumes out of the area with an approved, leak proof exhaust pipe extension.

Remove Paint Before Welding or Heating

⚠ WARNING

Hazardous fumes can be generated when paint is heated by welding, soldering or using a torch. To avoid potentially toxic fumes and dust, remove paint before heating.

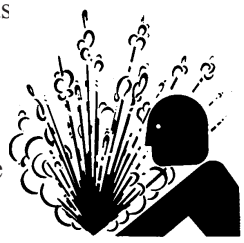
- Remove paint a minimum of 100 mm (4 in.) from the area that will be affected by heat.
- If paint cannot be removed, wear an approved respirator.
- If you sand or grind paint, use an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers from the area.
- Allow at least 15 minutes for fumes to disperse before welding or heating.

Do not use a chlorinated solvent in an area where welding will occur. Work only in areas that are well ventilated. Dispose of paint and solvent properly.

Service Cooling System Safely

⚠ WARNING

Opening a pressurized cooling system can release explosive fluids and causing serious
Before opening any pressurized cooling system, make sure the engine has been shut off. Do not remove a filler cap unless it is cool enough to comfortably grip with bare hands. Slowly loosen cap to relieve pressure before opening fully.



Avoid High Pressure Fluids

⚠ WARNING

Relieve pressure prior to disconnecting pressurized lines. Escaping fluid under pressure can penetrate the skin causing serious injury. Always relieve pressure before disconnecting hydraulic or other pressurized lines. Tighten all connections firmly before re-applying pressure.

If searching for leaks, use a piece of cardboard. Always protect your hands and other body parts from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any high pressure spray injected into the skin must be removed within a few hours to prevent the risk of gangrene or other infection.

Avoid Heating Near Pressurized Fluid Lines

⚠ WARNING

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns and bodily injury. Pressurized lines can rupture when heat goes beyond the immediate flame area. Do not weld, solder or use a torch or open flame near pressurized lines or other flammable fluids.

Do Not Open High-Pressure Fuel System

⚠ DANGER

Many Northern Lights engines use high-pressure fuel injection. High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt any repair of fuel lines, sensors, or other components between the high-pressure fuel pump and nozzles on engines with high pressure fuel systems.

⚠ ONLY AUTHORIZED TECHNICIANS CAN PERFORM REPAIRS ON AN HIGH PRESSURE FUEL INJECTION SYSTEMS.

B. Safety Instructions

Avoid Hot Exhaust

⚠ WARNING

Avoid exposure to and physical contact with hot exhaust gases. Exhaust parts and streams can reach high temperatures during operation, leading to burns or other serious injury.

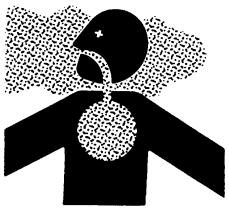
Cleaning exhaust filters can also lead to exposure to hot exhaust gas and the injury risk associated with it. Avoid exposure to and physical contact with hot exhaust gases when cleaning exhaust filters.

During auto or manual/stationary exhaust filter cleaning operations, the engine will run at elevated temperatures for an extended period of time. Exhaust parts and streams can reach high temperatures during operation, leading to burns or other serious injury.

Avoid Harmful Asbestos Dust

⚠ WARNING

Inhaling asbestos fibers may cause lung cancer. Avoid breathing any dust that may be generated when handling components containing asbestos fibers, including some gaskets.

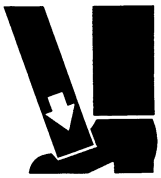


The asbestos used in these components is usually found in a resin or otherwise sealed. Normal handling of these components is not dangerous, as long as airborne dust containing asbestos is not generated.
Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding materials containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If this vacuum is not available, apply a mist of oil or water on the material containing asbestos. Keep all bystanders away from any area where asbestos dust may be generated.

Use Proper Lifting Equipment and Techniques

⚠ WARNING

Lifting heavy components incorrectly can cause severe injury or damage to machinery. Avoid unbalanced loads. Do not use lifting eyes. Lift the generator set using lifting bars inserted through the lifting holes on the skid. Follow all recommended removal and installation procedures in this and associated Northern Lights manuals.



Use Proper Tools

⚠ CAUTION

Makeshift tools and procedures can create safety hazards. Always use appropriate tools for the job.

Use power tools only to loosen threaded parts and fasteners. For loosening and tightening hardware, always use the correct sized tools.

Do not use US measurement tools on metric fasteners, or vice versa. Use only service parts that meet Northern Lights specifications.

Dispose of Waste Properly

⚠ CAUTION

Disposing of waste improperly can threaten the environment and lead to unsafe working conditions. Potentially harmful waste used in Northern Lights equipment can include oil, fuel, coolant, filters and batteries.

Use leakproof containers to drain fluid. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain or into any water source.

Scope

During maintenance, repairs or retooling of a Northern Lights generator set, simply turning the machine off or unplugging it while it is being worked on does not give enough protection to others who are not performing the maintenance or repair. Many serious accidents happen when someone thought the machine was turned off, or all of its energy was safely blocked or released.

General Policy

To avoid dangerous or hazardous situations, refrain from any of the following:

- Removing or bypassing a guard or other safety device
- Placing any part of your body in a position where you could be caught by moving machinery.
- Cleaning or oiling machinery when in operation.
- Adjusting circuits, chillers, pumps, air handlers, valves, circuit breakers or fans while in operation.
- Working on piping or high pressure systems.

Lock Out/Tag Out Instructions - Electrical Equipment

⚠ WARNING

Be sure the equipment's ON/OFF switch is in the OFF position and is unplugged from any electrical source before attempting to perform any type of work on the equipment. Obtain an electrical plug cap cover with a lockset. Secure the plug terminal end using the electrical plug lockout cap. Lock the cap and retain the key.

If the equipment is directly wired into an electrical box with a shut off switch, obtain a lock pad and/or the appropriate colored tags and place the lock and tag through the shut off lever. Retain the key until the repair is completed and the machine is safe to start. Be certain the shut off lever is in the OFF position before restarting. NEVER give a lock out key to unauthorized personnel.

If the equipment is directly wired into an electrical box without a shut off switch and lock out capability, then a circuit breaker lock out will be required. Obtain a circuit lock and tag set. Install the lock onto the circuit breaker box. Ensure the unit ON/OFF switch is in the OFF position before restarting.

Lock Out/Tag Out Instructions - Pneumatic and Hydraulic Equipment

⚠ WARNING

For servicing pneumatic and hydraulic equipment, the following additional procedures must be implemented, following completion of lock out/tag out procedures for the unit to be serviced:

Shut off air, water or supply valves at the equipment to be serviced.

Check the local bleed-off point for completed release of pressurized air, water or oil.

If shutting off of air, water or other material cannot be achieved at the local supply valve, shut off valves further back in the system and re-check the bleed-off point until complete shut-off is achieved.

Affix a DO NOT OPERATE tag to each valve handle that requires shut off. Each DO NOT OPERATE tag must be signed and dated by the authorized technician servicing the equipment.

Lock Out/Tag Out Instructions - Air Hose Connected Pneumatic Equipment

⚠ WARNING

Equipment connected to the compressed air system through an air hose with a detachable fitting must be shutdown and unplugged. Excess air must be bled prior to removing the air hose, prior to any maintenance or repair activities.

Affix a DO NOT OPERATE tag to the air hose near the detachable fitting. Each DO NOT OPERATE tag must be signed and dated by the authorized technician servicing the equipment. Check that the equipment cannot be operated by activating the ON switch.

Stored Energy

⚠ WARNING

Immediately after applying Lock Out or Tag Out devices, ensure that all potentially hazardous stored or residual energy is relieved, disconnected, restrained and otherwise rendered safe.

Verification of Isolation

⚠ CAUTION

Verify the machinery or equipment is actually isolated and de-energized prior to beginning work on a machine or on equipment that has been locked out.

Restarting Procedures

⚠ CAUTION

Follow the procedures below prior to restoring energy:

- Ensure that all machinery or equipment is properly reassembled. Inspect the machinery or equipment to verify non-essential items have been removed.
- Ensure that all personnel are safely outside danger zones. Notify personnel that lock out/tag out devices have been removed and energy will be reapplied.
- Only authorized personnel may remove lock out/tag out devices or notices.

1. Product Information

This manual provides instructions on the installation, operation and maintenance of Northern Lights DECS diesel particulate filter (DPF).

DECS is designed to trap diesel particulates (soot) exiting the marine engine. Heat from the engine exhaust burns off the particulates in a continuous manner. With the DPF installed, the equipment can be operated as normal in most respects. An Exhaust Monitor/Logger allows the operator to monitor the status of the DPF.

A. Product Description:
Catalyzed wall-flow particulate filter with precious metal catalyst.

B. Application:
DECS is intended for use on most marine diesel engines that meet the following criteria:

- *Marine applications with medium to heavy duty cycles.*
- *Engines certified to Euro Stage 1, 2 or 3A, or US EPA Tier I, II or III.*

C. Sound Attenuation and Silencing:
Approximately 15-20 dBA. Additional silencing is available. For more information, please contact Northern Lights.

D. Required Operating Conditions:

- *Minimum 60% load for a minimum of 30% operating time.*
- *Or minimum operating temperature of 300°C for a minimum of 30% of the time.*

E. Balance Point Temperature:
Balance point temperature is 280-340° C. Actual temperature will depend on engine model and fuel sulfur level.

Particulate Type	DECS
Particulate Matter by particle count[1]	>99%
Particulate Matter by mass[2]	85-95%
Carbon Monoxide	90%
Hydrocarbons/ Volatile Organic Compounds (VOC)	60-80%
Oxides of Nitrogen (NOx)	No change in overall NOx, though an increase in NO_2/NO ratio may occur.
Fuel Sulfur Limits	<15 ppm

1 - Ultra-fine and fine particles (diameter 10-500 nm)
2 - ISO8178 or CARB Method 5 (front half) test conditions with fuel sulfur <15 ppm

F. Regeneration:
Regeneration is the process in which trapped particulates inside the DPF are burnt off. For continuous regeneration to occur, the engine must be operated so that its duty cycle produces an exhaust temperature that is greater than the balance point temperature of the DPF for greater than 30% of the time.

Since high exhaust temperatures are required for a DPF to function properly, the manufacturer may request an 8 to 72 hour data log of the engine exhaust temperatures in order to confirm whether DECS is suitable for the application.

G. Exhaust Monitor/Logger:
The manufacturer requires that an exhaust monitor/logger be installed on all applications. For more information, please see Section 4 - Exhaust Monitor/Logger - beginning on page 12.

Filter Installation

It is necessary to install the DPF as close to the exhaust manifold or turbocharger of the engine as possible, due to the DPF's requirement for heat. In addition, the DPF should be mounted so that it is isolated from engine vibration and external loads from the exhaust system.

For installation assistance, please contact Technical Support toll-free 1-800-762-0165.

The custom DECS DPF design is used for marine generator sets. Please follow the instructions below to install the DECS DPF:

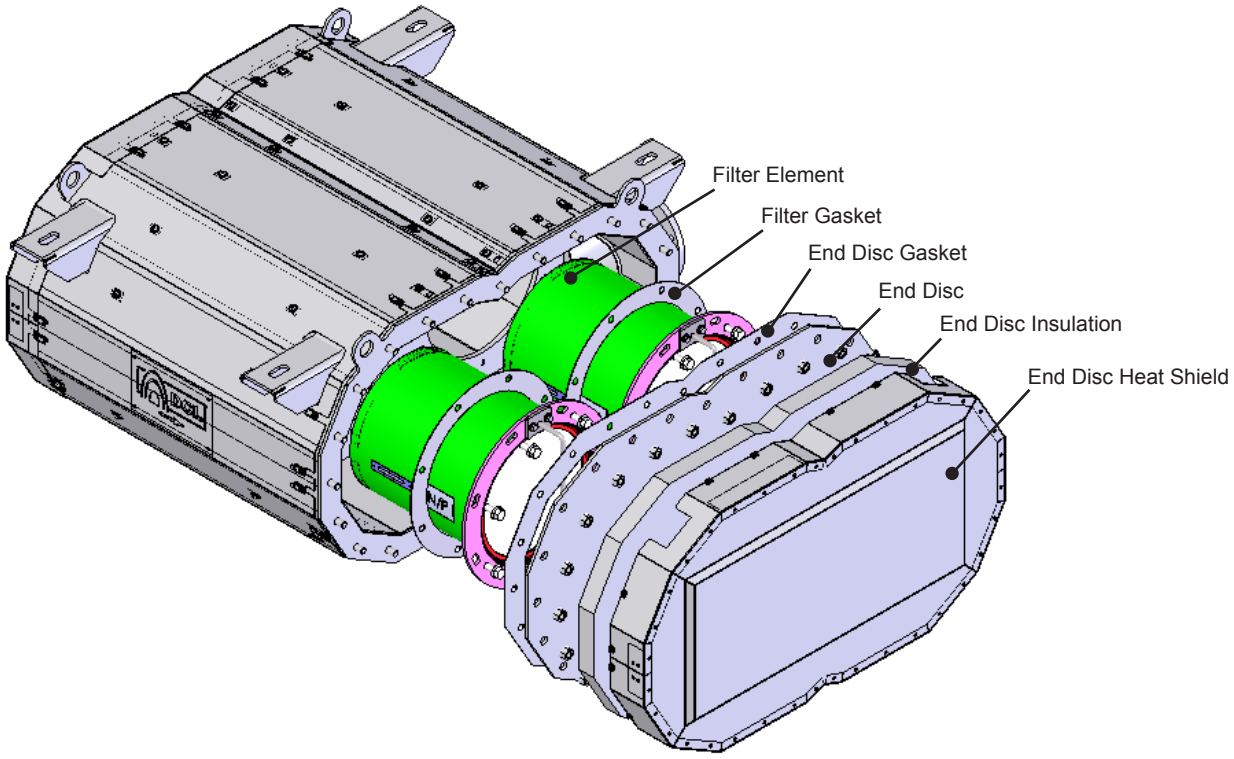
1) The DPF is to be mounted upstream of the original equipment muffler.

2) Determine a suitable horizontal space as close as possible to the engine exhaust outlet.

3) Allow adequate space (see custom drawing) for loading and unloading the individual filter units.

4) Secure the DPF feet or brackets to structural steel.

5) Use a flex pipe to isolate the DPF Housing from vibrations from the engine or exhaust stream.



2. Installation

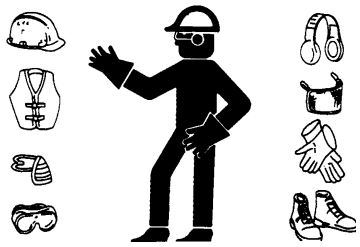
Use High Heat Ovens Safely

⚠ WARNING

Avoid exposure to and physical contact with hot surfaces and gases. Exhaust parts and streams can reach high temperatures during operation, leading to burns or other serious injury.

Cleaning exhaust filters can lead to exposure to hot surfaces and exhaust gas and the injury risk associated with it. Avoid exposure to and physical contact with hot exhaust gases when cleaning exhaust filters.

Only operate high-heat ovens or kilns while wearing suitable protective clothing, including gloves, goggles and all other protective equipment recommended by the kiln manufacturer.



2.1 Removal Instructions for Filter Units

a) **Ensure that generator set is locked out/tagged out per instructions on page 7.**

b) Open clips on heat shield cover in place and remove heat shield cover and insulation.

c) Remove the nuts on the outer wall and remove the filter access panel.

d) Remove the filter access panel gasket. Dispose if damaged.

e) Remove the nuts on the inner wall and carefully remove the filter unit using the filter handle.

f) Remove the filter unit gasket. Dispose if damaged.

2.2 Installation Instructions for Filter Units

a) Install a filter unit gasket for each filter on the inner chamber wall.

b) While holding the handle, install the filter units by pushing them into the filter holders.

c) Install and fasten the flanged nuts to 50~75 ft-lb torque to secure each filter.

d) Install the filter access panel gasket on the outer chamber wall.

e) Install the filter access panel on the outer chamber wall.

f) Install and fasten the flanged nuts on the outer wall to 50~75 ft-lb torque.

g) Install heat shield cover and insulation and use clips to fasten.

2.3 Replacing Heat Shield Insulation

a) Remove the clips holding the service end cover(s) in place and remove the service end cover(s).

b) Remove the screws holding the body heat shield pieces and remove the heat shield pieces.

c) Replace deteriorated insulation with new insulation.

d) Install the body heat shield pieces and use clips to fasten.

e) Install service end cover(s) and use clips to fasten.

Engine Operation

In most respects, the engine can be operated in the normal manner once the DPF is installed. For some engines however, load requirements may change over the engine's operation which could result in exhaust temperatures that may be too low to allow for continuous regeneration of the DPF. In cases where the DPF is not regenerating regularly, backpressure may rise to a point where an alarm light from the display panel will appear.

Operating Requirements

- Do not operate the engine at low load for longer than 1 continuous hour.
- Keep the engine well maintained and operate at a low lube oil consumption rate.
- Use ultra-low sulfur diesel fuel.

Exhaust Monitor/Logger

Use of an Exhaust Monitor/Logger is required with all DPF installations. This monitor should be installed before use of the DPF to ensure safe operating conditions.

Full information on the Exhaust Monitor/Logger begins on page 12.

4. Exhaust Monitor and Logger

4.1 General System Description

4.1a Logger Basics
The DECS Exhaust Monitor/Logger is a system for monitoring the status of the DECS Diesel Particulate Filter (DPF). Exhaust gas back pressure and temperature readings are taken continuously. An alarm panel mounted in the operator's cabin provides a visual reference point for operating exhaust gas back pressure and temperature. Additionally, the monitor provides important information regarding any errors that occur with the DPF system via a problem codes indicator.

The logging feature of the system allows for analysis of operating history. Other options available for this system include an add-on GSM/GPRS unit which provides the ability to monitor the status of the system remotely, and an optional CAN bus system which can output logger info to a remote location.

Northern Lights requires that a working exhaust monitoring system be installed with every DECS.

4.1b Memory
The Exhaust Monitor/Logger has two separate memories:

4.1b.i Memory for Measured Values
Pressure and temperature are continuously measured at one second intervals. Ten second mean values are computed and stored in the memory with the corresponding date and time.

The storage capacity of the circular memory is sufficient for roughly 360 days (24 hours/day) of operation when recording two external input channels (pressure and temperature).

Once the logger memory is full, the circular memory system begins to overwrite the oldest stored data. This is a continuous process.

4.1b.ii Alarm Function Memory
The purpose of the alarm function is to report various system problems such as: high or low back pressure events, a break in the connection to the temperature probe, etc. As well, alterations to settings made in the control box setup are registered in this secondary memory. Each entry is stored together with a record of the relevant time and date, and commentary. The non-volatile circular memory is designed for a service period of 10 years, and can store up to 20,000 data records.

4.1c Download Kit & Software (Optional)
The optional download kit and software provides the ability to download the operating history of the exhaust temperature and back pressure for analysis and evaluation. The software provides an easy to use interface to review the collected data and alarm history log. See Section 6 for detailed information on the download kit and software.

4.1d Special Programs
If more sophisticated functions are required than those described in this manual (i.e. secondary alarm outputs, dosing control requirements, etc.) please contact your Northern Lights factory representative (1-800-762-0165 or info@northern-lights.com) for assistance.

4.2 Components

Table 4.1, below lists the individual components of the DECS Exhaust Monitor/Logger, Remote Monitoring System (Optional) and the DECS Download Kit (Optional).

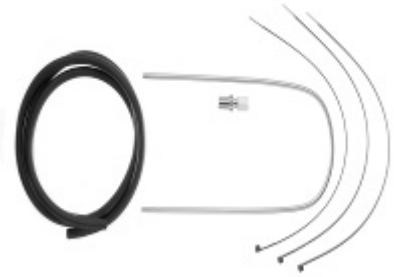
Table 4.1 – Components List

Item Description	Component Part Number	Quantity
DECS Exhaust Monitor/Logger (System Part Number: X0800-0036-00)		
Control Box	X0800-0036-01	1
Off-Road Cable Harness (inc. Thermocouple)	X0800-0036-02	1
Off-Road Pressure Monitor Display (IP67)	X0800-0036-04	1
Stainless Steel 1/4" Connector	X0800-0036-05	2
Stainless Steel Tubing (~20")	X0800-0036-06	1
High Temperature Resistant Hose (~6ft)	X0800-0036-07	1
Fuse	X0800-0036-08	1
Display Face Mounting Bracket	X0800-0036-12	1
Condensate Trap	X0800-0036-15	1
1/4" NPT - Hose Fitting	X0800-0036-19	2
Ring Clamp	X0800-0036-26	2
Threaded Screw	X0800-0036-27	2
DECS Remote Monitoring (System Part Number: X0800-0035-00)		
GSM/GPRS Module	X0800-0035-02	1
Cable Harness	X0800-0035-03	1
GSM/GPRS Antenna	X0800-0035-04	1
Hub Box	X0800-0035-05	1
DECS Download Kit (System Part Number: X0800-0034-00)		
USB Serial Converter	X0800-0034-01	1
Network Cable - 2"	X0800-0034-02	1
USB Extension Cable	X0800-0034-03	1
DECS Exhaust Monitor/Logger Software	X0800-0034-04	1
Converter (Ethernet - Female Deutsch)	X0800-0034-05	1

4. Exhaust Monitor and Logger

Components

CONTROL BOX (X0800-0036-01)
Installs in the engine compartment. The control box contains the logic for the system. It has a connection for the cable harness and a connection for the pressure hose. A mounting bracket is also secured to the back of the unit for installation purposes. The control box is rated IP63 for dust and water penetration, and has an operating temperature of -20°C to 80°C.

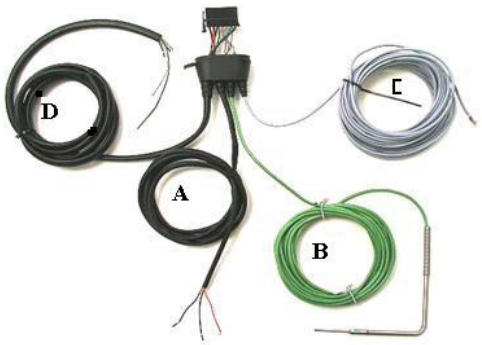


HIGH TEMPERATURE RESISTANT HOSE (X0800-0036-07)
STAINLESS STEEL TUBING (X0800-0036-06)
STAINLESS STEEL 1/4" CONNECTOR (X0800-0036-05)
Provides pressure line connections between the exhaust system and the control box. The pressure connection set includes a stainless steel connector, stainless steel tubing, and the high temperature resistant hose. The high temperature resistant hose is flexible for easy installation.

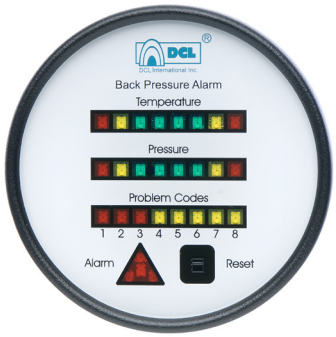
FUSE KIT (X0800-0036-08)
Integrated in the power-supply (permanent positive polarity) to provide protection against over-voltage. The fuse is required to be installed to protect the control box.

Components

CONDENSATE TRAP (X0800-0036-15)
Must be mounted vertically in a location that will allow moisture in the system to collect in the trap. The trap must be installed such that the arrow on the trap points in the direction of the exhaust flow (towards the control box). Before installing the condensate trap, it is important to make sure the drain valve located at the bottom of the trap is closed by pulling down on the nozzle and twisting to the right. See fig. 4.1 on page 18.



CABLE HARNESS (X0800-0036-02)
Contains the thermocouple, and provides the necessary connections between the control box and the power source. The cable harness contains four main terminals, as described in table 4.2 on page 17.



DISPLAY PANEL (X0800-0036-04)
Must be installed in view of equipment/engine operator. The Display panel consists of 3 LED bars, the alarm light, and reset button, which are used to indicate the operating status of the DPF.

4.3 Installation

⚠ CAUTION Ensure generator set is locked out/tagged out as per instructions on page 7.

4.3a Control Box Mounting

⚠ CAUTION Disconnect battery before proceeding with steps 4.3a - 4.3e

The control box is to be installed in a position that will protect it from impact, excessive water and excessive heat. Inside the engine compartment is generally the most ideal location for mounting the control box. Installation should be done such that the connectors (backpressure hose fitting and wiring harness) are facing downwards. It is also desired to position the control box above the exhaust system. This will prevent condensate (from the exhaust) from being drained into the pressure sensor located in the control box. A condensate trap (provided) must be installed regardless of whether the control box is installed above or below the exhaust system.

⚠ CAUTION Excessive temperatures outside of the control box operating range (-20°C - 80°C) may result in failure of the operating box. Ensure that the control box is located where it will be protected from impact, excessive water and excessive heat.

4.3b Back Pressure Connections

Important - Remove exhaust pipe components before proceeding with the following instructions.

i) Drill a hole 3" - 6" upstream of the filter in the exhaust pipe at the 12 o'clock position.

ii) Weld a ¼" NPT female port over the drilled hole making sure that exhaust gases cannot escape around the perimeter of the weld.

iii) Insert the provided stainless steel tubing through one stainless steel ¼" NPT connector and insert into the ¼" NPT female port. Position the tubing such that it sits slightly into the exhaust stream and tighten the connector to lock the stainless steel tubing in this position.

⚠ CAUTION Ensure to ground while welding.

⚠ CAUTION The stainless steel tubing is not to be shortened as it is used to dissipate heat from the exhaust.

⚠ CAUTION For the proceeding instructions, please refer to figures 4.1 - 4.4 on page 18 which illustrate proper and improper back pressure line connections.

iv) Determine an appropriate place to mount the condensate trap. The trap location should allow moisture in the system to collect in the trap. (see page 18)

v) Mount the condensate trap using the provided screws. Ensure vertical orientation of the trap and install such that the arrow on the trap points in the direction of the exhaust flow (towards the control box).

vi) Cut the high temperature resistant hose. Connect one piece to the stainless steel tubing and secure with a ring clamp. Connect the other end of the hose to a ¼" NPT fitting, and connect it to the condensate trap. For best results and longevity, avoid coiling the stainless steel tubing and high temperature resistant hose. If coiling is unavoidable, ensure that the coils allow for condensate to drain either back into the exhaust stream, or into the condensate trap.

vii) Use the remaining portion of the high temperature resistant hose to connect the control box to the condensate trap.

viii) Ensure that the condensate trap is closed by pulling down on the nozzle and twisting to the right, until locked into position.

4.3c Temperature Sensor Connections

i) Drill a hole 3" - 6" upstream of the filter in the exhaust pipe at the 12 o'clock position.

ii) Weld a ¼" NPT female port over the drilled hole making sure that exhaust gases cannot escape around the perimeter of the weld.

iii) Insert the thermocouple through a stainless steel ¼" NPT connector and insert into the ¼" NPT female port. Position the thermocouple such that the tip is approximately in the middle of the exhaust tubing and tighten the connector to lock the thermocouple in this position.

iv) Be sure not to secure the thermocouple wire to any components that may become hot during operation.

v) Reinstall the exhaust pipe components.

⚠ CAUTION Ensure to ground while welding.

4.3d Display Mounting

An optional display panel mounting bracket is included with the exhaust monitor/logger kit. The display panel should be mounted such that it is visible to the machine/engine operator, and such that the Deutsch connection located behind the display is accessible. It is safe to mount the display outdoors as the unit is rated IP67 for dust and water protection.

4.3e Cable Harness Connections

Connect all necessary cables from the cable harness before connecting the cable harness plug to the interface on the control box.

Please see table 4.2 at right for details on individual wire connections.

⚠ CAUTION i) Ensure battery is disconnected (should still be disconnected from section 4.3a).

ii) Install the fuse on the constant positive power wire and connect the power supply wires from coil A.

iii) Connect cable C to the display panel.

iv) Connect the harness plug to the interface on the control box.

v) Tape up the ends of all wires from coil D as for normal monitor/logger use, these additional inputs and outputs will not be needed.

vi) Re-connect the battery.

If there are any questions regarding installation, please contact the manufacturer at 1-800-872-1968.

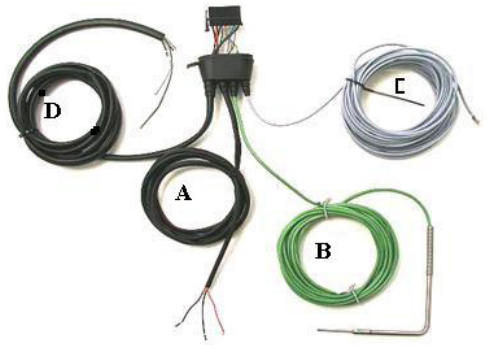


Table 4.2 – Terminal Description

A: Power Supply	
Red	Battery (10-30 VDC)
Black/Red	Ignition
Black	Ground
B: Thermocouple	
C: Bus to Display Panel (Male Deutsch Connector)	
D: Inputs and Outputs	
Violet	Input for rpm
Brown	Vacant Input 1
Blue/Yellow	Vacant Input 2
Black/White	Alarm Output 1
Black/Green	Alarm Output 2

4. Exhaust Monitor and Logger

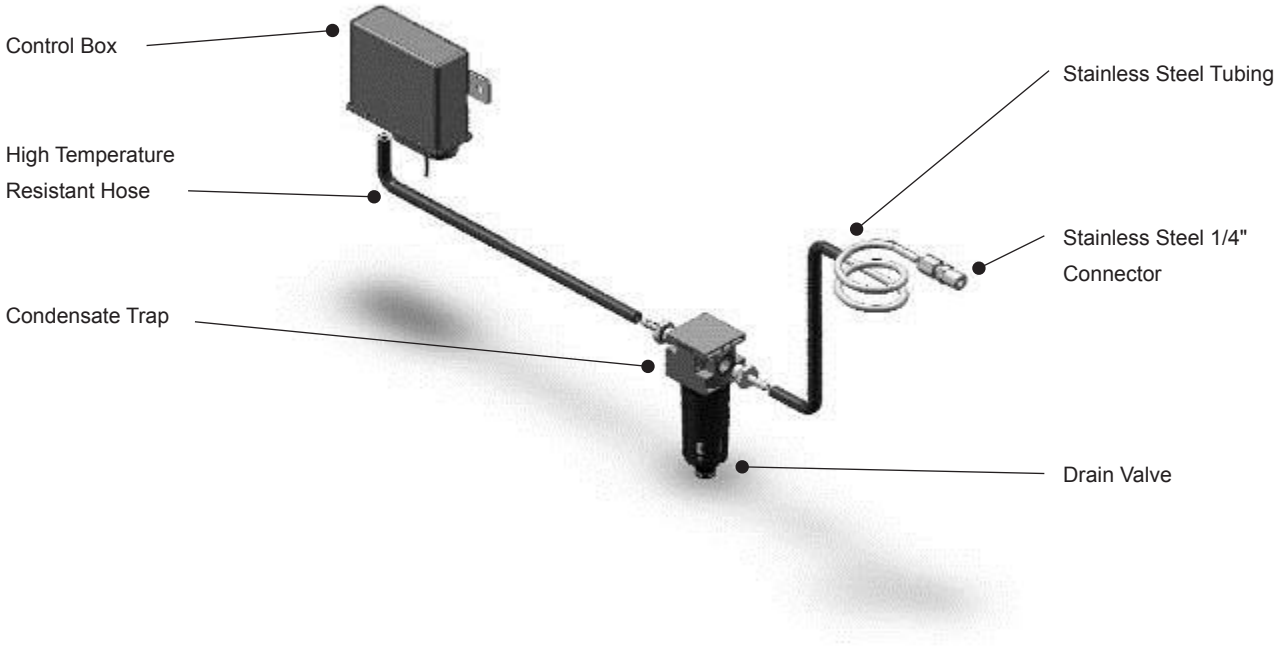


Fig. 4.1 Acceptable Set-Up

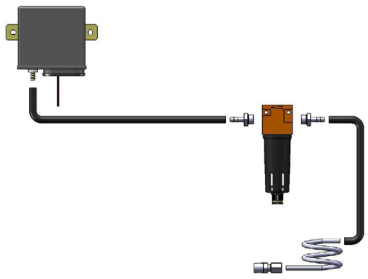


Fig. 4.2 Acceptable Set-Up

Fig. 4.3 Acceptable Set-Up

Fig.4.4 Un-Acceptable Set-Up

4.4 Operation

4.4a. Pressure Monitor Display

The DECS Exhaust Monitor Logger display panel is show below.

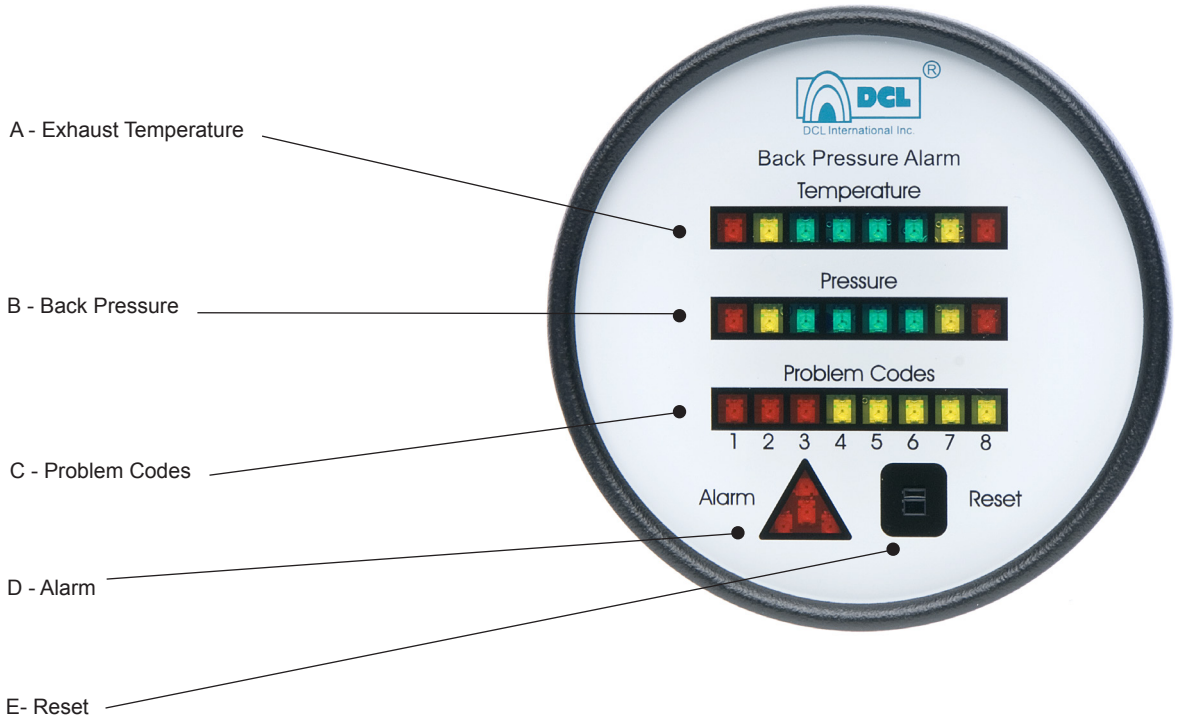


Table 4.3 – Display Panel Features

Feature	Description
A. Temperature Indicator LED Bar	Provides a guide as to the relative temperature of the exhaust system
B. Pressure Indicator LED Bar	Provides a guide as to the relative back pressure of the exhaust system
C. Problem Code LED Bar	Used as a diagnostic tool to determine the root cause of a system problem
D. Alarm Lamp	Illuminates in order to warn the operator of a system problem
E. Reset Sensor	Allows monitor/logger problem codes and alarms to be reset

Self-Check

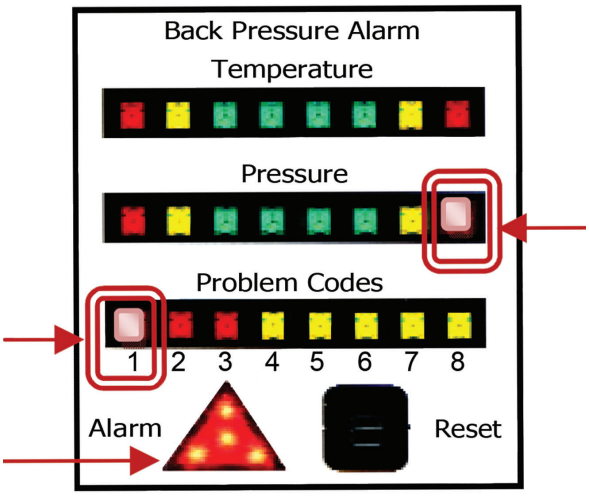
Upon ignition, the monitor will proceed with a self-check during which the LEDs will go through a sequence to determine proper functionality of the monitor. Once the self-check is complete, the temperature and pressure indicator bars will illuminate showing current parameter status.

4.4b Troubleshooting

During operation, the alarm lamp may illuminate warning the operator that a problem has arisen with either the DPF or the monitor/logger itself. The following troubleshooting information has been formulated to assist installers and operators with resolving problems which may be experienced in field. For convenience table 4.2 in Appendix B lists and summarizes a number of various problem codes and corrective actions to be taken by the operator.

4.4b(i) Error Code 1: Upper pressure limit reached

What to Look For: On the Display Monitor, problem code 1 LED light along with the Pressure 8 indicator LED will be illuminated and the Alarm Lamp will be flashing.



Alarm Description: Pressure inside the filter has increased to a level above the maximum allowable safe soot load, causing excessive back pressure. This may be a result of a build-up of soot in the filter, caused by an engine malfunction or low duty-cycle, and/or a build-up of ash material in the filter, usually caused by neglecting to perform a required scheduled maintenance at every 1000 operating hours.

Instructions: If the high-pressure Alarm Lamp is triggered, reset the monitor manually by moving your finger over the alarm Reset Sensor. This should cause the alarm to turn off. If the Alarm Lamp again illuminates within 2 minutes after continuing with normal operation, then proceed with the following:

- Apply as much load as possible for a period of 20 minutes*.
- Reset the Alarm Lamp manually by moving your finger over the Reset Sensor if it has not turned off automatically during the high torque operation.
- If within 2 minutes of resetting the Alarm Lamp, the Alarm Lamp comes back on, remove the DPF and perform a Level 1 Cleaning or Level 2 Cleaning (see Section 2, page 10 of this manual for cleaning instructions).

If the Problem Persists: If you continue to experience the alarm after the above steps are taken, there is most likely a problem with the engine, resulting in excess soot build-up in the DPF. Conduct an opacity test on the machine without the DPF in place to confirm this issue and consult your equipment dealer for resolution.

Future Steps: To avoid this problem in the future, utilize the machine in applications with heavy duty-cycles wherever possible. Keep up with all scheduled maintenances for both the DPF and engine to ensure both continue to perform optimally and as required.

*The high exhaust temperatures generated from high torque operation will cause the DPF to self-regenerate. Do not operate the equipment unsafely or in a manner that will cause damage to the equipment or its components. If uncertain of how to properly conduct this operation, please contact the manufacturer.

4.4b(ii) Error Code 7: Time and day

What to Look For: On the Display Monitor, problem code 7 LED light will be illuminated and the Alarm Lamp will be flashing.

Alarm Description: If you experience Alarm Code 7 this means the date and time is not set and data is not being recorded.

Instructions: To reset the date and time with your computer connected to the control box, do the following:

• Open the MRS Terminal program.

• Click on Parameters

A new window will open up, which contains all the parameters/default settings. Changes can be made to the date and time by simply clicking on the 'Set Control Box Time' button. The current time and date set on your laptop/PC will be transferred to the control box. Therefore it is important to ensure that your laptop/PC is displaying the correct time and date.

4.5 Maintenance

In order to ensure that the monitor/logger is functioning properly and to extend the useful life of the monitor/logger system, regular maintenance must be performed on the temperature sensor and the pressure connections. Below are the maintenance requirements for these components.

Table 4.4 – Regular Maintenance Schedule

Component	Frequency of Cleaning	Cleaning Instructions
Temperature Sensor (Thermocouple)	Once a year or every 1000 hrs of operation	• Remove the temperature probe from the exhaust stream • Using a cleaning solvent, wipe down the probe and reinstall into the exhaust stream
Pressure Connections	Once a year or every 1000 hrs of operation	• Remove the high temperature resistant hose from the control box and disconnect from the stainless steel tubing • Remove the stainless steel tubing from the exhaust stream • Rinse each component with water to remove soot build-up within each tube • Blow-dry both components with compressed air • Reassemble the pressure connections
Condensate Trap/ Moisture Separator	As required	• Remove condensate from trap as necessary

4.6 Download Kit and Software: Optional

The optional download kit and software provides the ability to download the operating history of the exhaust temperature and back pressure for analysis/evaluation. The software provides an easy to use interface to review the collected data and alarm history log.

Carrying Case

CD- Software Installation

Converter: Ethernet-Female Deutsch

Network Cable

USB Signal Converter

USB Extension

4.6a Software Installation Instructions

i) Do not connect the signal converter to your PC/laptop at this stage!
ii) Insert the CD supplied with the download kit, and start the '2nd_Analyser_Setup.exe' file. Choose your language, press the 'ok' button, and follow the on screen instructions until installation is complete. See above for Download Kit Parts List
ii) For the destination folder, use the recommended C:\ default location.
iv) Open the MRS-Terminal program. If it is not in English perform the following: click on the 'setup' tab, followed by 'sprache. Choose English and click "Yes" to the pop up message. Close and re-open the MRS-Terminal program. The changes will be applied.

4.6b Making the Connections

i) Connect the USB signal converter into a USB port on your PC/laptop.
- Wait a few seconds to ensure the serial box has been recognized by the Windows operating system: The first time the USB signal converter is connected, an information bubble will appear indicating "found new hardware" followed by a second information bubble stating the USB has been recognized. Subsequently, you will no longer see these messages.
- It is now safe to make the other connections.

ii) Make sure the power is on by turning the ignition key. Leave the ignition on until the download is complete.

⚠ CAUTION To test, plug the off-road monitor display into the male Deutsch plug from the wire harness. If the power is on the display will illuminate.

iii) Using the supplied hardware, connect the male Deutsch plug from the wire harness to the USB signal converter.

4.6c Download

i) Open the MRS-Terminal program on your desktop.

ii) Click 'Load Data from Control Box'.

- The download will begin automatically; if there is a lot of data stored in the control box, this may take up to 20 minutes.

- During the download, at the bottom of the screen you should see consistently changing info which is a sign that the data from the control box is being read. Once complete, there will be a message at the bottom of the screen which says, "Data from Control Box has been downloaded". The data on your control box has now been downloaded and saved as two files on the hard disk, (a zip file and Microsoft Access file).

NOTE: The zip file is a compressed file password protected, and suitable for sending as an email attachment. **When sending a download file to the manufacturer for analysis, please be sure to send the zip file.**

iii) Once you are finished with the MRS-Terminal program, you can end/close it and unplug the connections. There is no particular order to unplug the connections, and the download data has already automatically been saved.

4.6d Retrieving Downloaded Data

i) Downloaded files can be retrieved by going to: C:\CPK-Terminal\DATA

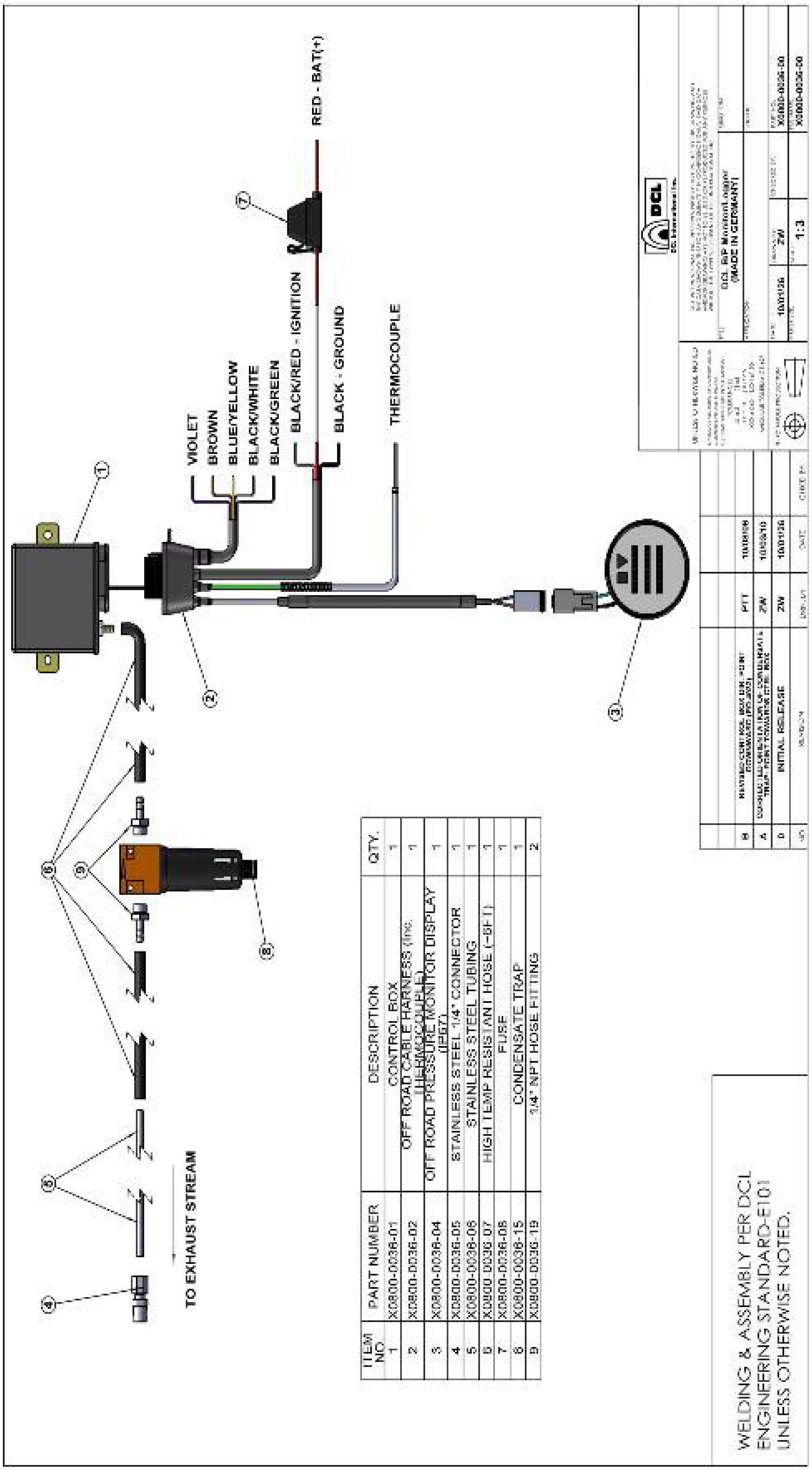
ii) To review downloaded data, open MRS-Terminal and click 'Import Control Box Data From Database'. When the database opens, choose which file to view from the default folder.

4.7 Optional Equipment

Remote Monitoring System (Optional)
The remote monitoring system consists of an additional component which can be tied into the DECS Exhaust Monitor/Logger system. The system works with the use of a SIM card. Data is transferred through the cellular network to a PC, where it can be accessed remotely for assessment. A monthly plan and additional hardware are required. For further details regarding this system, please contact the factory.

CAN Bus System (Optional)
The CAN Bus system consists of an additional component which can be tied into the DECS Exhaust Monitor/Logger system. The system provides the necessary connections allowing for the output or data logging of J1939 signals. For additional information regarding this system, please contact the factory.

4.8 Electrical Diagram



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	X0800-0036-01	CONTROL BOX	1
2	X0800-0036-02	OFF ROAD CABLE HARNESS (Inc. THERMOCOUPLE)	1
3	X0800-0036-04	OFF ROAD PRESSURE MONITOR DISPLAY (IP67)	1
4	X0800-0036-05	STAINLESS STEEL 1/4" CONNECTOR	1
5	X0800-0036-06	STAINLESS STEEL TUBING	1
6	X0800-0036-07	HIGH TEMP RESISTANT HOSE (~5FT)	1
7	X0800-0036-08	FUSE	1
8	X0800-0036-15	CONDENSATE TRAP	1
9	X0800-0036-19	1/4" NPT HOSE FITTING	2

4.9 Technical Information and Specifications

Control Box (ECU)		
Temperature	**Ambient temperature:** -20 - 80 °C	**Measuring range:** 50 … 1050 °C
Pressure	**Measuring range:** 0 - 600 mbar	**Tolerance:** 2% of full scale Overpressure safe up to: max. 2.0 bar
Power supply:	10 - 30 V DC	
Current rating:	150–170 mA (in operation); 1 mA (standby)	
Protection type:	IP63	
Alarm outputs:	2 x 5 A power high-side drivers, Overload-protected, BTS 436	
Inputs:	min. 9 V	
Oscillation level:	10 g at natural frequency	
Dimensions:	95 x 100 x 38 mm	
Electrical protection:	Reverse polarity, short circuiting and overvoltage. All electrical components and connections are encapsulated in synthetic resin	
Panel Box (Display)		
Protection type	IP67 (round shaped instrument)	
Dimensions	85 mm □, T = 44 mm	
Interface	Deutsch Plug	
Voltage supply via the Control Box		
Cable harness Temperature probe: K type Oil- and water-resistant	**Measuring range** max. 1100 °C	

5. Maintenance

⚠ CAUTION **Use Compressed Air Safely**

Use extreme caution when using compressed air. Follow the manufacturer's instructions exactly to prevent injury or property damage. Always wear required safety clothing, including gloves and goggles when operating compressed air. Never point compressed air directly at self, or another person, or at any object not intended for its use.

The following are maintenance requirements to follow for servicing the DPF. Due to large variations in operating conditions, the maintenance schedule may change slightly depending on the specifics of the application. Requirements for servicing DPFs are found in the table below.

Action	Frequency	Description
Check for leaks	Every 200 hours of operation	Visually inspect the piping, fittings, clamps and gaskets in the exhaust system for exhaust leaks. Looks specifically for evidence such as soot present near connection. Repair any leaks at once.
Check pressure transducer	Every 200 hours of operation	Remove pressure transducer and manually apply pressure to the line. Check line for leaks. Indicator lights must illuminate at a specified back pressure.
Filter Cleaning	Every 1000 hours of operation (more frequently if high ash levels accumulate)	Conduct Level 2 Cleaning (see section 4.2 for details.)

5.1 Level 1 Cleaning (Stop Gap)

⚠ CAUTION a) **Ensure that generator set is locked out/tagged out per instructions on page 7.**

b) Remove the DPF filter unit(s) from the housing.

c) Attach to the filter inlet (sooted end of DPF), a vacuum which feeds into a high-efficiency particle arrestance (HEPA) filter making sure that all connections are airtight to prevent soot/ash from escaping before being forced through the HEPA filter.

d) Using oil-free compressed air (~80 psi), blow the particulates/ash from the outlet end of the DPF towards the inlet of the DPF, through the vacuum and through the HEPA filter. The air gun should be held a minimum of 2 inches from the surface of the DPF to prevent damaging the filter itself.

e) Move the air gun around to ensure that all of the DPF channels on the outlet have been exposed to the compressed air. Compressed air cleaning should be performed for an approximate duration of at least 10 minutes.

f) Remove the HEPA filter and store away for reuse or properly dispose of, as per local regulations, if saturated with soot/ash.

g) Re-install DPF filter unit(s) into the housing.

Alternatively, please contact Northern Lights for the location of the nearest approved DPF cleaning facility.

5.2 Level 2 Cleaning

1. Remove the DPF filter unit(s) from the housing.

2. Place the DPF filter unit(s), inside an oven or kiln ensuring that the inlet and outlet of the DPF are exposed. Do not sit the DPF vertically in the oven so that the DPF inlet or outlet filter faces are against the surface on which the DPF is resting.

3. Increase the temperature of the oven to 600^{o}C over a period of 1.5 – 2 hours.

4. Retain an oven temperature of 600^{o}C for a continuous period of 16 hours to allow complete combustion of accumulated soot in the DPF.

5. Decrease the temperature to a level that will allow for safe removal of the DPF by hand.

6. Remove the DPF from the oven and perform a Level 1 Cleaning to remove the noncombustible ash content.

7. Re-install the DPF filter unit(s) into the housing.

Alternatively, please contact Northern Lights for the location of the nearest approved DPF cleaning facility.

Appendix - DECS Warranty Statement

This Limited Warranty applies to the following product lines:

NORTHERN LIGHTS Diesel Exhaust Cleaning System (DECS)

Northern Lights, Inc. (herein "NL") extends to the purchaser and user (herein "Owner") of the product the following limited warranty (herein "Warranty"). Please read it carefully.

NORTHERN LIGHTS WARRANTY AND RESPONSIBILITIES

Subject to the terms and conditions set out below, NL warrants the product and its factory installed parts to be free from defects in material and workmanship under normal use and service.

If the product is purchased for and used primarily in a commercial endeavor, the warranty period shall extend from the date of delivery to the original end user for a period of twelve (12) months or 1000 hours of use, whichever comes first. If the product is purchased for and used primarily in personal, family or household use, the warranty period shall extend from the date of delivery to the original end user for a period of twelve (12) months or 1000 hours of use, whichever comes first.

The obligation of this Warranty shall be limited to repairing or replacing any part of the product which NL agrees is defective in materials or workmanship under normal use and service during the warranty period. If during the warranty period the product or any of its parts are found to be defective because of workmanship or materials, it will be repaired or replaced without charge if the Owner prepays the transportation charges and returns the item to NL's authorized warranty dealer. To find the location of the nearest authorized warranty dealer, write NL at the address below or telephone NL at the number below.

Upon request by the Owner and agreement by NL, repair of product or replacement of parts under this Warranty may be completed at a place other than an NL authorized warranty dealer. See "Owner's Responsibilities" below.

OWNER'S RESPONSIBILITIES

Within thirty (30) days of purchase, Owner or authorized agent of Owner must complete, sign and deliver to NL the warranty registration card in order to validate this Warranty. Owner must operate unit as described in the "Operating Procedures" section of the Operator's Manual.

At the time of presentation of product for service under this Warranty, the Owner or authorized agent must present evidence of the date of original purchase of the product.

If pre-approved repair of product or replacement of parts under this Warranty is completed at a place other than at an NL authorized warranty dealer, Owner shall pay NL's or its authorized dealer's reasonable travel expenses, including travel time.

In the event of any product failure at sea which is covered by this Warranty, Owner is responsible for the cost of towing the vessel to a repair dock and for any associated docking and harbor charges.

Owner shall pay costs of any labor required to remove and reinstall the product and/or parts thereof, any premium for overtime labor requested by the Owner and costs for transporting the product and/or parts thereof to and from the place where warranty work is performed.

Owner is responsible for communication, expenses, meals, lodging and any other incidental costs incurred by Owner or Owner's agents as the result of a failure subject to this Warranty.

WARRANTY LIMITATIONS

This Warranty will not apply to equipment put in service more than twenty-four (24) months from date of shipment from factory, and will not apply in any country with which trade is restricted or banned by the US Department of State, at or after the time of sale or claim.

If the product is used primarily in a commercial endeavor, neither NL nor any company affiliated with NL will be liable for general damages, including bodily injuries, except as set forth above, or for incidental or consequential damages, including but not limited to, loss of use, loss of profits, loss of production, expense of substitute equipment or other commercial loss or for damage to property in which the equipment is installed. The same limitations shall apply to a product used for personal purposes with respect to all non-personal injuries, general, incidental and consequential damages.

Some countries or states do not fully allow the above exclusions or limitations of general, incidental or consequential damages, so the above exclusions or limitations may not apply to you.

This Warranty extends only the original parts and accessories.

This Warranty is transferable to a new Owner during the warranty period. No transfer forms or fees are required.

This Warranty does not extend to failure resulting from an accident or disaster or from Owner or operator abuse or neglect.

Service parts worn out by usage and not due to defects in workmanship or material are not covered by this Warranty.

NL is not responsible for failure resulting from improper repair or use of defective parts or parts not approved by NL.

NL is not responsible for failure of product or parts resulting from improper installation or unauthorized modifications.

NL is not responsible for failure caused by negligent handling or abuse in installation or storage in improper environment which results in corrosion or freezing damage to equipment.

NL is not responsible for failure caused by any third party's transportation damage to NL's product.

NL is not responsible for damage if any warning alarm system is ignored.

NO REPRESENTATIONS AND LIMITATIONS OF IMPLIED WARRANTY

This written Warranty is in lieu of all other express warranties, obligations or liabilities. If this equipment is used properly in a commercial endeavor, no implied warranty, including that of merchantability and fitness for a particular purpose is extended. If the product is used primarily in personal, family or household use, any implied warranty, including that of merchantability and fitness for a particular purpose, shall be limited to twelve (12) months.

Some countries and states do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.

No person is authorized to make any representations or promises on behalf of NL or to modify the terms or limitations of this Warranty in any way except in writing and signed by an authorized employee of NL.

This Warranty gives you specific legal rights, and you may have additional statutory rights which vary from one country or state to another.

Owner or Owner's Agent acknowledges that Owner has read and understands the limitations of warranty and remedies information for applicable goods and agrees to be bound by the same. NL's responsibility is limited to the repair or replacement of any part NL agrees is defective in materials or workmanship under normal use and service during the warranty period. NL limits remedies to those provided in this warranty statement and expressly excludes liability for lost profits, incidental and consequential damages. Other than those warranties listed herein, NL makes no express or implied warranties respecting its products, including but not limited to the warranties of merchantability and fitness.

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