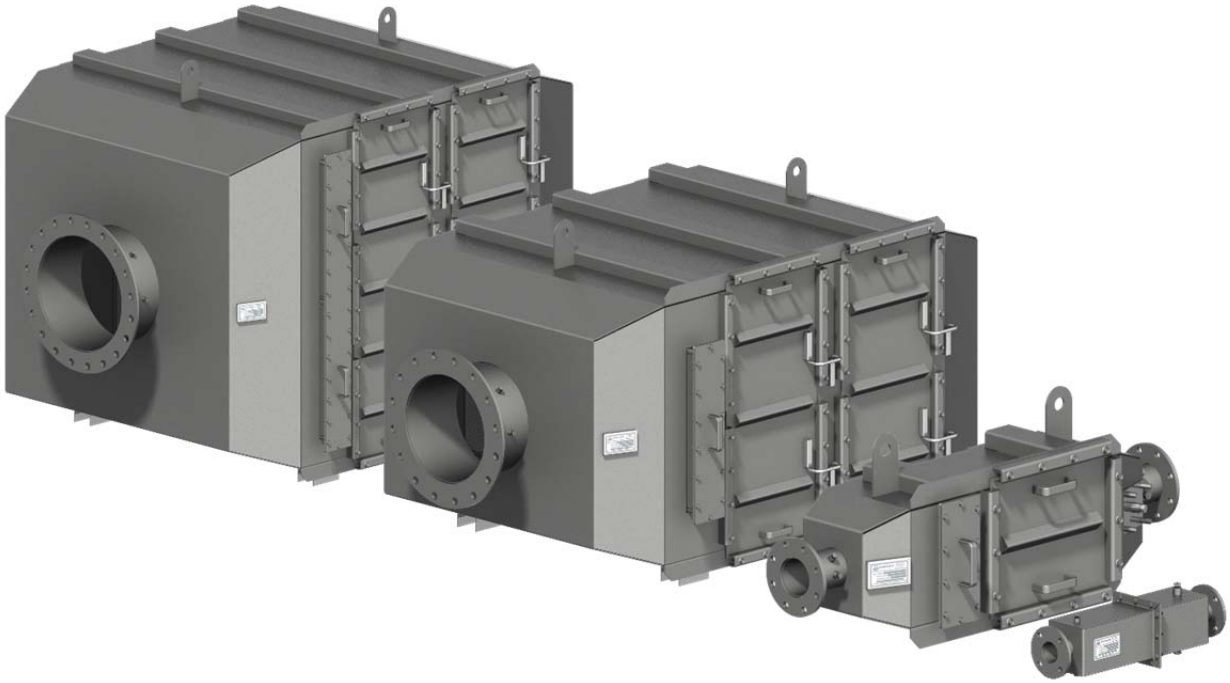

MIRATECH® LTR™
CARB Verified DECS
DOC DPF System

Installation, Operation and Maintenance Manual

Manual Release: 2015-07-13

CAUTION

Read this entire manual and any other publications relevant to this project prior to installing, modifying, or operating the equipment described herein. Follow safe work practices, observe all local, state and federal codes, and use this manual for safe, effective operation. Improper installation, operation or other use of this product could result in any combination of poor performance, equipment damage, human injury, or possible death.

MIRATECH reserves the right to change or alter any and all specifications at any time without prior notification and without incurring any obligation to such changes. The information included in this publication is believed to be accurate at the time of publication; however, no responsibility is taken by MIRATECH unless expressly given.

Please inspect each housing prior to installation and commissioning. The catalyst elements are pre-loaded and ready for operation unless otherwise specified at the time of order.

To place an order, or for technical assistance, please refer to the contact list on page 46.

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1. Introduction

The LTR is designed for maximum reduction of engine exhaust emissions such as Carbon Monoxide (CO), Unburned Hydrocarbons (HC) and Particulate Matter (PM). The LTR has also been optimized for Low Temperature Regeneration capability, regenerating at temperatures as low as 500° F. For many engines, it will be possible to regenerate the LTR DPF at engine loads above 30%, with properly insulated exhaust piping. With proper engine control and maintenance practices, the LTR will provide years of trouble free emissions abatement.

The MIRATECH LTR is designed to remove over 85% of particulate matter (PM or soot) from stationary diesel engine exhaust. The captured particulate matter is burned off passively (no additional heat input required) through catalytic oxidation with the available exhaust gas temperature.

This manual provides information for maximum performance and life span of your MIRATECH LTR. Therefore, it is imperative that operators or anyone working on the LTR system read and understand these instructions prior to installing or performing any work on the MIRATECH LTR. All installation and maintenance work shall be carried out by MIRATECH authorized installers, and in accordance with applicable codes and safety standards.

Please contact the MIRATECH Technical Service Department if you have any questions or encounter any problems with your MIRATECH LTR system. Our company goal is to provide the highest quality products and customer service.

The LTR is an assembly of a Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) modules, assembled in an integrated housing.

The DOC is made of proven VORTEX™ substrate and is coated with precious metals to promote specific oxidation reactions to convert:

- CO to CO_2
- Unburned Hydrocarbons to CO_2 and H_2O (Water)
- Some NO will be converted to NO_2, to support the regeneration process in the DPF module.

The DPF module is made of multiple DPF blocks made of porous Mullite substrate. It will capture the PM with a filtration efficiency of 85% or better. Once the PM is captured, it can be catalytically oxidized with the support of NO_2 for the oxidation process.

Regeneration occurs when the PM is oxidized on the DPF. When the oxidation rate of the PM exceeds the PM rate coming from the engine, the pressure drop through the DPF will reduce. The temperature where this occurs is the “Balance Point Temperature”.

For regeneration to occur, several conditions are required:

- There is enough NO_2, O_2 and temperature (heat) in the exhaust gas stream.
- The exhaust gas stream is above a “Balance Point Temperature”.

2. California Air Resources Board (CARB) Requirements

A. Authorized Installer Responsibilities

1. Introduction

On October 1, 2013 the California Air Resources Board (CARB) approved amendments to the *Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines* (the Procedure) in Title 13, California Code of Regulations, Sections 2700 through 2711; which include the requirements that Diesel Emission Control Strategy (DECS) Manufacturers, Distributors, Installers, and End Users must comply with.

Under these regulations the following subsections are especially important:

- §2706.t – Pre-Installation Compatibility Assessment
- §2706.u – Requirements for Installers of Diesel Emissions Control Strategies
- §2707 – Warranty Requirements

The new regulations **specifically impact Authorized Installers and End Users**. There are specific obligations and responsibilities these individuals must comply with including going through a certified training program provided by the Manufacturer (MIRATECH). Part of the training includes knowing the information contained in this manual (**t**he MIRATECH LTR Installation, Operation, & Maintenance Manual).

Anyone touching a Verified DECS must go through the same training process as an Authorized Installer (e.g. filter cleaning services; anyone who stocks/sells spare parts, etc.).

In addition, the **regulations reference certain documents and checklists** that are described in the regulation that must be filled out and maintained. CARB also prepares various mail-outs to help inform Manufacturers, Installers, and End Users. These documents cover compatibility assessment, installation, commissioning, maintenance, and service.

Consequences may arise if an Installer does not comply with these regulations and has not gone through certified training. If a repair/installation results in a failure, and the End User pursues a warranty claim, CARB will issue a Notice of Violation and said party could be subject to fines and/or other civil penalties.

2. Key Requirements

This section provides a summary of the Authorized Installers and End Users key requirements. However the required procedures must be obtained and verified from CARB's *Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines* (the Procedure) in Title 13, California Code of Regulations, Sections 2700 through 2711.

The requirements include:

- Perform a Pre-Installation Compatibility (PIC) Assessment
  - Specific details on *how* to perform the assessment are covered in Section B below.
  - The PIC documents that the DPF is compatible with the Engine and its Application; it is one of the key documents that must be recorded and kept by the Installer, the End User, and the Manufacturer.

- Provide an installation warranty of the duration specified in the Regulation, which can be up to 5 years or 4200 hours depending on engine size. The installation warranty language is defined in the Regulation (section 2707). An excerpt is below for your information:

YOUR WARRANTY RIGHTS AND OBLIGATIONS - Installation

(Installer's name) must warrant that the installation of a diesel emission control system is free from defects in workmanship or materials which cause the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706. The warranty period and the extent of the warranty coverage provided by (installer's name) must be the same as the warranty provided by the product manufacturer, and the same exclusions must apply.

OWNER'S WARRANTY RESPONSIBILITY - Installation

As the vehicle, engine, or equipment owner, you are responsible for presenting your vehicle, engine, or equipment, and diesel emission control system to (installer's name) as soon as a problem with the installation is detected.

If you have questions regarding your warranty rights and responsibilities, you should contact (Insert chosen installer's contact) at 1-800-xxx-xxxx or the California Air Resources Board at 9528 Telstar Avenue, El Monte, CA 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

- Commission the DPF and DPF Data Logger and provide a written Statement of Compatibility to the End User upon completion of Commissioning
  - The Statement of Compatibility will include a copy of the Commissioning Report and the Pre-Installation Compatibility Assessment.
  - The Authorized Installer is required to provide the End User training on operations and maintenance at commissioning.

- Track all PIC's, installations (with End User contact info), and warranty claims. Maintain records of them and be able to provide them to CARB or the DPF Manufacturer upon request.

- Report annually by March 1st to the DPF Manufacturer and to CARB an Installation Warranty Report listing all installations of DPF's for the preceding year, and any installation warranty claims for the preceding year.

- Obtain and maintain appropriate tools and spare parts (e.g. DPF Data Logger service kit).

3. Key Documents

There are certain documents and checklists which the Regulation requires Authorized Installers to provide to the End User, CARB, and the DPF Manufacturer. These document requirements cover compatibility assessment, installation, commissioning, maintenance, and service.

A summary of the key reporting requirements include:

Documents the Authorized Installer must provide to each End User:

1. Pre-Installation Compatibility Assessment
2. Installation, Operation, and Maintenance Manual
3. A "written statement of compatibility" (see CARB memo MSC11-11, dated 4/12/2011)

Documents the Authorized Installer must provide to CARB:

1. Authorized Installer Warranty Report, submitted annually to CARB for annual warranty claims, due March 1. See CARB memo ECAR-14-02 "Annual Warranty Report Format for Installers and Manufacturers of Diesel Emission Control Strategies".

Documents the Authorized Installer must provide to the Manufacturer

1. Copy of the Authorized Installer Warranty Report submitted annually to CARB.
2. Pre-Installation Compatibility Assessment for every installation.
3. Commissioning Report (including End User contact information).

4. CARB Publications Useful for the Installer and End User

CARB has published a number of Mail Outs which provide interpretation and/or supporting information to help comply with the Regulation. Listed below are the relevant publications known by MIRATECH at the time this Manual was published. We encourage you to visit the CARB website and sign up for their automatic e-mails so you are notified when new documents are posted (http://www.arb.ca.gov/listserv/listserv_ind.php?listname=ms-mailings).

ECAR 14-02	Annual Warranty Report Format for Installers and Manufacturers of Diesel Emission Control Strategies. http://www.arb.ca.gov/msprog/mailouts/mouts_14.htm
MSO 13-07	Installation and Maintenance of your Diesel Emission Control Strategy. http://www.arb.ca.gov/msprog/mailouts/mouts_13.htm
MSO 13-06	Authorized DECS Installers, Pre-Installation Compatibility Assessment and Training Requirements. http://www.arb.ca.gov/msprog/mailouts/mouts_13.htm
MSC 11-11	Pre-Installation Compatibility Assessment Requirements. http://www.arb.ca.gov/msprog/mailouts/mouts_11.htm

NOTE:
Rules are subject to change by CARB. It is the Authorized Installer's and/or End User's responsibility to be in compliance with CARB regulations. The information in this Manual is provided as a courtesy and is a summary of the requirements as of the date the Manual was published.

All requirements and procedures must be reviewed for all of the specific regulations that must be met regarding verified DECS. Each of the approved amendments and all of the regulations can be found on California's Air Resources Board website:

http://www.arb.ca.gov/regact/2012/verdev2012/verdev2012.htm

B. Pre-Installation Compatibility (PIC) Assessment

In order to ensure a successful installation and proper application of the LTR, a Pre-Installation Compatibility Assessment (PIC) must be performed. The PIC can be broken down into two major categories: Compatibility Criteria defined in the CARB Verification Executive Order issued for the LTR, and Suitability Criteria defined by MIRATECH. The Authorized Installer must work with MIRATECH to ensure all Compatibility and Suitability Criteria are met before installing the LTR.

The Pre-Installation Compatibility Assessment for New Engine installations will often be complete before the Engine is installed. Most of the PIC will entail verifying that the Compatibility Criteria in the Executive Order are satisfied, reviewing the Engine performance data to determine what load(s) create sufficient exhaust temperature for particulate regeneration, and reviewing the proposed exhaust system layout to ensure the LTR is located in the appropriate location.

Existing Engines will require a more involved PIC. The same Executive Order Criteria will need to be satisfied, but a thorough inspection of the Engine and the proposed LTR installation will need to be completed. During that inspection the individual performing the PIC Assessment will need to check the Engine's maintenance records and its state of repair (or engage a qualified service technician to do so).

A PIC checklist is located in *Appendix A: Pre-Installation Compatibility Checklist* for your use.

1. Criteria for Compatible Engines, per the Executive Order – New or Existing Engines

a. Engine family name must be on the Engine Family list included in the Executive Order. The latest Engine Family list can be found on the CARB website at http://www.arb.ca.gov/diesel/verdev/vt/stationary.htm.
b. The Engine must be used in Stationary Applications for Emergency Standby generators.
c. Engine is Tier 1, 2, or 3 certified.
d. Engine must be certified to PM of ≤ 0.22 g/bhp-hr.
e. Engine must be in its original certified configuration.
f. Fuel must be Ultra Low Sulfur Diesel (ULSD).
g. Engine must not employ EGR.
h. Engine must not have an existing DOC.
i. Engine must not have an existing DPF.
j. Engine must be four-stroke.
k. Engine must be certified for use in California, or certified by the United States EPA.

l. Engine must be well maintained and not consume lube oil greater than specified by the Engine Manufacturer.

2. Suitability Criteria defined by MIRATECH – New Engines

a. Engine Duty Cycle / Exhaust Gas Temperature Profile
   i) Will the engine be operated such that after 18 cold starts it will operate at sufficient load to regenerate the collected PM?
   ii) What is the load profile during typical engine run events (e.g., maintenance runs, load tests, outages, etc.)?
   iii) Operating schedule – how often and for how long is the engine run?
   iv) Attach Engine Manufacturers data sheet indicating exhaust temperatures at part load conditions, and maximum allowable backpressure.

b. Engine lube oil compatibility
   i) Lube oil should be intended for use in engines with Aftertreatment devices.
   ii) Sulfated ash content should not exceed 1% by weight.
   iii) Record the lube oil type and/or attach a data sheet.

c. Proposed Exhaust System Schematic
   i) Will there be so much restriction from piping and other equipment that the back pressure from even a clean DPF will be near the limit for the engine?
   ii) Attach calculations or other supporting documents for system components and backpressure to the PIC form.

d. Service Considerations – Housing Access and Clearance
   i) Is there room to gain access and service the DPF and DOC elements?
   ii) Determine a suitable location to mount the Operator Display for the DPF Data Logger – it must be plainly visible to operators or technicians.

e. Exhaust Insulation, Housing Material Selection
   i) Exhaust piping between the engine and DPF should be insulated to retain exhaust heat. Exhaust piping downstream of the DPF does not need to be insulated unless required for personnel protection or other requirements.
   ii) The DPF housing should be insulated to retain exhaust heat. If the exhaust temperature will exceed 900°, the DPF housing has to be stainless steel. Attach estimates of inlet temperature (under steady state conditions) to DPF at various load points.

3. Suitability Criteria defined by MIRATECH – Existing Engines

NOTE:
Prior to installation, it is recommended the operator use data-logging to understand the engine load and exhaust temperature profiles (value, duration) during a typical operating duty cycle for the application. This proactive process is vital in understanding how best to design and operate the DPF system for desired regeneration and cleaning frequencies.

Suitability Criteria for Existing Engines are the same as for New Engines, however there are additional factors regarding engine condition and maintenance which must be considered.

a. Site Inspection / Suitability Criteria / Pre-qualification check list
   i) Engine Operating Hours – are they within the OEM's emissions warranty?
   ii) Work Practices / Maintenance History and Records Review
      (1) Have Engine Manufacturer's recommended practices been followed?

(2) If not, or no records exist, the engine should be serviced to ensure it is in good operating condition.
(3) Are records available to document:
(a) ULSD is being used.
(b) Correct lube oil is being used.
(c) Make-up oil additives (if any) are appropriate.
(d) Oil consumption rate (as a percentage of fuel consumption).

iii) Basic Engine Condition Assessment. Assess the general state of repair of the engine. Specific examples include, but are not limited to:
(1) Is there evidence of tampering/defeating any of the Engine's emissions related systems? If so, those systems must be repaired such that they are functioning to manufacturer's specifications.
(2) Signs of poor maintenance (e.g., oil leaks, exhaust leaks, fuel leaks, etc.).
(3) Signs of fuel contamination (e.g., lube oil in the fuel, etc.).
(4) Check tailpipe for signs of wet-stacking, excess PM, etc.

iv) Review ECM Fault History
(1) Are there active faults?
(2) Is there a history of repeat faults?
(3) Are there maintenance records available to document repairs to address faults?
(4) Perform engine service/repairs as needed to resolve persistent faults.

v) Exhaust System Layout
(1) How much exhaust back pressure does the existing exhaust system create? Calculations can be used to determine existing back pressure, however taking an actual measurement in the field (with the engine running at full load) is more useful.
(2) Will the addition of the DPF create more backpressure than allowed for the engine? The exhaust system may need to be revised, or highly restrictive silencers replaced.
(3) Proposed DPF location. It must be upstream of existing silencers, as close to the engine as practical.
(4) Temperature loss through piping. A rule of thumb is 6° F drop per foot of uninsulated exhaust pipe. If the exhaust piping is not insulated, you may have to plan on adding insulation after the DPF is installed.

4. Documentation & Record Keeping

a) After the PIC is completed, attach all relevant documents (e.g., engine performance sheets, layout sketch, lube oil data, etc.).
b) Retain the completed PIC in your customer file, and send a copy to MIRATECH with the completed Commissioning Report.
c) A copy of the PIC should be given to the End User as part of the Written Statement of Compatibility.

5. Warranty Statement

YOUR WARRANTY RIGHTS AND OBLIGATIONS - Product

MIRATECH warrants the diesel emission control system in the application for which it is sold or leased to be free from defects in design, materials, workmanship, or operation of the diesel emission control system which cause the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California

Code of Regulations, Title 13, sections 2700 to 2706, and 2710, for the periods of time listed below in **WARRANTY COVERAGE,** provided there has been no abuse, neglect, or improper maintenance of your diesel emission control system, engine or equipment, as specified in the owner's manuals. Where a warrantable condition exists, this warranty also covers the engine from damage caused solely by the diesel emission control system, subject to the same exclusions for abuse, neglect or improper maintenance of your equipment. Please review your owner's manual, project specific documentation and terms and conditions for other warranty information. Your diesel emission control system may include a core part (e.g., particulate filter, diesel oxidation catalyst) as well as hoses, connectors, a back pressure monitor (if applicable), and other emission-related assemblies. Where a warrantable condition exists, **MIRATECH** will repair or replace your diesel emission control system at no cost to you including our diagnosis, parts, and labor.

WARRANTY COVERAGE - PRODUCT

For an engine larger than 50 HP and used in a stationary application, the warranty period will be 5 years from the original date of shipment from MIRATECH or 4,200 hours of operation, whichever occurs first. If any emission-related part of your diesel emission control system is defective in design, materials, workmanship, or to the requirements in the California Code of Regulations, Title 13, sections 2700 to 2706, and 2710, within the warranty period, as defined above, **MIRATECH** will repair or replace the diesel emission control system, including parts and labor for engines located in the United States. This coverage also applies to any parts replacements, sizing changes, or adjustments that are required to appropriately match the diesel emission control system to the engine which it is installed.

In addition, **MIRATECH** will replace or repair the engine components to the condition they were in prior to the failure, including parts and labor, for damage to the engine proximately caused solely by the verified diesel emission control strategy. This also includes those relevant diagnostic expenses of **MIRATECH** in the case in which a warranty claim is valid. **MIRATECH** may, at its option, instead pay the fair market value of the engine prior to the time the failure occurs.

OWNER'S WARRANTY RESPONSIBILITY - PRODUCT

As the engine, or equipment owner, you are responsible for performing and documenting in writing the required maintenance described in your owner's manual. **MIRATECH** strongly recommends you retain all maintenance records and receipts for maintenance expenses for your engine, or equipment, and diesel emission control system. If you do not keep your receipts, fully document required maintenance or fail to perform all scheduled maintenance, **MIRATECH** may have grounds to deny warranty coverage. You are responsible for documenting your diesel emission control system problems in writing, to **MIRATECH** as soon as a problem is detected. You further agree to provide access to the engine or equipment at no charge to representatives of **MIRATECH** to troubleshoot the problems you have documented. The warranty repair or replacement should be completed in a reasonable amount of time, and should typically not exceed 30 days. If a replacement is needed, this may be extended to 90 days should a replacement not be available, but must be performed as soon as a replacement becomes available.

If you have questions regarding your warranty rights and responsibilities, you should contact **MIRATECH** at 800-640-3141 during normal Central Time Zone (Oklahoma) business hours or

the California Air Resources Board at 9528 Telstar Avenue, El Monte, California 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

Possible Scenarios for Denial of Warranty Coverage for LTR Diesel Oxidation Catalyst & Diesel Particulate Filter – Product and Installation

1. Mechanical damage due to improper installation, support, or handling of the housing or filters.
2. Mechanical damage due to improperly operating engine or engine related problems.
3. Physical change in location of the housing unless performed by an Authorized Installer. Changing the location will require completion of a new Pre-Installation Compatibility Assessment and submission of it to **MIRATECH**.
4. Acts of nature – damage by earthquake, lightning or storm related damage.
5. Clogging of the DPF by a foreign substance (such as silencer packing material).
6. DOC or DPF contamination by exposure to excessive catalyst poisons (such as an engine coolant leak).
7. Operating over the allowable backpressure for the DPF or engine.
8. Operating outside the design engine operating conditions:
    a. Exhaust temperature too low.
    b. PM emissions too high.
    c. Exhaust flow too high.
    d. Ash content of lube oil higher than specified.
    e. Excessive lube oil consumption.
9. Contaminated fuel or fuel that does not meet the design specifications.
10. Lack of proper maintenance or documented activities.
11. Improper DPF cleaning, maintenance, or installation.

3. Installation

A. Housing Location

The location of the LTR housing in the exhaust stream is extremely important for the operation and maintenance of the system. The LTR housing is designed to connect into the exhaust pipe with the inlet and outlet flanges. All LTR housings come standard with flat faced flanges with 150lb ANSI standard bolt pattern. Piping and housing flanges should be mated using a flange gasket, nuts and bolts suitable for the maximum exhaust temperature of the engine. The physical location of the LTR housing is recommended to be as close to the outlet of the engine to retain as much heat as possible. The housing must be installed horizontally unless specially designed for vertical installation. If a packed silencer is used in conjunction with the DPF, it must be placed downstream of the LTR housing.

MIRATECH discourages an exhaust piping design with close-coupled elbows (whether short-radius or long-radius) directly connected to the LTR housing because of a number of potential problems that may be encountered. These problems include poor distribution of exhaust gas flow, elevated pressure drop, and impaired emissions conversion efficiencies. These problems may not exist in all cases, but it can be costly to reconfigure exhaust piping should a problem arise.

Many exhaust piping designers employ a two to three pipe diameter rule-of-thumb because, in most cases, a straight piping run of two to three pipe diameters in length generally allows for the exhaust gas to return to fully-developed flow after a flow disturbance such as an elbow. Sound piping design practices should be used when designing the layout of the exhaust system.

For ease of service, the housing should be installed such that DPF block removal for visual inspection and cleaning may be performed with ease and the least engine downtime. Non-slip walking grids and/or safety railings are recommended in the area surrounding the housing. Alternately, room for an adequate personnel lift should be provided. The inspection/cleaning ports and door are located on one side of the housing. The housing should be situated so that access to this side is greater than or equal to the width of the housing. Refer to the project-specific drawings for clearance requirements for the maintenance and inspection doors. For ease of serviceability and flexibility of installation MIRATECH offers access/service doors located on either side of the housing.

Flow direction is critical; all housings have a directional arrow on the nameplate indicating which way the exhaust flow should travel through the LTR housing.

B. Mounting

The LTR housing is not a structural member and must be supported properly so that no forces or moments act on the inlet or outlet flanges. Housing may be supported by structural supports or hangers suspended from the ceiling. Each LTR housing with six or more modules come equipped with mounting feet to assist in mounting and securing the housing. Due to the small nature of housings smaller than six modules, installers typically build in supports to the enclosure or engine room to accept the LTR housing. Mounting feet can be provided on housing of less than six modules if specified during quoting process for a nominal fee. The housing must be supported from the bottom unless specially designed. Hanging or supporting the housing by the lifting lugs is not acceptable.

High temperature exhaust causes thermal expansion of exhaust components during engine operation. To ensure that no forces or moments act on the converter as a result of its thermal expansion, the supports on the inlet end of the housing should be fixed, and those on the outlet end of the housing should allow for float during thermal expansion. Expansion joints should be fitted to the exhaust piping to ensure that no forces are transferred to the housing as a result of thermal expansion of the exhaust pipe or other exhaust components.

C. Insulation

MIRATECH recommends insulating the exhaust piping, between the engine exhaust flanges and the LTR housing inlet flange, and the LTR itself to minimize heat loss. This will allow passive regeneration with a lower partial engine load than with bare steel. By insulating the LTR housing, retained heat in the DPF can extend the operating window for passive regeneration.

Carbon steel housings must not be insulated if exhaust temperatures will exceed 900°F (482°C). Insulating carbon steel housings at high temperatures will severely shorten the life of the housing and void the warranty. If insulating a housing where exhaust temperatures exceed 900°F stainless steel is required.

When installing insulation on the LTR housing special care should be taken to allow proper clearance and access to all service and access doors and all sample ports located on the housings. Refer to the specific project drawings for locations of doors and sample ports.

D. DPF Data Logger Installation

Please review the DYNtest Installation & Operation Manual in Appendix E. The instructions provided here are a supplement to the DYNtest Manual.

Note:
The date and time can be brought forward if the power supply has been interrupted for a period longer than one hour. However if the time and date have to be set back, only a period of one hour will be accepted. Longer time changes can only be made after an entire reset of the system has been made.

The DPF Data Logger kit comes with all the proper components to monitor the temperature and back pressure at the inlet of the LTR housing. Each kit contains: (1) Controller, (1) Display, (1) Pressure Gauge Assembly, (1) Moisture Separator, (1) Fuse Kit and (1) Wiring Harness. The authorized installer is responsible for all tubing, additional wire and other hardware not provided with the kit.

The controller must be mounted within 15 feet of the inlet to the LTR. When selecting a location for the controller environmental conditions should be considered. The controller is rated IP64 which is dust tight and withstands splashing water. It should be mounted in a location where the ambient temperature is between 14°F - 176°F.

Figure 1: Controller

The display must be mounted within 15 feet of the controller. The display needs to be mounted so it can be viewed during normal engine operation and that the wiring harness is easily accessible. The wiring harness is used to connect the Controller to a PC/Laptop for setting Parameters as well as retrieving data files. The display has two threaded studs that can be used to mount it in a control panel.

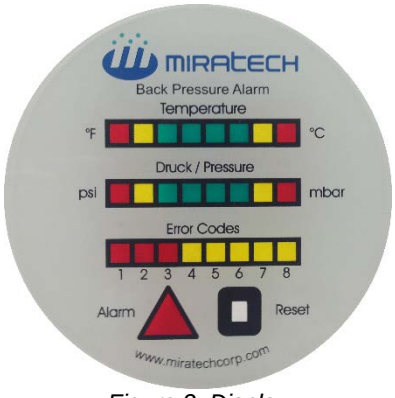


Figure 2: Display

Once the controller and display are mounted the wiring harness can be connected to the controller. In the harness there are wires for: Power, Alarm Outputs, Run Signal, Display and Thermocouple. The DPF Data Logger requires a source voltage of 10-30 VDC. The fuse kit should be installed between the positive side of the voltage source and the controller.

Figure 3: Wiring Harness

Figure 4: Fuse Kit

The alarm outputs are not required but can be tied into an audible or visual alarm and are programmable during commissioning to alarm on temperature and pressure set points. A run signal is required from the engine to initiate data logging. The run signal can be connected to the positive post on the starter or the ignition / kill switch. The display is connected using the preinstalled RJ 45 connector on the wiring harness and the back of the display panel. The

thermocouple should be connected to one of the ¼" NPT ports at the inlet of the LTR. The thermocouple should be installed so it does not extend past the center of the exhaust stream. Special care should be taken when routing all wires to keep them free of any exhaust piping that could potentially cause damage.

Before connecting the moisture separator, the pressure gauge assembly should be located and installed relative to the controller and LTR inlet. The pressure gauge assembly is intended to be mounted close to the controller. The purpose of the pressure gauge is to indicate the actual backpressure value in addition to the bar-graph scale on the display. A small piece of flex tubing can be run from the barb fitting on the controller to the barb fitting on the pressure gauge assembly. Care should be taken that the pressure gauge assembly is mounted below the controller so condensate cannot form and plug the pressure line.

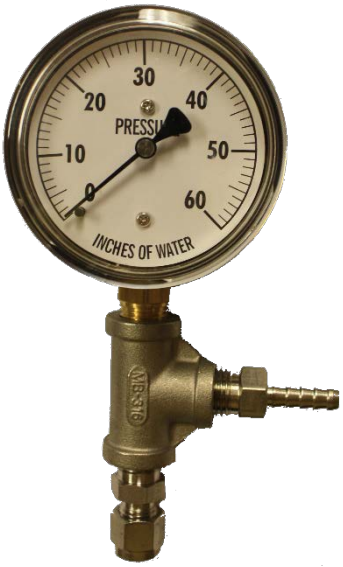


Figure 5: Pressure Gauge

The moisture separator should then be mounted in a way that the pressure lines from the LTR inlet and the pressure gauge assembly slope down to the moisture separator. Plastic tubing (such as PVC, PFA, etc.) may be used to connect the pressure lines. Use a piece of stainless steel tubing running about 2 - 3 feet away from the LTR inlet connection and connect the plastic tubing to that. A ¼" NPT x ¼" Compression fitting is provided with the DPF Data Logger to connect pressure tubing to the LTR inlet.

4. Operation

The MIRATECH® LTR™ Diesel Particulate Filter is a passively regenerated filter. The advantage of a passive system is no additional heat input from an auxiliary burner or electric heater is required. It is suitable for applications where the exhaust temperature and flow rates are high enough to oxidize the particulate matter that has been accumulated. In order for the LTR to work properly simple practices as detailed in this section must be followed to ensure trouble-free operation.

A. Engine Lube Oil

Operators must follow all engine manufacturer requirements for compatible lube oil (e.g. ash content, TBN) and monitor lube oil consumption rate to ensure it meets manufacturer's requirements. Lube oil sulfated ash is a common source of catalyst masking and/or fouling. To reduce the risk of masking and/or fouling it is important to minimize the lube oil consumption rate and use lube oil with low sulfated ash, compatible with and formulated for DPFs. Ash from burned lube oil collects in the DPF blocks and does not regenerate. Over time, ash accumulates in the DPF resulting in increased backpressure. Therefore, the filter must be cleaned periodically to remove the ash. Using the lowest ash content lube oil allowed by the engine manufacturer, and ensuring low oil consumption rate, will maximize the filter maintenance interval and service life. The lube oil ash content and consumption rate should be maintained at or below the levels called out in the project-specific documents provided by MIRATECH. MIRATECH requires a lube oil with less than 1% ash content by weight for use with the LTR.

B. Fuel

The LTR, installed as a CARB verified system, must use Ultra Low Sulfur Diesel (ULSD) fuel with sulfur content less than 15 ppm.

C. Engine Operation

During many installations repeated cold starts and excessive idling may occur. If possible, to prevent the DPF from becoming plugged the DPF blocks should be removed from the LTR housing during commissioning of a new engine installation. The engine, the driven equipment (e.g. a generator), interconnects, and other system components in a new installation will usually require test runs, de-bugging, and the like, which often requires numerous starts and stops and prolonged idle periods. Further, if the DPF blocks were to reach a plugged condition and require regeneration, the installation may not be at a stage at which load can be applied to the engine to create the necessary regeneration conditions and duration. If the LTR is left installed and operated at conditions with zero regeneration possible (e.g. cold starts, prolonged idling), the DPF blocks will plug with accumulated particulate. For some engines, the not-to-exceed published PM emission rate at idle will plug the blocks in as little as 12 operating hours. At that plugged condition, the DPF must be regenerated immediately: further operation will either plug the DPF irreversibly (requiring complete replacement), or leave the DPF at risk of a runaway regeneration (i.e. a meltdown) when regeneration next initiates. Once project installation is completed, the system components are de-bugged and functioning correctly, and the operating duty cycle of the engine is following its "normal" design profile, the DPF blocks should then be installed, sparing them from the heavy particulate deposition that often occurs during the final stages of completing the project installation.

Once the engine installation and commissioning is completed there are several best practices when operating an engine installed with an LTR. The operator must follow the engine manufacturers recommended startup/shutdown practices to avoid accumulation of particulate in the DPF without the opportunity for it to regenerate. Operators shall maximize engine operating conditions in which the regeneration burn-off rate of the DPF exceeds the particulate deposition rate of the engine. The burn-off rate and ideal temperatures are discussed in the Filter Regeneration section. The most important thing for an operator to pay attention to when running their engine is to minimize the amount of time at which the engine is operating at an idle or low load condition at which there is not adequate exhaust temperature at the LTR inlet for regeneration.

D. Filter Regeneration

For standby generator applications, the LTR has demonstrated the capability in CARB verification testing to undergo 18 consecutive cold start cycles without resulting in unacceptable backpressure. However, backpressure should always be monitored to determine when regeneration is required so that full load-carrying capability remains without exceeding the engine's maximum allowable exhaust backpressure.

The need for regeneration is due to particulate build up in the filter with no regeneration occurring. There are many things that affect the diesel particulate deposition rate in the DPF. The first is the particulate matter concentration in the exhaust stream. Higher particulate concentrations will plug the DPF more quickly than lower concentrations. This can fluctuate due to engine transients (e.g. turbo lag, cold start emissions), inlet air density changes (e.g. elevation), clogged intake air filters, changes in turbo-charger performance or efficiency (as could be induced by an excessive backpressure on the engine exhaust system), inter-cooler performance, worn fuel injectors, lube oil consumption, lube oil ash content, etc. The second is the exhaust flow rate. Higher exhaust flow rates will yield higher backpressures across the DPF. A high exhaust flow rate with a high particulate concentration accelerates the plugging of DPF's. If an operator has a high back-pressure on the engine at idle or low load conditions and then increases the load and exhaust flow rate, a much higher back-pressure will be observed. The third thing that affects the particulate deposition rate is the DPF temperature relative to the exhaust temperature. Cold DPF blocks in a hot exhaust (e.g. immediately after startup, during warm-up) will not regenerate. DPF block temperatures must be high enough to activate and sustain the oxidation reactions which burn out the accumulated particulate.

To better understand how to regenerate the filter it is important to understand what affects the regeneration or "burn-off" rate of the filter. Engine exhaust flow and temperatures play a major role in this. Lower exhaust flow rates, typically associated with lower engine loads, generally have lower exhaust temperatures and lower velocities through the DPF blocks which both impede the regeneration reaction. Along with exhaust gas temperature the actual DPF block temperature is a factor in regeneration rate. A "cold" DPF will not burn off and remove diesel particulate, it will only accumulate particulate matter. Depending on the engine warm-up procedures and operating load on the engine, DPF blocks may require 10 – 60 minutes of engine run time before the DPF blocks reach a temperature where regeneration is possible. The next thing that can affect the regeneration rate is the exhaust chemistry. Wet particulate and diesel aerosols in the exhaust will plug a DPF more quickly than dry particulate. NO_2 present in diesel exhaust will accelerate the oxidation reactions in a DPF. The LTR uses a diesel oxidation catalyst to oxidize both diesel aerosols and NO, yielding drier particulate and higher NO2 concentrations, both of which enhance DPF regeneration reactions. The other factor affecting regeneration rate is the composition of the ash/PM loading on the DPF block. As the DPF accumulates operating hours, it will also accumulate ash from combusted particulate and lube oil. As the ratio of ash to diesel particulate within the DPF changes, so does the regeneration activity. This will be observed by changes in regeneration burn-off rate at a given temperature (i.e. slower burn-off rates are indicated by a lower inches WC/hour decrease in DPF backpressure).

To better understand when regeneration is required the operator should monitor the back pressure on the filter, exhaust temperature at the inlet of the LTR housing, engine load and operating hours since last servicing. When operating the engine the operator must monitor the back pressure on the LTR housing to determine if regeneration or service is required. The chart below shows the typical operating curve for an LTR housing. A plot representative for each installation will be provided after commissioning of the system. If after regeneration the back

pressure decreases and stabilizes at a back pressure in the service interval area (or region) the filter has accumulated enough ash to warrant cleaning as described in the Maintenance section. Operating the filter in the service interval region will limit the number of hours your engine can operate before regeneration is required.

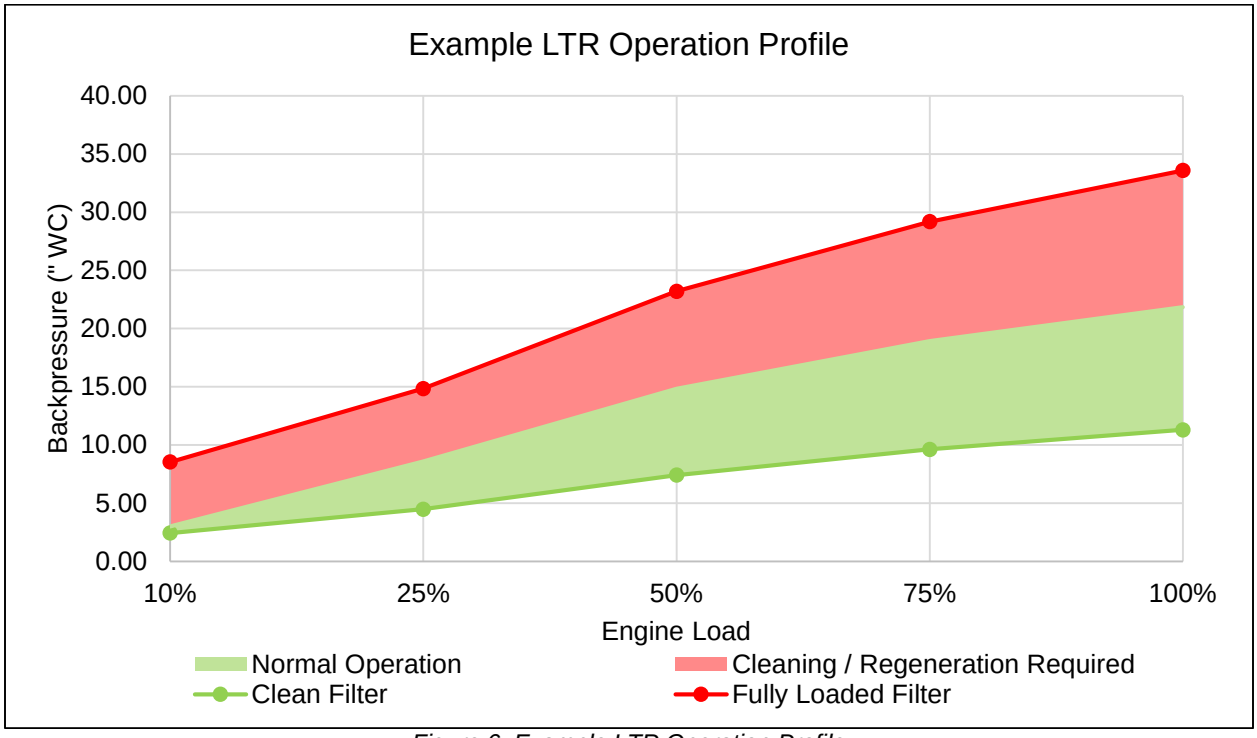


Figure 6: Example LTR Operation Profile

Due to the many variables that affect DPF regeneration, the regeneration performance can be very dynamic. In general, there are a few guidelines on how a system performs, based on field data from installed systems. All guidelines assume the system is in equilibrium and DPF blocks are at the same temperature as the exhaust. All temperatures are approximate, may vary from installation to installation, and will often drift over time as the DPF blocks age.

- **Below 500°F**
  The particulate accumulation rate will typically exceed the regeneration burn-off rate within the DPF: the particulate from current operation is accumulating faster than it is being combusted by the reactions within the DPF. The operator will observe an increase in the pressure drop across the DPF. The pressure drop can increase at a rate of 2 inches WC/hour or higher! As exhaust temperature decreases below 500°F, the rate of pressure drop increase (inches WC/hour) will accelerate as the reactions slow and combustion of particulate is extinguished. With pressure drop across the DPF increasing at a rate of 2 inches WC/hour, the DPF can reach a plugged condition in as little as three hours, or sooner if the DPF is already loaded with accumulated particulate from prior operation.
- **Between 500 and 525°F**
  The operator will find an engine condition at which the regeneration burn-off rate equals the particulate deposition rate: the particulate from current operation is combusting as quickly as it is accumulating within the DPF. The operator will observe no net change in the pressure drop across the DPF at this equilibrium condition.

- **Above 525°F**
  The particulate from current operation as well as accumulated particulate from prior operation are burning off. The operator will observe a decrease in the pressure drop across the DPF. At about 525° F, the pressure drop will decrease at a rate of 0.80 inches WC/hour. As exhaust temperature increases above 525°F, the rate of decrease (inches WC/hour) will increase as the reactions accelerate (e.g. 2.80 inches WC/hr at 650°F, 6 inches WC/hr at 700°F). When all of the accumulated particulate from prior operation is combusted, the pressure drop across the DPF will stabilize.

Reliance upon temperature alone as the metric for engine and DPF operating decisions can lead to irreversible plugging and/or the catastrophic failure of runaway regeneration.

5. Commissioning

Commissioning the LTR product ensures that all equipment has been installed properly, the equipment is performing as it was designed, and that the operator is trained on proper operating parameters and items to watch for during engine operation. Commissioning the LTR system can only be completed by a MIRATECH Authorized Installer or MIRATECH Field Service Technician. For more information on how to become an Authorized Installer or to schedule a field service technician visit please contact MIRATECH. A template of the commissioning report format can be found in *Appendix B: Commissioning Report Template* for your reference.

A. Pre-Commissioning Inspection

Prior to commissioning the system a Pre-Commissioning installation inspection should be conducted. This should be completed once all MIRATECH equipment is installed and prior to the engine being run for the first time. During this walk through the following items should be inspected for proper installation.

Proper Housing Orientation – Standard LTR housings are designed for horizontal unidirectional flow. Each LTR has a nameplate mounted on the same side as the access and service doors. Ensure that the nameplate is affixed to the housing and that the flow arrow is pointing in the same direction as the exhaust flow.

Inlet & Outlet Connections – Standard LTR housings come with flat faced flanges with 150# ANSI standard bolt pattern. Flanges should be sealed together with a flange gasket between the piping flange and housing flange and secured using all bolt holes available in flange. Engine should not be commissioned until all bolts are present to prevent any exhaust gas leaks.

Housing Supports – The LTR housing is not a structural member. Check to ensure that the mounts on only one side of the housing are fixed and the other side is free to slide for housing thermal expansion. The housing must be supported from the bottom unless specially designed. Hanging or supporting the housing by the lifting lugs is not acceptable.

Access & Service Doors Installed – Prior to shipment from the factory all access and service doors are gasketed and installed. By visual inspection ensure that the gasket material is present between the door(s) and housing. If gasket material is not present the door(s) that do not have gasket material should be removed and gasket applied.

DPF Data Logger Installation – Check to ensure the DPF Data Logger and all components are installed correctly. Check that the pressure gauge is easily accessible and can be read during engine operation. The display should be visible, and the wire harness easily accessible to connect a computer for data retrieval. All connections on the inlet neck of the housing should be tight and secured using anti-seize. The pressure tubing directly adjacent to the housing should be stainless steel. The routing of all pressure tubing should slope down to the moisture separator. All wiring should be routed away from any hot surfaces.

General Exhaust Train Inspection – An overall inspection of the exhaust train should be completed. Notes and pictures, if allowed, should be taken of the location of the LTR housing relative to the engine. A schematic should be drawn showing all piping and components installed. Lengths and diameters of piping should be noted as appropriate. If there is a silencer installed upstream of the LTR housing it should be confirmed that it is not internally packed. If insulation is installed on the exhaust train or on the LTR housing, the thickness, type of insulation, and what is insulated should be documented.

Application Specific Notes – While this manual tries to capture all items related to every installation there can always be certain things that stand out from application to application. Any site-specific notes regarding the application should be made on the Commissioning Report.

B. DPF Data Logger Commissioning

Note:
The date and time can be brought forward if the power supply has been interrupted for a period longer than one hour. However if the time and date have to be set back, only a period of one hour will be accepted. Longer time changes can only be made after an entire reset of the system has been made.

Commissioning the DPF Data Logger ensures the system is connected properly and the correct alarm set points are made in the system. Prior to commissioning the DPF Data Logger the installer must read the DYNTEST Installation & Operating Manual in *Appendix F: DYNtest Installation & Operations Manual.*

To begin commissioning the DPF Data Logger verify all wiring connections match the wiring interconnect. Any missing or incorrect terminations should be corrected prior to applying power to the system. Review the wiring harness connection to the controller and all connections are secure and have not been tampered with. Prior to supplying power to the wiring harness validate the fuse assembly has been installed on the positive power side and the fuse is installed. Apply power to the system which will allow it to initialize.

1. Connecting a computer

Whether you are retrieving data or commissioning the system a computer must be connected to the system. When connecting a computer to the DPF Data Logger these steps must be followed.

1. The engine must be shut down.

2. Plug the USB adapter of the Data-Analyzer dongle into the USB Port of your PC/Laptop and wait until it is recognized by the operating system.

Figure 7: Data Analyzer Kit

3. Disconnect the wiring harness from the Display.

Figure 8: Display with Harness

4. Once the USB adapter has been recognized by the PC/Laptop, connect the bus cable from the controller to the Data-Analyzer dongle.
5. Each time the Data-Analyzer dongle is disconnected from the bus cable of the controller you must disconnect the USB adaptor from your PC/Laptop, reinsert the adaptor and wait for the operating system to recognize it. Then you may reestablish the connection between the USB adapter and the bus cable of the controller.

2. Setting Parameters

It is recommended that initial parameters be set prior to commissioning based on the initial sizing of the product. Once the system commissioning is complete the parameters should be updated to reflect the data acquired during the commissioning process. To set the parameters the DPF Data Logger should be connected to a laptop as described above and complete the following steps.

1. Once connection is established load the parameters from the Controller to the laptop, as well as (if necessary) make changes to any parameters via the “PARAMETERS” tab.
2. To load parameters from the Controller to PC/laptop, click on “Load Parameters from ControlBox” button as circled in blue in Figure 9.
3. It is imperative that you set the date and time on the Controller. This is done by clicking the “Set ControlBox Time” button as circled in black in Figure 9.

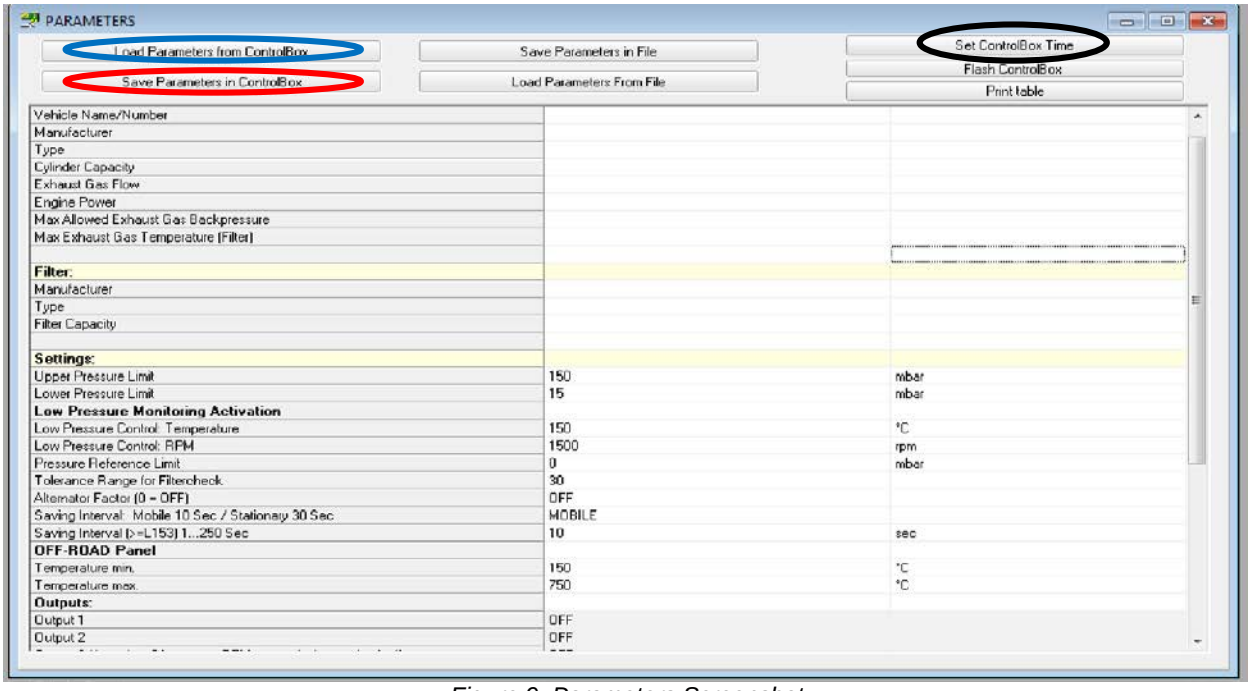


Figure 9: Parameters Screenshot

- Once the Controller parameters are loaded to PC/laptop, changes can be made by selecting/highlighting the value required to change, input the new value and hit enter on keyboard.

4. Once all changes have been made, finalize the changes by clicking on “Save Parameters in ControlBox” circled in **red** in Figure 9. This will send those changes to the Controller.

5. Table 1 shows the different parameter variables with a definition of each variable. The shaded cells require entry for proper Data Logger Operation; other fields are optional.

   CARB requires (2) two alarms to notify the operator when the backpressure limit is approached (Pre-High Alarm) and when the backpressure is reached or exceeded (High Alarm). These alarms are preprogrammed based on the Upper Pressure Limit parameter. If alarms need to be annunciated out to an additional monitoring system it is recommended to program output 1 and output 2 for the Pre-High Alarm and High Alarm respectively.

When setting alarm outputs (Output 1-3) the following terms define the user inputs required:

- **Data Type**
  - T – Temperature
  - P – Pressure *(This will be used for Output 1 and 2)*
  - F – RPM *(Not used)*
- **Set Point** – This should be set to the value of the data type at which you want the alarm to engage.
- **X>S** – Alarm will engage when measured value 'X' is greater than setpoint 'S'.
- **TI** – The time delay before the alarm will actually engage, second or minutes (user selectable).

Note: All units in the DPF Data Logger are metric. Therefore, conversions may be required based on available data.

- Temperature: °C = (°F - 32) x 5/9
- Pressure: mBAR = Inches Water Column x 2.491

6. Once all changes have been made, finalize the changes by clicking on "Save Parameters in ControlBox" circled in **red** in Figure 9. This will send those changes to the Controller.

Table 1: Data Logger Parameter Table

Description	Recommended Value	Units	Definition
Engine:			
Vehicle Name / Number			Engine number for reporting
Manufacturer			Engine manufacturer for reporting
Type			Type of engine for reporting, if applicable
Cylinder Capacity			Cylinder capacity of engine for reporting, if applicable
Exhaust Gas Flow			Exhaust Flow for reporting, if applicable
Engine Power			Engine Power for reporting, if applicable
Max Allowed Exhaust Gas Backpressure			Maximum Backpressure on Engine
Max Exhaust Gas Temperature (Filter)			Maximum Backpressure allowable for Filter
Filter :			
Manufacturer	MIRATECH		
Type			Enter full MIRATECH part number
Filter Capacity			Not required
Settings:			
Upper Pressure Limit		mbar	Recommended to enter estimated fully loaded DPF backpressure or the engine's maximum backpressure, whichever is less
Lower Pressure Limit	10	mbar	
Low Pressure Monitoring Activation			
Low Pressure Control: Temperature		°C	Not required for stationary applications – leave default value
Low Pressure Control: RPM		rpm	Not required for stationary applications – leave default value
Pressure Reference Limit		mbar	Not required for stationary applications – leave default value
Tolerance Range for Filtercheck	30		Not utilized if RPM is not monitored - RPM tolerance range that must be held for 5 seconds for filter check function
Alternator Factor (0 = OFF)	OFF		Allows DPF Data Logger to function without RPM signal
Saving Interval: Mobile 10 Sec / Stationary 30 Sec	STATIONARY		
Saving Interval (>=L 153) 1...250 Sec	30	sec	Interval at which data is logged in data logger
OFF-ROAD Panel			
Temperature min.		°C	Minimum Temperature for color bar on Display
Temperature max.		°C	Maximum Temperature for color bar on Display
Outputs:			
Output 1	OFF		Can be set for Temperature or Pressure
Output 2	OFF		Can be set for Temperature or Pressure
Output 3 (Attention: Disconnect RPM source before activation!)	OFF		Can be set for Temperature or Pressure
Delayed Decay (>= L71) / Pulse Time [ms] - Output 1 (>= L 75)	OFF	sec	Time delay at which alarm is reset once alarm condition is no longer active.
Delayed Decay (>= L71) / Pulse Time [ms] - Output 2 (>= L 75)	OFF	sec	Time delay at which alarm is reset once alarm condition is no longer active.
Special Program Output 1 (0 = OFF)	OFF		Not Applicable
Special Program Output 2 (0 = OFF)	OFF		Not Applicable
Pump Control Delta Digits (0 = OFF)	OFF	Dig	Not Applicable
Output Monitoring (>= L 167)	OFF		Not Applicable
Devices:			
MINI_PLC	OFF		Not Applicable
CAN_IO	OFF		Not Applicable
GSM	OFF		Not Applicable
Outputs Mini_PLC			
PLC_Output 1	OFF		Not Applicable
PLC_Output 2	OFF		Not Applicable
PLC_Output 3	OFF		Not Applicable
PLC_Output 4	OFF		Not Applicable

3. Downloading Data

To retrieve the log files from the DPF Data Logger a laptop/PC must be connected to the controller as described above and complete the following steps.

1. Once connection is established upload the loaded parameters from Controller, as well as (if necessary) make changes to any parameters via the “ANALYSIS” tab, circled in **red** in Figure 10.
2. The user can either select to download all of the stored information from the Controller, or select a specific file to download from the Controller to analyze.
3. To select a specific file click on “Load Directory” circled in **yellow** in Figure 10. A screen will appear listing the data files available to download. Select the desired data file for download.
4. To load all data from the Controller click on the “Load Data from CONTROL BOX” circled in **blue** in Figure 10.
5. Once the data is loaded, click on “Import CONTROL BOX Data from Database”, circled in **green** in Figure 10. Once all data is loaded choose the desired data to analyze.

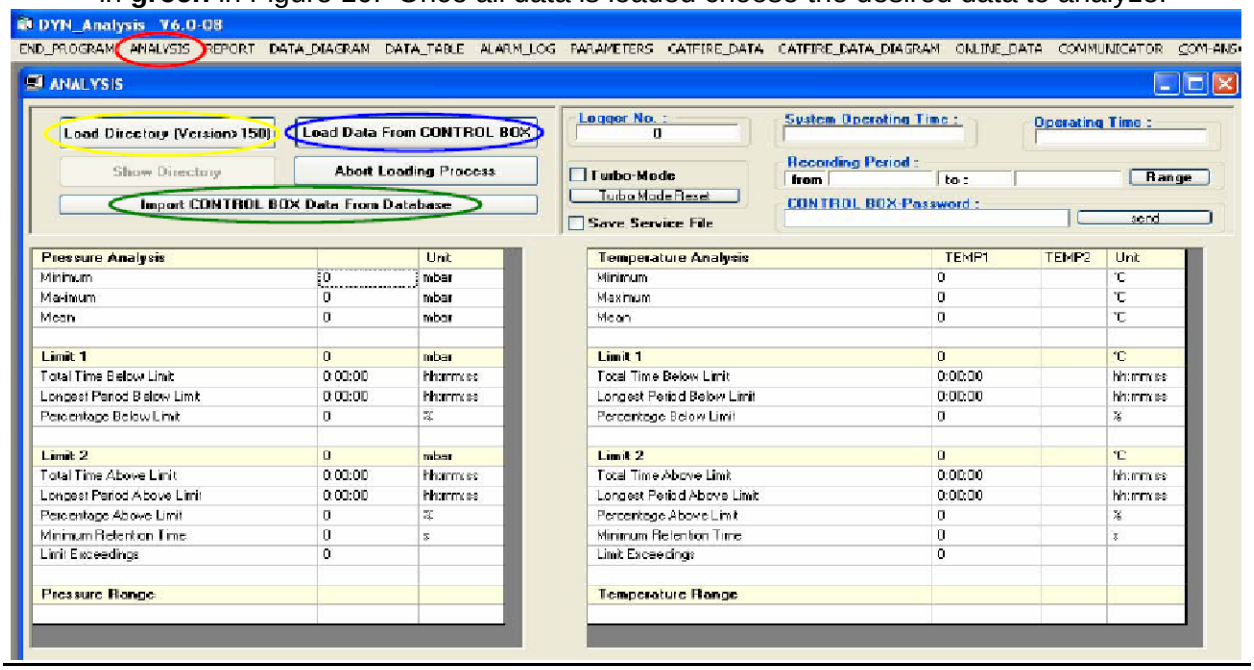


Figure 10: Datalogger Screen Shot

C. DPF Commissioning

To physically commission the system means running the engine at different load points to ensure the back pressure and regeneration behave as the system was designed. First begin by starting the engine per the engine manufacture’s recommended startup/warm up procedures. Once the engine is warmed up begin applying a load to the engine. Once load is applied to engine allow engine to stabilize for 10-15 minutes at which time the back pressure reading should be taken and documented from the pressure gauge. Once the pressure is read the next load can be applied and same process completed.

It is recommended that data be taken at 4-5 engine loads to properly map the operating window of the LTR. Typical engine load points are 10% (or Idle), 25%, 50%, 75% and 100% engine load. During each load point the back pressure may fluctuate due to soot loading or regeneration. The load point at which the back pressure begins to decrease should be noted during commissioning. Knowing the approximate time and load at which this occurs allows the

technician to review the log reports and know the approximate temperature regeneration occurred for this load profile. The regeneration temperature can change over time based on how the filter is loaded with soot and ash.

Once 100% load is achieved it is recommended to run an additional 30 minutes or until the back pressure stabilizes which means the filter has completely regenerated any soot that accumulated during commissioning. Since the run time for commissioning is typically less than 2-3 hours the amount of ash accumulation should be negligible under normal operating conditions.

Once the engine has been run through the load curve a new data plot similar to that of Figure 6 in the operation section should be completed by the Authorized Installer or MIRATECH field service technician and provided to the end user for future reference. To understand the use of this chart please review the Operation Section of this manual.

Upon shutdown of the engine reconnect a laptop/PC to the DPF Data Logger Controller and download the data acquired during the commissioning run of the system. This file should be retained by the Authorized Installer, and provided to the End User and MIRATECH as part of the Commissioning Report. Once the data is downloaded any changes to the back pressure and temperature alarms based on the new operation curve should be entered. A screenshot or list or all input parameters should gathered and added to the Commissioning Report. Save all changes in Controller, disconnect laptop/PC and reconnect display for normal operation.

Check and drain the moisture separator once commissioning is complete.

6. Maintenance / Troubleshooting

A. Warning & Fault Alarms

The DPF Data Logger has many alarm events that can indicate to the operator that there is a potential problem with their Data Logger or the LTR system. A full list of alarms can be found in *Appendix F: DYNtest Installation & Operations Manual*. A list of common alarm codes and items to check can be found in Table 2.

Table 2: Common Error Codes

Error Code	Alarm	Causes	Resolution
21	No communication between Controller and Display	Cable has become disconnected or faulty wire.	Verify all connections at controller and display are secure. If problem continues try connecting to a Laptop/PC as described in Section 5. If laptop cannot connect contact MIRATECH for replacement wire harness. If laptop connects contact MIRATECH for replacement display.
32	No pressure 10 minutes after ignition has been switched on	A) The switch for the engine is on but engine is not running. B) Bad pressure connection or condensate is trapped in pressure line. C) Water separator is full.	A) Turn the switch off or start the engine. B) Ensure all pressure connections are secure. Blow out all pressure lines to ensure they are clear of water and debris C) Empty water separator.
34	Damaged Temperature Probe	Faulty or damaged thermocouple.	Verify all connections are secure and inspect thermocouple for damage. If error still exists contact MIRATECH for replacement thermocouple.
36	Upper Pressure Alarm	The measured back pressure exceeds the upper pressure limit for more than 5 seconds.	It is either time to regenerate the filter or clean the filter. Please see *Filter Regeneration* in *Section* 4

B. Effects of Engine Maintenance on DPF Performance

The mechanical condition of an engine can have a significant effect on DPF performance. Operators should follow all maintenance procedures required by the Engine Manufacturer. A poorly maintained engine will produce more soot which will plug the DPF more quickly. Some of the maintenance items are:

- Fuel injectors: Repair and replace at intervals required by the engine manufacturer's maintenance schedule. Worn fuel injectors can lead to excessive fueling and more soot generation and accumulation in the filter. Fix worn hydraulic injectors to stop lube oil leaks into the fuel.
- Air filters: Replace at intervals required by the engine manufacturer. Dirty air filters reduce air flow to the engine leading to more soot generation.

- Turbo chargers: Check turbo charger for proper operation and excessive wear. Turbo chargers that do not produce sufficient air or have leaking seals lead to more soot or the presence of lube oil in the exhaust.
- Fuel filter: Replace at prescribed intervals. Look for the presence of lube oil in the fuel filter during regularly scheduled maintenance. A blackening of the filter may indicate that oil from the crank case is mixing with the fuel due to a leaky injector or worn seals.
- Coolant: Monitor your coolant consumption by keeping a log of the coolant added to the engine. Coolant leakage can poison the DPF catalyst leading to filter plugging.
- Lube oil: Change the lube oil at intervals indicated by the engine manufacturer and track its' usage. Lube oil ash collects in the DPF leading to filter plugging. Therefore, it is important to ensure that the engine is not consuming lube oil at a rate higher than recommended by the engine manufacturer. If the lube oil consumption exceeds specifications, the engine must be repaired. Increased lube oil consumption also leads to increased ash load, resulting in more frequent cleanings. The ash is not destroyed by the regeneration process that breaks down the soot.

C. Periodic Inspections

WARNING

Operators should comply with all applicable safety standards and OSHA regulations when installing or servicing the LTR. Protective gear such as gloves, hard hats, goggles, air filtration masks, and ear protection, should be worn to reduce the risk of injury during the course of cleaning and maintaining the LTR. Collected particulate should be disposed of in accordance with applicable regulations.

During normal operation or preventative maintenance visual inspections should be made of the LTR housing and data logging equipment. While inspecting the housing some of the items to look for are exhaust gas leaks around service & access doors and inlet and outlet flanges. All mounting supports should be inspected for weaknesses or failures. All pressure lines should be inspected for cracks, heat induced damage and that they are secured at both locations. The pressure gauge should read a pressure within the normal operating conditions backpressure. All wires on the wiring harness should be inspected for any wear marks, cuts or crimps. Any issues observed through visual inspections should be addressed in a timely manner to prevent future downtime of the engine.

After the first thermal cycle to 80% of maximum temperatures, the external bolts should be checked to ensure they are tight.

D. DOC Removal and Installation

The catalyst should be inspected periodically for physical damage and fouling. If conversion efficiency or regeneration profile changes significantly over time physical inspection should be performed. After removing the catalyst element, inspect for cell blockage or other obstruction. Excessive cell blockage must be cleaned before catalyst is re-installed.

A close visual inspection of the foil structures and outer frame of the element may indicate thermal deactivation. Typical signs of thermal deactivation are pinholes in the foil substrate, blue discoloration of the stainless steel frame, or in severe cases, meltdown of the metal substrate.

Prior to performing any service it is recommended to have spare element and lid gasket on hand. To purchase additional gasket kits please contact MIRATECH.

1. Element Removal

To remove the DOC in an LTR1 or LTR2 housing, remove the nuts and bolts in the middle of the housing. After removal of nuts and bolts slide the inlet end of the housing off of the DPF block. The spider assembly must then be removed to gain access to oxidation element.

For LTR4 and larger housings, locate the oxidation catalyst access door. The access door is the small rectangular access door that is located closest to the inlet flange. Once located remove and retain the nuts and bolts in the access door for future use. Once the access door is removed the lid gasket material should be inspected. If the gasket has a glassy appearance or is brittle to the touch it should be removed and discarded.

The element can then be removed by grabbing the top portion of the element and pulling from the housing. Once the element is removed the gasket should be removed from the catalyst and discarded. Clean out any gasket or ash residue from the housing.

2. Element Installation

There are two different element installation procedures based on the housing size. For LTR1 and LTR2 housings refer to *LTR1-LTR2 Element Installation* below. For all other housings refer to *LTR4 and Larger Element Installation, below,* for oxidation element installation.

To install the DOC into the LTR housing, gasket must first be applied to the element. The gasket material has double-sided tape to hold it in place during assembly. Remove the paper backing from the tape and wrap the element gasket around the catalyst element. The gasket should be centered on the element with the ends meeting on the top. Trim one end of the gasket so the frayed edges slightly overlap.

Figure 11: Gasketed Element

a. LTR1-LTR2 Element Installation

To install the oxidation element identify the inlet side of the LTR housing. The inlet side can be identified by the nameplate, which is located on the inlet side of the housing. Once the element has gasket begin by sliding the element with gasket into the oxidation track in the inlet side of the LTR housing as shown in Figure 12 and Figure 13.

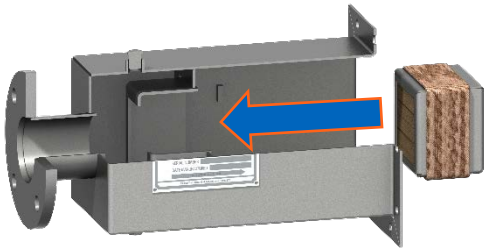


Figure 12: Installing Oxidation

Figure 13: Oxidation Installed

Once the Element is installed the spider assembly must be installed. Slide the spider assembly into the LTR housing until it contacts the oxidation element face as shown in Figure 14 and Figure 15. Refer to *LTR1-LTR2 DPF Installation* for the procedure to install the DPF block(s), closing, and securing the housing.

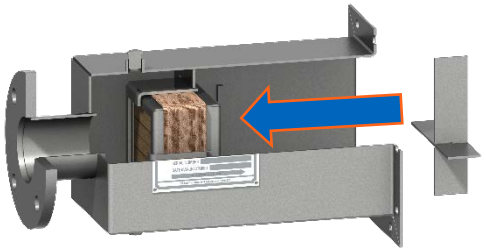


Figure 14: Installing Spider Assembly

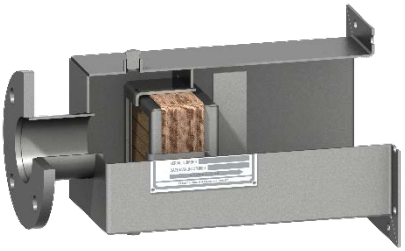


Figure 15: Spider Assembly Installed

b. LTR4 and Larger Element Installation

Once the element gasket has been installed slide the catalyst element into the oxidation track(s) with the open side of the handle facing downstream. Ensure the element slides completely into the bottom of the track.

Figure 16: Oxidation Element Being Installed in Housing

Figure 17: Oxidation Element Installed in Housing

Once the element(s) are installed in the housing the lid gasket should be applied to the oxidation access flange. Cut the lid gasket into 4 pieces of proper length to cover the entire mating surface. Remove the plastic backing from the two-sided tape on the lid gasket and apply the lid gasket to the entire mating surface.

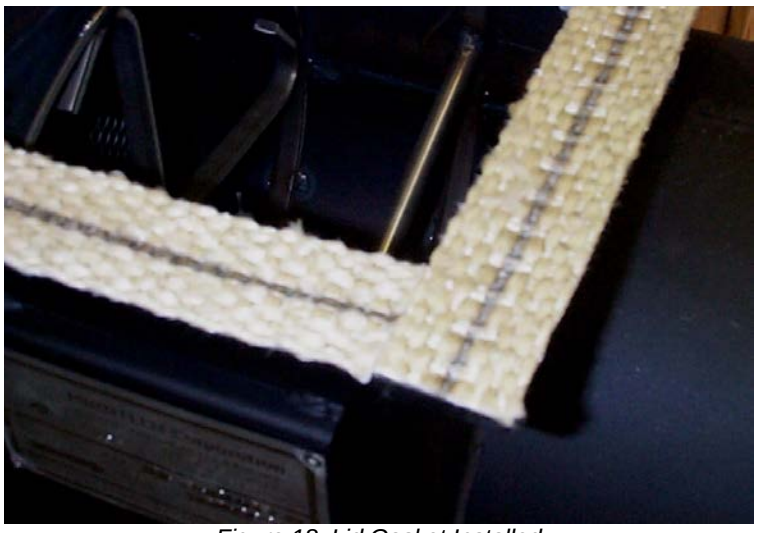


Figure 18: Lid Gasket Installed

Install the oxidation access lid and insert the bolts through the lid gasket. Install the nuts and tighten to complete the assembly. When tightening the lid nuts and bolts it is recommended to begin tightening in the center and work in a criss-cross pattern to ensure the lid is secured tight and sealed properly. High-temperature anti-seize compound should be used on all threaded components (i.e. nuts, bolts, plugs).

E. DPF Removal and Installation

Warning

DO NOT REMOVE ACCESS DOORS UNTIL THE UNIT HAS COOLED COMPLETELY. DO NOT BLOW AIR INTO THE FILTER BLOCKS UNTIL THEY HAVE COOLED COMPLETELY. EXPOSING HOT FILTER BLOCKS TO COOLER AIR WILL CAUSE THEM TO CRACK OR BREAK, DUE TO EXCESSIVE THERMAL GRADIENTS. FILTER BLOCKS THAT ARE CRACKED OR BROKEN DUE TO RAPID COOLING ARE NOT WARRANTABLE.

1. DPF Removal

a. LTR1-LTR2 DPF Removal

Once the entire unit has cooled, remove the nuts and bolts on rectangular mating flange in center of housing and proceed as follows:

- Slide inlet end of housing away.
- Carefully remove DPF blocks(s).

b. LTR4 and Larger DPF Removal

Once the entire unit has cooled, remove the access door and service door, if applicable, and proceed as follows:

- Remove the door tray and set aside.
- Remove the top tray (located between the top row of DPF blocks and the housing) and set aside. Dispose of expansion material and gasket mat in accordance with all local and federal regulations. Expansion mat may not be reused after engine operation.
- Starting at the top, remove the first layer of DPF blocks followed by the steel tray. Keep the trays; they can be reused if not damaged.
- Carefully remove each layer of DPF blocks and set aside.

2. DPF Installation

a. LTR1-LTR2 DPF Installation

The oxidation catalyst element and spider assembly must be installed as described in *Element Installation*. Once element assembly is installed slide the DPF block(s) into the LTR housing as shown in Figure 19 and Figure 20.

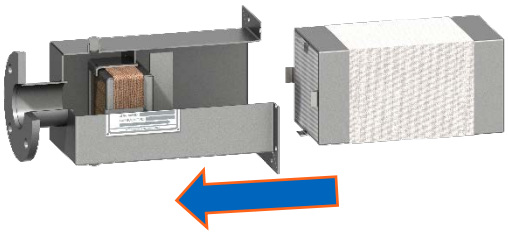


Figure 19: Installing DPF Block

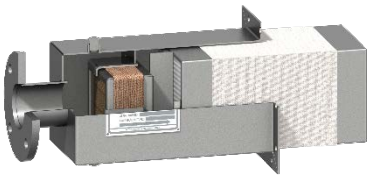


Figure 20: DPF Block Installed

To seal off and close the LTR housing the outlet section must be slid onto the DPF block. Gasket material should be applied to the flange prior to the outlet section being slid into place. Figure 21 and Figure 22 shows the outlet section of the housing being slid into place and the finished product ready for use, respectively.

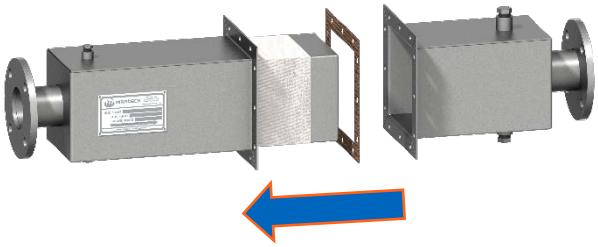


Figure 21: Installing Outlet Section

Figure 22: Fully Assembled Housing

b. LTR4 and Larger DPF Installation

To load the DPF blocks in the LTR housing the DPF access door and service door, if applicable should be removed and placed aside as shown in Figure 23. When removing door take care not to discard the bolts and door channels as they will be reused when reattaching the door(s).

Figure 23: Access Door Removed

The LTR system can have as few as 1 DPF block, or up to 110 DPF blocks in a single housing. Filters are stacked in layers horizontally separated by trays. The base layer of filter blocks is placed on a steel tray between tracks inside the DPF housing. To begin installing the first layer install a tray and ensure it fits between the tracks and against the wall of the housing as shown in Figure 24.

Figure 24: Bottom Layer Installation

Each DPF block has a Unidirectional Device Design (UDD). This is a tab at the upstream end of the DPF block's metal cap. With this tab and the LTR trays, it is impossible to flip the DPF block in the housing, for reverse flow cleaning. All LTR DPF blocks must be installed with the UDD tabs pointing upstream. When installing the DPF blocks in the tray ensure that the UDD tab lines up with slot in tray as shown in Figure 25. Any other direction (flipping the tab to the downstream side) is prevented by the physical layout of the tray and the housing internals. Any attempts to modify the MIRATECH LTR DPF blocks, tabs, and trays will void the warranty. This type of action is strictly prohibited by CARB.

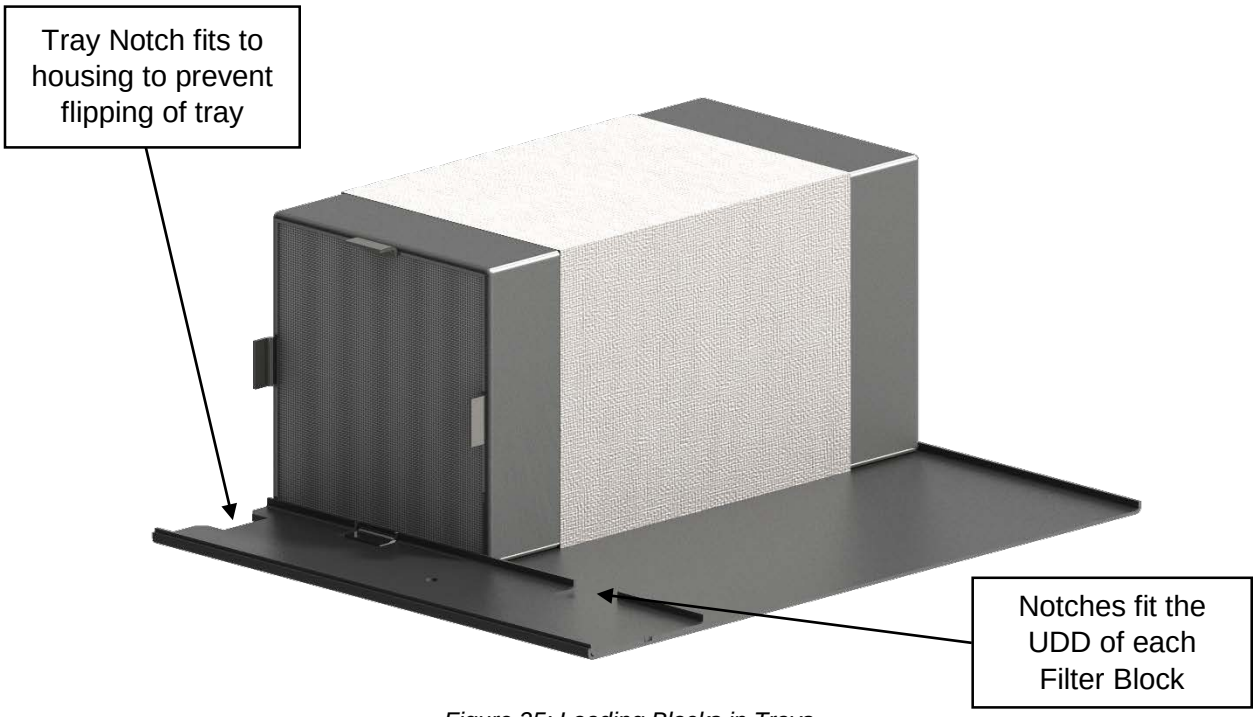


Figure 25: Loading Blocks in Trays

Any other direction, flipping the DPF block's UDD tab to the downstream side, is prevented by the physical layout of the tray and the housing internals. Any attempts to modify the LTR DPF blocks, metal caps, UDD tabs and/or trays will void the warranty. This type of action is strictly forbidden by CARB**.**

Once the bottom DPF layer is installed, a steel tray is placed atop this layer and on each consecutive DPF layer thereafter as shown in Figure 26. The purpose of the tray is to provide vertical alignment and tie the previous layer to the next.

Figure 26: Installation of Second Layer

Once ***all*** DPF blocks are installed a top tray, designed to hold bundled expansion mat layers, is used to cap the top layer of filter blocks and seal the space between it and the DPF housing to eliminate blow-by. Once the tray is installed slide in expansion mats to fill the gap between the housing and top tray to determine the number of layers of expansion mat are required as shown in Figure 27. Allow between 1/16" to 1/8" gap between the expansion mat and the top of the housing as this will be taken up by the fire curtain.

Figure 27: Determining Top Tray Expansion Mat

Once the number of expansion mat layers is determined remove the top tray from the housing and set aside. In preparing the expansion mat bundle for the top tray, make sure the expansion mat extends to the end of the tray as shown in Figure 28. It is important that the proper thickness and length be used to eliminate exhaust blow-by.

Figure 28: Determine Length of Expansion Mat

Once the appropriate amount of layers has been determined, assemble the expansion mat bundle by wrapping the expansion mat layers in the fire curtain material, securing together with masking tape as shown in Figure 29. Wrap the bundle tightly as that will make installation easier.

Figure 29: Assembling Expansion Mat Bundle

After the expansion mat bundle is complete place the bundle in the center of the top tray as shown in Figure 30. To keep bundle from moving on the tray a small amount of masking tape can be used to secure the bundle to the top tray.

Figure 30: Expansion Mat Bundle Installed on Tray

Install the top tray with expansion mat bundle back into the housing. To do so angle the tray slightly down as shown in Figure 31 and begin sliding the tray assembly into the housing. Special care should be made to keep the tray clear of the UDD tabs on the DPF Blocks. The top tray is designed to slide in clear of the UDD tabs. Slide the top tray assembly all the way into the housing so that the tray comes in contact with the wall on the opposite side of the housing.

Figure 31: Installing Top Tray Assembly in Housing

Figure 32: Top Tray Assembly Almost Installed

To eliminate blow-by, a separate door tray, designed to hold bundled expansion mat layers, is used to seal the vertical space between access door and the DPF blocks. To prepare the door tray lay it on a flat surface with the channel in the center of the tray facing up. The top of the tray must be identified in order to properly install the expansion mat. It is easiest to identify the downstream side of the tray which is the side that has two tabs bent 180 degrees from the rest of the lip. By identifying the downstream side the orientation of the tray should now be

established. Install two or three layers of expansion mat into the channel leaving approximately 1 ½" of extra expansion mat at the top of the tray as shown in Figure 33.

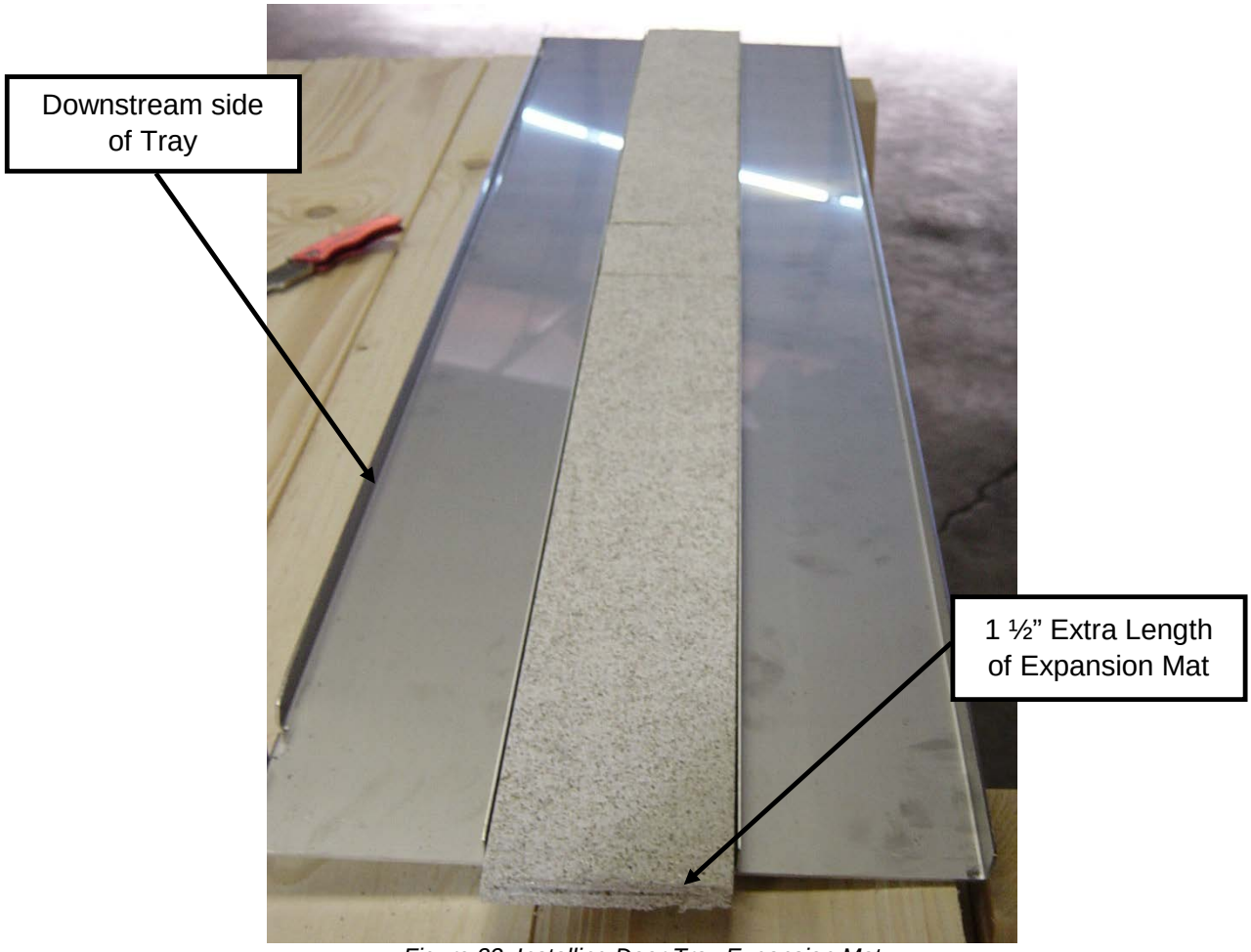


Figure 33: Installing Door Tray Expansion Mat

Once the expansion mat lengths have been determined secure the expansion mat to the door using masking tape along each edge as shown in Figure 34. This will hold the expansion mat in place during installation while still allowing it to expand once heat is applied.

Figure 34: Securing Expansion Mat on Door Tray

Install the door tray in the LTR housing by sliding the tabs on the right side of the tray behind the DPF blocks as shown in Figure 35. The tray and expansion mat should fill the space between the sides of the DPF block to where the access door will be installed.

Figure 35: Installing Door Tray

Before the DPF access door and service door, if applicable, are installed, door gasket should be installed. If gasket is already on the door and it does not appear glassy or is not brittle it may be reused. If new gasket is required lay the door down on a flat surface with the outside surface facing down. Install the new gasket by removing the plastic backing from the two-sided tape on the door gasket and wrap it around the edge of the door as shown in Figure 36. When completing each corner cut each gasket piece clean so there are no frayed ends and gasket pieces create a tight seal minimizing any risk of blow by of exhaust gas as shown in Figure 37.

Figure 36: Installing Gasket Material

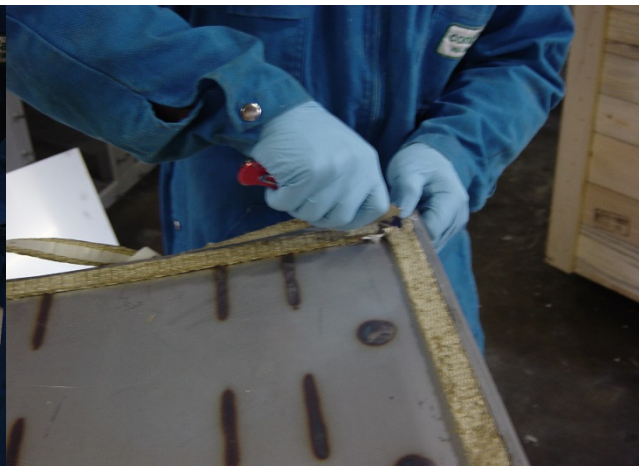


Figure 37: Creating Tight Seal

Once access door and service door, if applicable, has gasket installed secure the door(s) to the housing using the door channels and bolts provided with the housing as shown in Figure 38. **High-temperature anti-seize compound should be used on any threaded components (i.e. nuts, bolts, plugs).**

Figure 38: Access Door Installed on Housing

F. Safe Handling Practices

Handling the LTR Diesel Particulate Filter requires the same safety precautions as other exhaust system components. During installation of the LTR housing, one should:

- Follow site-specific safety rules/procedures (such as use of hard hats, safety glasses, gloves, steel-toe shoes, etc.).
- Lift the LTR by the lifting lugs provided on the housing. Follow safe rigging and lifting practices as dictated by local authorities and/or site specific requirements.

During operation, one should:

- Be aware of hot surfaces and take precautions to avoid burns. Operations/maintenance personnel should always wear long sleeves and long pants (no shorts) when working around hot equipment.
- Wear proper ear and eye protection.
- Use appropriate gloves around hot surfaces.
- Comply with all local safety rules.

While performing maintenance or inspections on the LTR's particulate filter blocks or oxidation catalyst element additional precautions must be followed. The state of California has determined that ash/soot collected in a DPF or on a DOC is hazardous waste. As such, personnel must wear appropriate breathing protection and prevent ash from being released into the air.

- Always wear a NIOSH approved dust mask.
- Wear safety glasses or goggles.
- Wear gloves when handling the catalyst or filter blocks as they may have rough or sharp edges.
- Wear steel or hard toe shoes as required by site specific safety rules.

If the particulate filter blocks will be removed to send out for cleaning, you may wish to wear disposable coveralls to avoid getting soot on your clothing.

If any ash will be vacuumed out of the housing or off the DOC and/or the DPF blocks, the vacuum must be equipped with a suitable HEPA filter and bag. The bagged ash and HEPA filter should be disposed of as hazardous waste according to local regulations.

If the DPF blocks and/or the DOC element will be removed from the housing, either to send out for cleaning or to return to MIRATECH for disposal, the blocks and/or elements should be bagged (and the bag sealed) prior to boxing for shipment. If a large number of DPF blocks are to be shipped, line a crate with a plastic bag and stack the blocks inside. Use Styrofoam or other padding between the blocks and the box/crate to prevent damage. If the Expansion Mat attached to the blocks has been removed, place Styrofoam padding between the blocks. Seal the bag and the crate or box prior to shipping.

G. Cleaning

DPF blocks and DOC elements should only be cleaned by qualified personnel using equipment that can prevent ash from being released into the air. Upon request MIRATECH can provide specific DPF block cleaning recommendations for authorized cleaning companies.

7. MIRATECH Contact Information

Any technical questions about the Application, Installation, Maintenance or Troubleshooting of the MIRATECH LTR should be directed to the contacts below.

CORPORATE OFFICE
MIRATECH
420 S. 145th East Ave., Mail Drop A
Tulsa, OK 74108-1305
Phone – (918) 622-7077
Toll Free (800) 640-3141
Fax – (918) 622-3928
www.miratechcorp.com

Pre-Sales Application Assistance – Application Engineering
applicationengineering@miratechcorp.com
(918) 622-7077 Opt – 4

Post-Sales Product Support and Training – Technical Service Department
technicalservicegroup@miratechcorp.com
(918) 622-7077 Opt – 9

To Order Parts or to check Order Status – Inside Sales
info@miratechcorp.com
(918) 622-7077 Opt – 3

Appendix A: Pre-Installation Compatibility Checklist

Pre-Installation Compatibility Assessment

800-640-3141 | MIRATECHCORP.COM

PROJECT INFORMATION				
Project Name:				
Site Location:				
Hours/Year Operation:				
Typical Percentage of Run Time @ Each Load:	*100%*		*75%*	
	50%		*25%*	
	10%			
Load Bank Available:	☐ Yes		☐ No	

ENGINE INFORMATION	
Engine Make:	
Engine Model:	
Serial Number:	
Engine Family:	
Engine Allowable Back Pressure:	
DPF Allowable Back Pressure:	
Attach Full & Part Load Engine Data including at minimum exhaust flow rate, temperature, engine emissions and desired emission(s) reductions.	

FUEL INFORMATION	
Fuel Type:	
Fuel Consumption:	@100% Load

LUBE OIL INFORMATION	
Lube Oil Ash Content:	
Lube Oil Consumption:	

CARB CRITERIA FOR NEW OR EXISTING ENGINES	Yes	No
1. Engine family on Engine Family List included in Executive order http://www.arb.ca.gov/diesel/verdev/vt/stationary.htm	☐	☐
2. Engine being used in Stationary Application for Emergency Standby Generator	☐	☐
3. Engine is Tier 1, 2 or 3 certified	☐	☐
4. Engine is certified to a PM rate of ≤ 0.22 g/bhp-hr	☐	☐
5. Engine is in its original certified configuration	☐	☐
6. Fuel is Ultra Low Sulfur Diesel (ULSD)	☐	☐
7. Engine does not employ EGR	☐	☐
8. Engine does not have an existing DOC or DPF	☐	☐
9. Engine is four-stroke	☐	☐
10. Engine certified for use in California, or certified by the United States EPA	☐	☐
11. Engine well maintained and not consume lube oil greater than specified by manufacturer	☐	☐

MIRATECH SUITABILITY CRITERIA FOR NEW AND EXISTING ENGINES	Yes	No
1. Engine able to operate at sufficient load to regenerate after 720 minutes (18 cold starts) of consecutive operation	☐	☐
2. Lube oil intended for after treatment devices and ash content does not exceed 1% by weight	☐	☐
3. Back pressure of existing equipment PLUS estimated DPF operation back pressure operation under engine manufacturer's allowable back pressure *(Attach calculations/documents of existing component back pressure)*	☐	☐
4. Room to gain access and service DOC and/or DPF elements	☐	☐
5. DPF Data Logger mounting location is easily accessible and visible during normal engine operation	☐	☐
6. Exhaust piping between engine and DPF is or will be insulated	☐	☐
7. DPF Housing is or will be insulated	☐	☐

MIRATECH ADDITIONAL SUITABILITY CRITERIA FOR EXISTING ENGINES	Yes	No
1. Engine operating hours within OEM emissions warranty	☐	☐
2. Have engine manufacturer's recommended maintenance / operation practices been followed	☐	☐
3. Any evidence of tampering/defeating any engine emission related systems	☐	☐
4. Signs of poor maintenance (e.g. oil leaks, exhaust leaks, fuel leaks, etc.)	☐	☐
5. Signs of fuel contamination (e.g. lube oil in fuel, etc.)	☐	☐
6. Tailpipe clear of signs of wet-stacking, excess PM, etc.	☐	☐
7. Any active ECM faults *(Provide documentation of corrective action on any active faults)*	☐	☐
8. History of repeat ECM faults *(Provide any maintenance records available that address faults)*	☐	☐
9. Are there any packed silencers upstream of proposed DPF location	☐	☐

If any shaded boxes are checked the application fails Pre-Installation Compatibility Assessment and equipment should not be installed without authorization of MIRATECH. Any changes to engine or site conditions after the completion of this assessment may require a re-assessment prior to installation.

MIRATECH Authorized Installer _____ Date _____

MIRATECH Use Only	
Proposal Number:	
Sales Order:	

Version: 2014-04-30

Appendix B: Commissioning Report Template

PROJECT & INSTALLATION INFORMATION	
Commissioning Date:	End User Company:
Installation Date:	Installation Address:
LTR Model:	
Serial No.:	End User Contact name:
	Phone:
Engine or Unit Number:	E-mail:
Engine Model:	
Engine Serial:	Authorized Installer Name:
Engine Family:	Company:
	Phone:
	E-mail:

INSTALLATION INSPECTION	YES	NO	NOTES:
Housing orientation, flow direction correct			
Flanges bolted			
Housing properly supported			
Access doors gasketed and bolted			
General exhaust system inspection			
DOC & DPF blocks installed *(N/A if housing shipped loaded)*			
DOC element gasket installed *(N/A if housing shipped loaded)*			
DPF top seal properly installed *(N/A if housing shipped loaded)*			
Adequate service access to DOC and DPF doors			
Data Logger Control Box mounted correctly			
Data Logger Display & Pressure Gauge clearly visible			
Moisture separator mounted at lowest point in tubing			
Wiring harness routed away from hot surfaces			
Wiring connections correctly landed			

DPF DATA LOGGER SET-UP	COMPLETE	NOTES:
Power up Logger, connect to laptop		
Set correct local date & time		
Input Parameters per IOM Manual		

DPF COMMISSIONING	NOTES:
Start engine, bring to rated speed, no load	
Record Back pressure at 0% load *(this will be a baseline to compare future no-load exercise operation to)*	

- At minimum, record back pressure at 0%, 50%, and 100% load. If possible record at other intermediate loads similar to typical operation. Note the load at which back pressure begins to decrease.
- Operate at 100% load until back pressure drops and stabilizes.

Time	Load (% or kW)	BP (inch WC)	Notes

Shut down engine at completion of load runs and regeneration

Continued next page

DATA RETRIEVAL & END-USER TRAINING		COMPLETE
Re-connect laptop to DPF Data Logger:		
Update Parameters if necessary		
Download log file, attach to commissioning report		
Download Parameter file (or take screen shot), attach to commissioning report		
Note the setting for Alarm 1 (pre-high pressure alarm):		
Note the setting for Alarm 2 (high pressure alarm):		

Provide Installation, Operation, & Maintenance manual to End User	
Provide End User Training	
Review Guidelines for Successful DPF Operation	
Review location of pressure gauge and DPF Data Logger display	
Review fault codes	
Review Pre-Installation Compatibility Assessment and End User responsibilities for proper maintenance	

DOCUMENTATION	COMPLETE
Provide following documents to End User, MIRATECH, and retain in your Customer File	
Pre-Installation Compatibility Assessment	
Commissioning Report, including Data file for commissioning run and as-left Parameter settings	
Statement of Compatibility	

Additional installation/commissioning notes:	
I certify that the MIRATECH LTR Diesel Particulate Filter has been properly installed and commissioned in accordance with the Installation, Operation, and Maintenance Manual	We have received the required CARB documents and End User training.
Authorized Installer Signature	End User Representative Signature

Appendix C: Ordering Parts or Returning Materials

1. Obtain the model number and serial number of the unit. The model number and serial number are on the nameplate affixed to the unit and also on the invoice.

2. Contact Inside Sales.

3. Inside Sales will confirm product part numbers, product lead times and current pricing. In a warranty situation, an RMA (Return Material Authorization) number will be issued. A list of part numbers for common replacement parts is provided in the Appendix D: Spare Parts for your reference.

4. Send a purchase order to Inside Sales, and Inside Sales will give you a sales order number to use for future reference.

5. The RMA or Sales Order number must be included when shipping any returned material.

No equipment may be returned to MIRATECH without first obtaining a Sales Order or RMA (Return Material Authorization) Number. Returned equipment must be packed securely to reach **MIRATECH** without shipping damages and shipped prepaid by an appropriate carrier.

Appendix D: Spare Parts

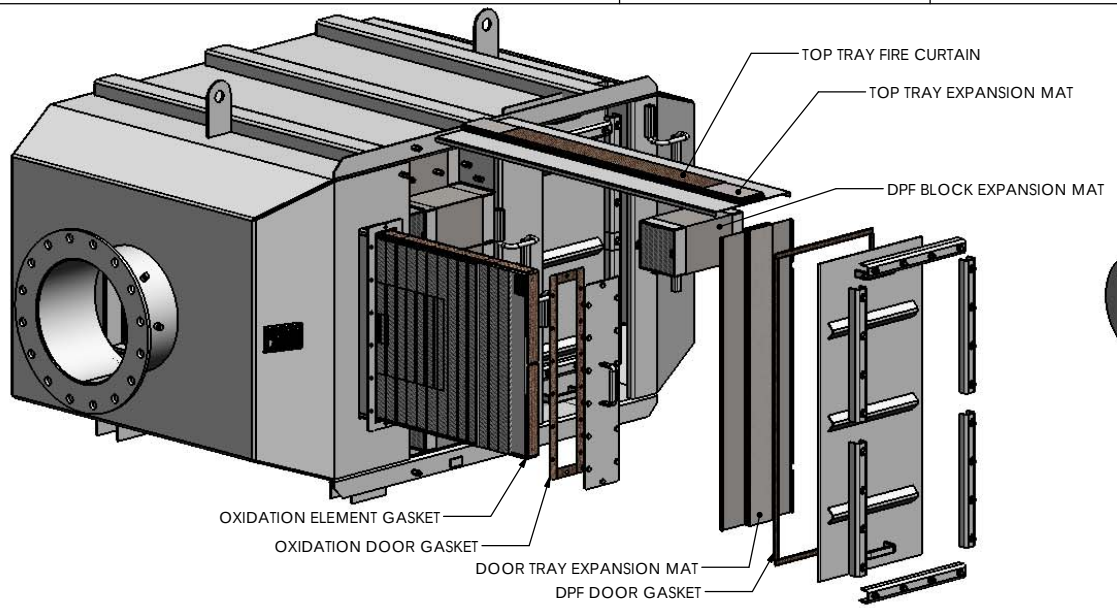
A. DPF Data Logger Spare Parts

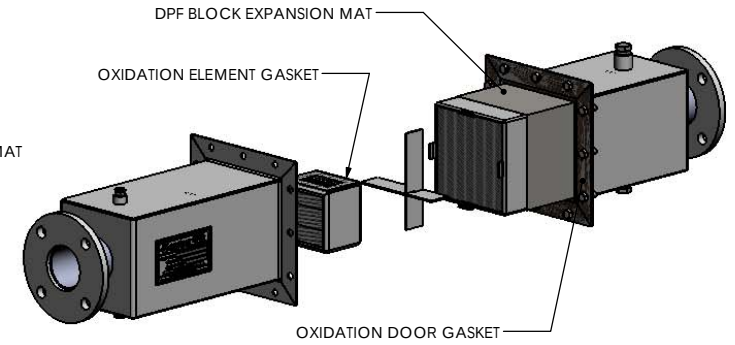
Description	Part Number
DPF Data Logger Kit	DPF-Datalogger-Assembly
Controller	DPF-Datalogger
Thermocouple (16’ Leads)	DPF-DataLogger-TC-5m
Moisture Separator	DPF-DataLogger-MS
Data Analyzer Kit	DPF-DataLogger-Data-Analyzer

B. LTR Housing Spare Parts

All replacement parts for the LTR housing can be found on the drawing on the next page. Please pay close attention to the quantities required as quantities vary per housing.

Top Tray Expansion Mat				Door Tray Expansion Mat			Top Tray Fire Curtain			DPF Block Expansion Mat		DPF Door Gasket		Oxidation Element Gasket		Oxidation Door Gasket
Housing	Length Req'd/Layer	Layers Req'd	Stock Part QTY	Length Req'd/Layer	Layers Req'd	Stock Part QTY	Housing	Length Req'd	Stock Part Type & QTY	Housing	Stock Part QTY	Housing	Total Length Req'd/Door	Housing	Total Length Req'd/Element	Total Length Req'd/Door
LTR1	-	-	-	-	-	-	LTR1	-	-	LTR1	4	LTR1	-	LTR1	19" [1]	30"
LTR2	-	-	-	-	-	-	LTR2	-	-	LTR2	8	LTR2	-	LTR2	29" [1]	46"
LTR4	313mm	3	2	331mm	4	2	LTR4	313mm	36" x 1 piece	LTR4	16	LTR4	68"	LTR4	51"	36"
LTR6	470mm	3	2	331mm	4	2	LTR6	470mm	36" x 1 piece	LTR6	24	LTR6	68"	LTR6	61"	36"
LTR9	470mm	3	2	489mm	4	2	LTR9	470mm	36" x 1 piece	LTR9	36	LTR9	79"	LTR9	68"	36"
LTR12	629mm	3	3	489mm	4	2	LTR12	629mm	36" x 1 piece	LTR12	48	LTR12	79"	LTR12	79"	36"
LTR15	788mm	3	4	489mm	4	2	LTR15	788mm	36" x 1 piece	LTR15	60	LTR15	79"	LTR15	90"	36"
LTR20	788mm	3	4	648mm	4	3	LTR20	788mm	36" x 1 piece	LTR20	80	LTR20	91"	LTR20	104"	60"
LTR24	942mm	3	4	648mm	4	3	LTR24	942mm	51" x 1 piece	LTR24	96	LTR24	91"	LTR24	114"	60"
LTR30	942mm	3	4	807mm	4	4	LTR30	942mm	51" x 1 piece	LTR30	120	LTR30	106"	LTR30	117"	60"
LTR36	942mm	3	4	966mm	4	4	LTR36	942mm	51" x 1 piece	LTR36	144	LTR36	114"	LTR36	122"	60"
LTR48	1258mm	3	6	966mm	4	4	LTR48	1258mm	51" x 1 piece	LTR48	192	LTR48	114"	LTR48	146"	60"
LTR56	1258mm	3	6	1124mm	4	5	LTR56	1258mm	51" x 1 piece	LTR56	224	LTR56	129"	LTR56	149"	60"
LTR64	1258mm	3	6	1283mm	4	6	LTR64	1258mm	51" x 1 piece	LTR64	256	LTR64	143"	LTR64	130"	120"
LTR72	1412mm	3	6	1283mm	4	6	LTR72	1412mm	36" x 2 pieces	LTR72	288	LTR72	143"	LTR72	140"	120"
LTR81	1412mm	3	6	1442mm	4	6	LTR81	1412mm	36" x 2 pieces	LTR81	324	LTR81	154"	LTR81	123"	120"
LTR90	1571mm	3	7	1442mm	4	6	LTR90	1571mm	36" x 2 pieces	LTR90	360	LTR90	154"	LTR90	153"	120"
LTR100	1571mm	3	7	1601mm	4	7	LTR100	1571mm	36" x 2 pieces	LTR100	400	LTR100	166"	LTR100	157"	120"
LTR110	1571mm	3	7	1601mm	4	7	LTR110	1571mm	36" x 2 pieces	LTR110	440	LTR110	166"	LTR110	170"	120"
Description: Stock Expansion Mat, 100mm x 1000mm x 5mm							Description: Stock Fiberglass Fire Curtain, 12" x 36" or 51"			Description: Stock Expansion Mat, 153mm x 185mm x 5mm		Description: Stock Vermiculite Gasket Tape, 0.750" x 0.170" THK x 100'		Description: Stock Element Gasket, 2.000" X 0.170" THK		Decription: Stock Lid Gasket, 1.600" x 0.060"
Part #: Expansion Mat - Tray							Part #: 36" - 1303.0026, 51" - 3010.0002			Part #: 3060.0032		Part #: Gasket-Door-0.75x0.170		Part #: Gasket - Element - 2.000" X 0.170"		Part #: Gasket - Lid - 1.600" X 0.060"





REVISIONS				
REV.	DESCRIPTION	DATE	SHEET(S)	DRAWN BY
0	ORIGINAL RELEASE	03/10/2014	-	CDT
1	UPDATED LTR1 / 2 GASKET LENGTH	07/06/2015	-	WEC

NOTE: QTY'S REQUIRED HAVE BEEN ROUNDED UP TO ACCOUNT FOR HOUSING TOLERANCE AND VARIANCES.

PROJECT NAME

PROPOSAL NUMBER

SALES ORDER NO.

CUSTOMER P.O.

DIMENSIONS ARE APPROXIMATE IN INCHES UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

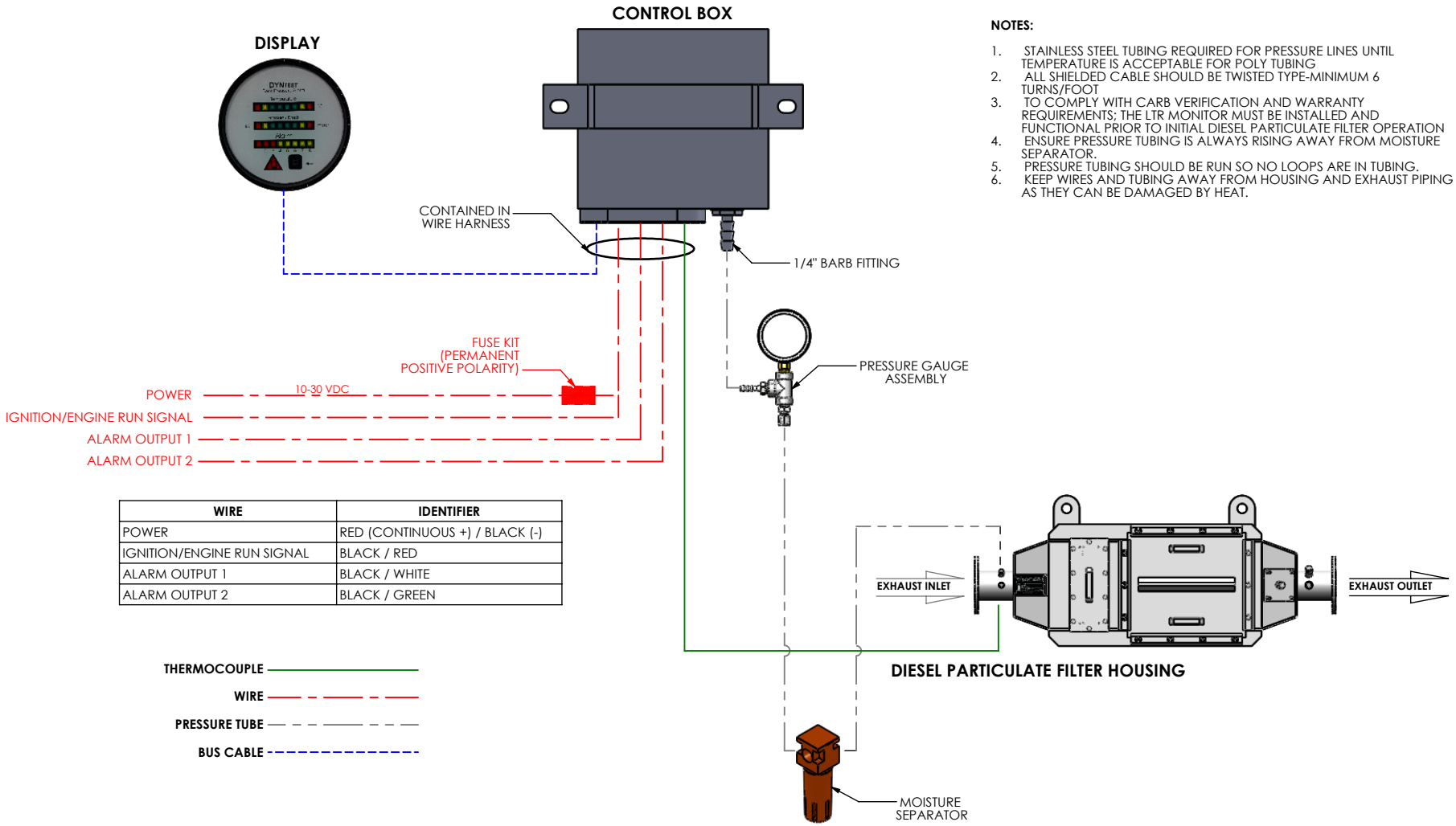
MIRATECH

LTR Gasket/Expansion Mat Production Drawing

DRAWN	DATE	DRAWING	REV
WEC	07/06/2015	LTR - Expansion Mat-Gasket Detail PD	1
REVIEWED BY	DATE	SIZE	SCALE	WEIGHT	SHEET
EQJ	07/06/2015	A	SCALE 1:24	WEIGHT: 2391 lb	SHEET 1 OF 1

Appendix E: DPF Data Logger System Interconnect

The drawing on the next page is a standard DPF Data Logger System Interconnect. Project specific drawings should always be referred to for construction.



NOTES:

1. STAINLESS STEEL TUBING REQUIRED FOR PRESSURE LINES UNTIL TEMPERATURE IS ACCEPTABLE FOR POLY TUBING
2. ALL SHIELDED CABLE SHOULD BE TWISTED TYPE-MINIMUM 6 TURNS/FOOT
3. TO COMPLY WITH CARB VERIFICATION AND WARRANTY REQUIREMENTS; THE LTR MONITOR MUST BE INSTALLED AND FUNCTIONAL PRIOR TO INITIAL DIESEL PARTICULATE FILTER OPERATION
4. ENSURE PRESSURE TUBING IS ALWAYS RISING AWAY FROM MOISTURE SEPARATOR.
5. PRESSURE TUBING SHOULD BE RUN SO NO LOOPS ARE IN TUBING.
6. KEEP WIRES AND TUBING AWAY FROM HOUSING AND EXHAUST PIPING AS THEY CAN BE DAMAGED BY HEAT.

WIRE	IDENTIFIER
POWER	RED (CONTINUOUS +) / BLACK (-)
IGNITION/ENGINE RUN SIGNAL	BLACK / RED
ALARM OUTPUT 1	BLACK / WHITE
ALARM OUTPUT 2	BLACK / GREEN

THERMOCOUPLE
WIRE
PRESSURE TUBE
BUS CABLE

PROJECT NAME	
PROPOSAL NUMBER	
SALES ORDER NO.	
CUSTOMER P.O.	

DIMENSIONS ARE APPROXIMATE IN INCHES UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

DRAWN	CLV	DATE	03/31/2014
REVIEWED BY	CDT	DATE	03/31/2014

MIRATECH

LTR-DPF DATALOGGER
System Interconnect

DRAWING	REV
LTR-DPF DATALOGGER SI	0

SIZE			
A	NOT TO SCALE		SHEET 1 OF 1

Appendix F: DYNtest Installation & Operations Manual

DYNTEST

Particulate-Filter Monitoring System

Installation and Operating Instructions

Rev. 1.11

(Panel V.4 / Logger V.4)

Incl. Bootloader

Downloads and Updates:
http://www.cpk-automotive.com

CPK Automotive GmbH & Co. KG > 48157 Muenster / Germany > Gildenstraße 4c > fax +49-(0)251-23948-54 > info@cpk-automotive.com

Table of contents

1 Description of Functions

The DYNTEST System is a system for monitoring particle filters and exhaust-gas back-pressure levels. It provides warnings when the exhaust-gas back pressure in exhaust systems reaches excessively high levels, as can happen when a filter becomes clogged with diesel soot. If the monitoring system detects back pressure levels which are too high, or severe damage to the filter, it first of all provides a visual alarm for the user by means of illuminated display lamps, and then generates a further audible alarm.

In addition, the DYNTEST System measures the temperature of exhaust gases before they reach the filter and measures the speed (in rpm) of the engine.

If desired, actual pressure, temperature or rpm values can be shown on the display at random. The pressure, temperature, and engine speed values are continuously written to memory. When an alarm is generated, it remains activated until the relevant values return to normal levels. The audible alarm is switched off when the alarm tone is acknowledged.

Pressure is measured in the range between 0 and 600 mbar. Temperatures in the range between 50 °C and 1,050 °C can be displayed.

The driver can ascertain by means of the temperature display whether the exhaust-system temperature is within the optimum range for the filter. If a back-pressure alarm is generated, the driver can raise the temperature of the exhaust gas by increasing the engine load and thus causing the filter to clean itself. The exhaust-gas back pressure will then be reduced, and the warning light will be extinguished. **Only the temperature value of the first temperature sensor (T1) is important for alarm functions. If a second temperature sensor (T2) is installed, this sensor is destined only for additional observation purposes.**

Upper Pressure Limit
When there is a build-up of soot on the surface of the filter, there will be an increase in back pressure. The switch point for the back-pressure alarm can be preset in accordance with the specifications of the individual engine or vehicle by means of the menu keys on the PanelBox. In the standard setting, the alarm is activated when the back pressure reaches 150 mbar. When an alarm is generated, the current pressure value and ERROR 36 start alternatively flashing on the display.

Lower Pressure Limit
Severe damage to the filter, the exhaust-gas supply pipe, or the connection to the pressure probe will result in a considerable reduction in pressure. If the values measured fall below the lower limit, this will generate an alarm. The lower limit can be set at the required level by means of the menu keys on the PanelBox. The standard setting is 15 mbar. If an alarm has been generated, the current pressure value and the message "ERROR 35" will flash alternately on the display.

Filter Check: Testing of the Filter for Damage
If the filter has suffered minor or moderate damage, there will be some reduction in pressure, though not so that it drops to the level of the lower pressure limit. However, in order to determine the extent of such damage, a test routine can, if desired, be initiated by means of the menu keys on the PanelBox. This test will automatically detect changes in current values by performing a comparison of these values with a reference value defined when the system was first set to work, or after a subsequent reset. If the values measured are not within a specific, freely definable range, a corresponding message will appear on the display, and at the same time the test findings will be written to memory (See Page 18).

MEMORY DEVICES

The DYNTEST System has two separate memories.

1. **Memory for measured values**
   Pressure, temperature, and RPM are continuously measured at 1 second intervals; mean values are computed depending on the storage interval set (default: 10 sec). These values are stored in the memory together with the corresponding date, time and operating hours.
   The storage interval is freely adjustable by means of the SETUP menu that can be called on the PanelBox.

   On vehicles, the data saving interval should be set to 10 seconds, i.e. a mean value is calculated from 10 measured values. The storage capacity of the circular memory is sufficient for 360 days (24 hours).
   Stationary engines may be in continuous operation for up to 24 hours at a time with no great variation in the engine load. The data saving interval for such engines should therefore be set to 30 seconds; due to the extended data saving interval these mean values are then stored for 1080 days.

   After the capacity limit of the memory has been reached, the oldest values are overwritten. The circular memory is only written to when the engine is in operation.

2. **Memory for the Alarm Function**

   Alarm reports (back pressure, break in the connection to the probe etc.) and alterations to settings made in the ControlBox setup are registered in this second memory. Each entry is stored together with a record of the relevant time and date, and a commentary. The non-volatile circular memory is designed for a service period of 10 years, and can store up to 20,000 data records.

ALARM OUTPUTS

If there is sudden damage to, or other unforeseen problems with, the filter system, immediate remedial measures (e.g. disconnection of the supply of additives, or the starting of regeneration) may be required. For this reason, the system has been provided with three independent additional outputs, whose functions can be configured by means of the PanelBox (via the SETUP menu) or via PC/Laptop. After a comparison has been made with a switch point, desired value or time value, and with due allowance having been made for

the hysteresis effect (delay time), a signal is output when a selectable pressure, temperature or engine-speed (rpm) value is reached.

Each time the engine is started, the output signal is reset.

SPECIAL PROGRAMS

If more sophisticated functions are required than those permitted by the alarm-output configurations described above, pre-prepared programs can be selected by a consecutive number and retrieved via the Panel Box menu. The special-purpose program called up is then assigned to one of the two alarm outputs.
The alarm output cannot be used for other signals while the special-purpose program remains active.

Special Programs are available, which will control actuators like i. e. for throttles, burners or additive dosing systems (FBC).
Please ask your dealer for details.

CONTROLS

The DYNTEST System performs continuous self-testing routines to ensure that functional and plausibility criteria are observed. When errors occur, these are automatically recorded in the error memory, and "ERROR XX" appears on the display. The DYNTEST logo flashes in the display during the first self test after the engine ignition is switched on.

To prevent stored parameters from inadvertently being altered by operating personnel, DYNTEST System is fitted with a software device that disables the maintenance-mode keys in the normal operating mode. However, parameters can be changed by authorized personnel at any time, once the system has been switched over to maintenance mode.

The DYNTEST System can also be used to keep records of the operational cycles completed by a vehicle, and permits uninterrupted on-the-road monitoring of vehicles as they are being driven. It can thus be used to determine, for example, if individual vehicles should be fitted with self-regenerating filters, and under what operating conditions this is recommendable.

In Version 3.0 of the DYNTEST System, and in all higher versions, an integrated **Bootloader** is supplied as standard. With the aid of the **Bootloader**, new ControlBox functions can be added to the operating system without data already stored in the ControlBox being lost.

2 The DYNTEST Bus System

The DYNTEST System can be upgraded and transformed into the DYNTEST bus system, which consists of a ControlBox (Master), a PanelBox (Slave 1), a Mini-PLC/SPS (Slave 2) and a GSM/GPRS Module (Slave 3) with a converter and interface cable which are used to convert and transmit signals to a PC where the incoming data are written to memory and then evaluated.

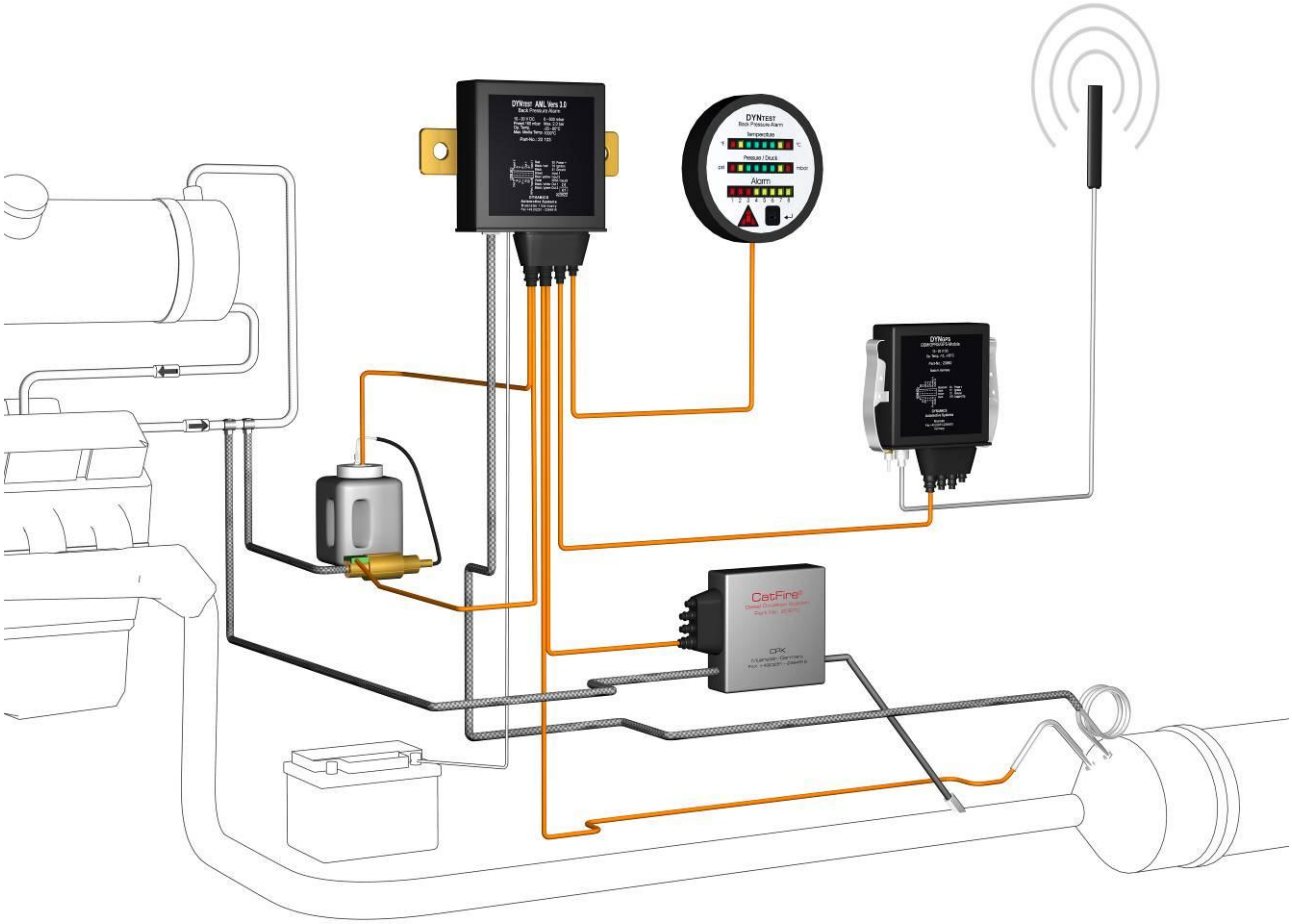


Figure 1: Schematic overview of the DYNTEST Bus System.

Integrated Special Programs are designed to control actuators like i. e. for throttles, AR (Active Regeneration), FBC (Fuel Borne Catalyst), De-Rating.

If required, separate information about each of the individual modules (e.g. CatFire®, RemCo®, LiquiCat®) in the bus system can be provided in different languages.

If you would like more detailed information about the DYNTEST system, visit our homepage (www.cpk-automotive.com) and feel free to get in touch!

3 Installation Instructions

The DYNTEST System **(product number: 20910)** system components, which are shown on page 7, are as follows:

1. **CONTROL BOX (IP 64; Part-No.: 20103; Fig.: 2)**

   –to be installed in the engine compartment–

   a) Connection to cable harness
   b) Connection for pressure hose and pipes

2. **PRESSURE CONNECTION SET (Part-No.: 20130; Fig.: 3; optional)**

   –provides pressure connection between the filter, the moisture separator, and the ControlBox–

   a) Stainless-steel fitting with clamp-ring connector
   b) Stainless-steel pipe, 54 cm
   c) HT hose (resistant to high temperatures)

3. **FUSE KIT (Part-No.: 20150; Fig.: 4; optional)**

   –integrated in the power-supply (permanent positive polarity); provides protection against overvoltage –

   a) Fuse
   b) Fuse holder
   c) Cable clamps (crimp connectors)

4. **CABLE HARNESS (Part-No.: 20118; Fig.: 5)**

   –for the power supply, and for the connection between the ControlBox and the PanelBox–

   a) Power supply (10-30 VDC)
   b) Input line and output line (I/O)
   c) Temperature probe, with 5-metre connecting cable (2x; optional)
   d) 10-metre bus cable for the connection between the ControlBox and the PanelBox; this cable is also used to transmit data that are to be analysed at a PC.

5. **DISPLAYS (PanelBox, Fig.: 6 and 7)**

   The customer can select with the order of the system between two displays. The difference exists on the one hand on the functions (Panelbox for the programming of the ControlBox, and off Road IP 67 only used as display) and the conditions of work.

5 a) PanelBox On-Road (Part-No.: 20111; Fig.: 8)

This display is used for installations in closed driver cabins on the dashboard

a) Switchable illuminated display in which temperature, pressure and engine-speed (rpm) readings are shown; menu items are also shown in this display when the system is in maintenance mode
b) 6 function keys (programming), 2 of them illuminate and have a signal function
c) Buzzer
d) Displays the measured values

5 b) PanelBox Off-Road (IP67; Part-No.: 20112, Fig. 7; optional)

The safety class system IP 67 shows already the operational area of this display. Mostly it is used, where the environmental condition vary very strongly (high temperature differences, high air humidity etc.).

a) Indicates on the basis colors (red, yellow, green) the range to the driver/user
b) Programming is not possible with this display
c) A signal light and a one grope sensor (to acknowledging the alarm)

Optional extras:

- 5- or 10-metre extension bus cable (with plug)
- Moisture separator (prescribed accessory)
- Temperature sensor with 10-metre cable

Fig. 2: CONTROL BOX with cable harness connected

Fig. 3: PRESSURE CONNECTION SET with installation instructions and mounting accessories

Fig. 4: FUSE KIT

Fig. 5: CABLE HARNESS

Fig. 6: ON-ROAD PanelBox with bus cable

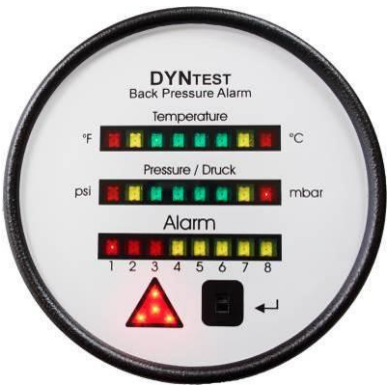


Fig. 7: OFF-ROAD PanelBox (special accessory) with protection type IP 67

3.1 Installation Procedure

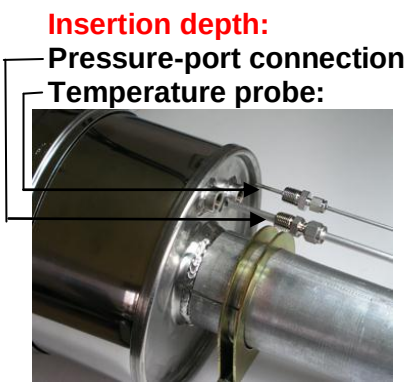
Instructions for the Installation of the ControlBox, the Temperature Sensor (T1) and the PanelBox (Display)

1. If the ControlBox cannot be installed above the exhaust system, a moisture separator must be connected into the system circuitry upstream of the ControlBox. The ControlBox must not be positioned too close to components that become very hot (exhaust, manifold). The plug connectors must face downwards. We recommend that the ControlBox be mounted on the vehicle with vibration-absorbing materials.

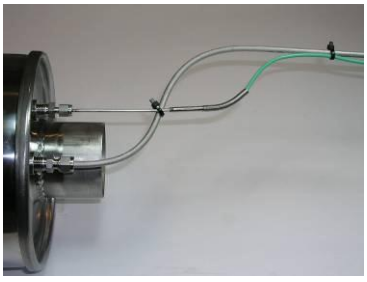
2. Next, the **stainless-steel pressure pipe** is connected to the pressure pipe joint on the filter by means of the supplied 1/4“ NPT clamp-ring connector. The pipe should be inserted **approx. 3 cm** into the filter inlet. If the pipe has to be adjusted for length, it should be wound into coils rather than cut to size. There should be a distance of at least 150 cm between the pressure-connection joint on the filter and the ControlBox. The high-temperature (HT) hose is attached to the end of the stainless-steel pipe and secured with cable ties. The other end is connected to the ControlBox, and is also secured with a cable tie. In order to prevent pockets of condensation from forming, and to ensure that any moisture which does collect can drip down unimpeded, the pipe-hose connection must be mounted in such a way that it is always rising. **To prevent build-ups of sooty deposits causing the pressure probe to malfunction, a moisture separator of the standard, commercially available type must be installed between the ControlBox and the stainless-steel pressure pipe, and securely attached to the vehicle.** Care must be taken to ensure that all connections are properly secured and pressure-sealed.

3. Next, the temperature probe (T1) is inserted in the corresponding ¼" NPT clamp-ring connector on the filter, and then secured in place. It should now reach about 5 cm into the filter-housing inlet. The tip of the temperature probe should now be positioned directly in the stream of the exhaust gas. If it is not, the probe can be pushed further than 5 cm inside the inlet on the filter housing. However, you should take care to ensure that the filter substrate is not damaged, and that the temperature-probe cable is kept clear of hot exhaust-system components!
   Do not overtighten the screw connection, as this could damage the probe. If necessary, the probe can be very gently bent, so that it is slightly curved. (On no account should it be bent sharply!) The probe cable should be secured to the ControlBox with cable ties in such a way that vibrations are damped. Care should be taken to avoid contact with components which heat up.

Testing ports

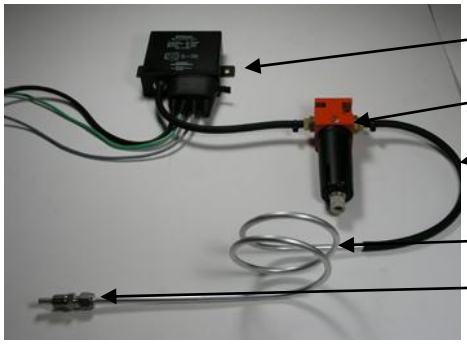


Insertion of probe into port

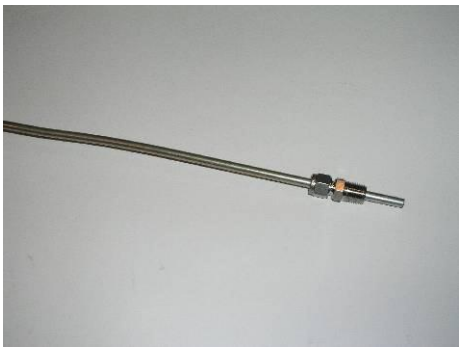


Probe cable held with ties to prevent swinging

Pressure connection



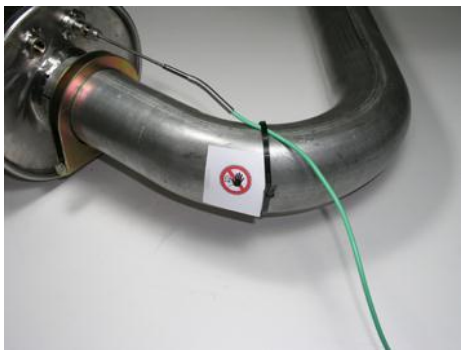
ControlBox
Moisture separator
Pressure hose
Pressure pipe (with coils facing upwards)
Clamp-ring screw connector



Pressure pipe RISING

Coils MUST NOT face downwards!

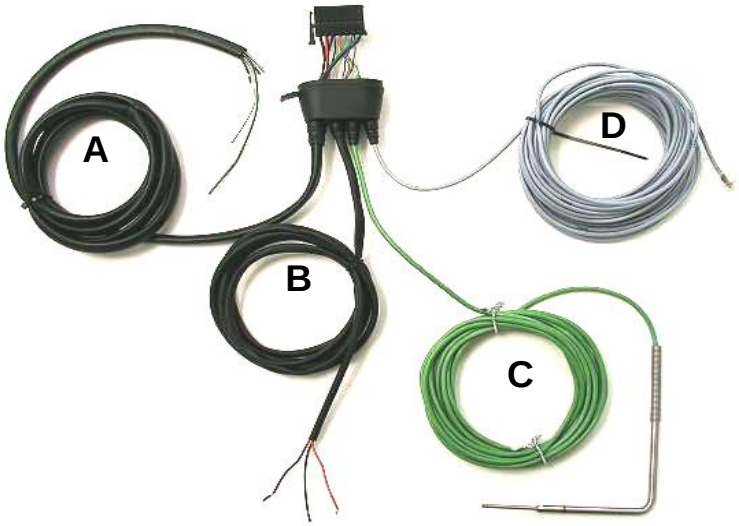
NO looping!



NO cables or hoses to be attached to components which heat up!

4. Connecting up the cable harness

IMPORTANT: DISCONNECT THE BATTERY BEFORE INSTALLATION!
After all the cables have been connected up, the 14-pole cable-harness plug is connected to the interface on the ControlBox, and the rubber bushing is secured with a cable tie. Ensure that the bushing is held firmly in place.



A Inputs and outputs (I/O)

Violet	input for revs data (frequency) at terminal W or vacant input / output (programmable)
Brown	input (vacant input)
Black/White	alarm output 1
Black/Green	alarm output 2

Important note:
The free ends of the alarm outputs have been bent round (to prevent short circuiting) and tucked inside the cable-harness jacket. These loose ends must be carefully drawn out and connected up in the prescribed manner before additional alarm functions or special programs are activated.

B Power supply

Red	continuous + (battery) (30)
Black/red	ignition + (15)
Black	- (Minus)

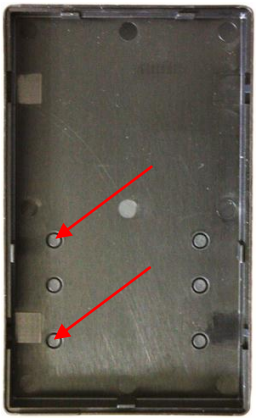
C Temperature probe with connecting cable (optional 2x)

D Bus cable to the PanelBox

Special purpose accessories:

Bus-cable extensions with couplers, 5 m and 10 m PanelBox with display (protection type IP67) – for use with construction machinery or the like

5. The PanelBox is mounted somewhere in the driver's cab where it will be clearly visible. The back panel of the Box is secured to the vehicle with 4 screws (see the figure on the left). The front part of the PanelBox, i.e. the part which contains the electronic components, is then set on the back panel and carefully clicked into place. The bus-cable Western plug connector is then pushed into the socket on the underside of the front. The PanelBox is now ready for operation, and the battery can be reinserted.



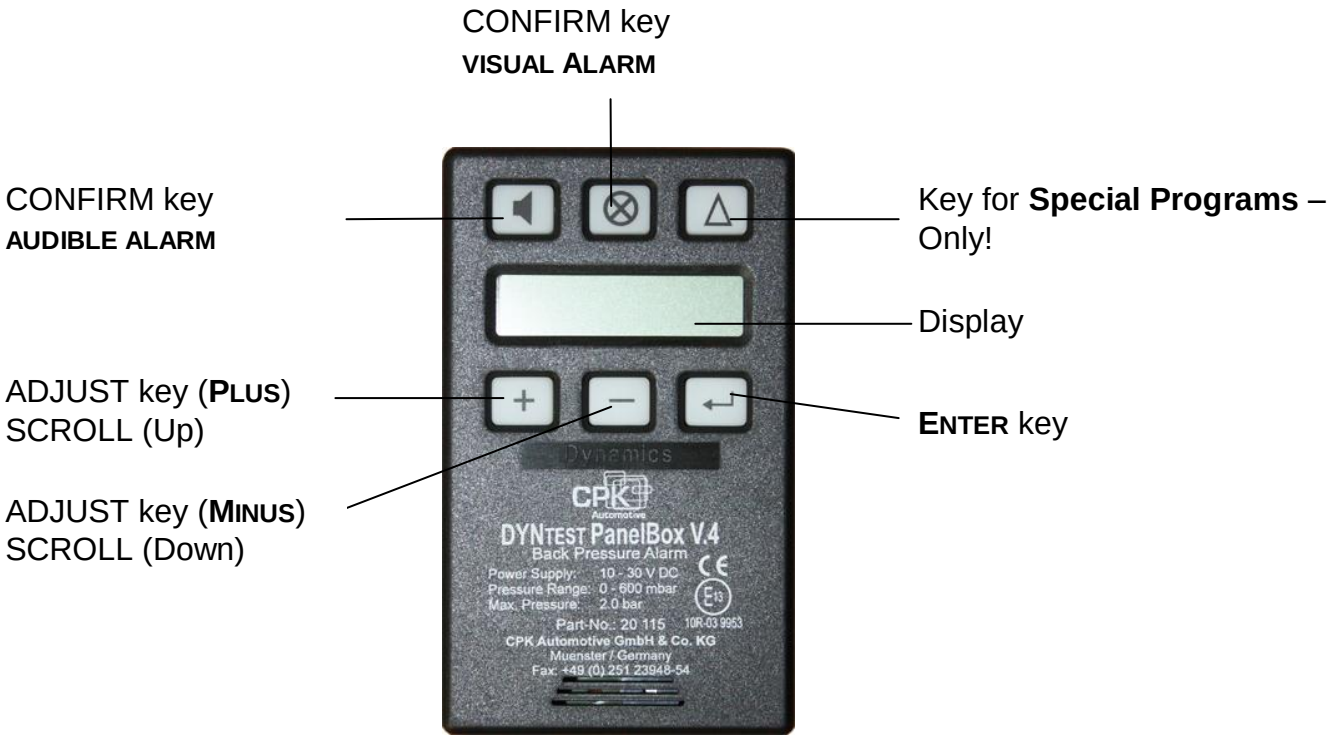
If the PanelBox has to be dismounted, the bus-cable Western plug connector must first be removed from the socket. To obtain access to the mounting screws, the housing should only be opened in the manner described below. Otherwise, there is a risk of damaging the electronic components!!!

3.2 Dismounting the PanelBox

Insert a screwdriver between the front and back parts of the Box in the vicinity of the bus-cable socket. Carefully lever open the housing by sliding the screwdriver along the back panel and gently prizing off the front part.

4 Operating Instructions

4.1 PanelBox - Keys and Functions (On Road)



The + and – key are used for scrolling (i.e. navigating the menu), and are always activated. The ↵ key can only be used in **maintenance mode** (see p. 17). The ↵ key is for initiating and confirming data input.

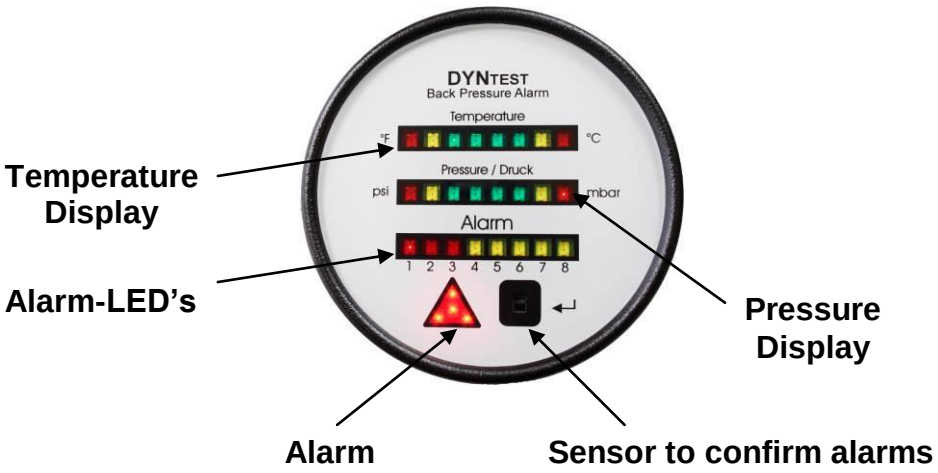
Values can be changed in maintenance mode by means of the + and - keys. New settings must all be confirmed by means of the ↵ key.

After the changes entered have been confirmed with the ↵ key, the new values will appear in the display after a short space of time.

Each of the keys is illuminated by its own orange LED.

The keys are transmitting the signal with a delay of <1 second.

4.2 PanelBox - Keys and Functions (Off Road)



This display is especially designed for off-road machinery operated under severe conditions. It may be integrated into the dashboard or attached to the body by a universal holder which allows for additional protection by means of rubber armoured brackets. The sturdy design meets the requirements of IP 67.

The pressure and temperature indicating LED are controlled by the parameters stored in the bus master (control box). A bright LED will show the actual value. Under normal conditions it will be green after starting from the lowest value on the left. The indicating colours start from red, change to yellow and consequently to green. Rising values will be displayed by yellow and finally red indicators on the right side of the bars.

Any error will easily be detected and promptly displayed. The error codes correspond to those of the on-road display. (see page 34)

4.3 Initial Operation

For the DYNTEST System to function properly the time and date (see p. 25) and also, if necessary, the generator frequency factor for the recording of engine speeds (see p. 24) must be set as soon as the system hardware has been installed. After this, the reference pressure (see p. 19) is set.

4.4 Basic Settings

The DYNTEST **Particle-Filter Monitoring System** is generally ready to be set to work directly after the measures outlined under "Initial Operation" have been performed. All operating values have been preset in the factory; in many cases these need not be changed, but new values may have to be specified for certain types of operation.

Factory Settings

Lower pressure limit	15 mbar
Upper pressure limit	150 mbar
Tolerance range for filter check	30 %
Engine speed (rpm)	OFF
Reference engine speed (rpm)	1500
Reference pressure	0 mbar
Lower temperature limit (Off-Road Display)	100 °C
Upper temperature limit (Off-Road Display)	700 °C
Out 1	OFF
Out 2	OFF
Special Out 1	OFF
Special Out 2	OFF

Operating Mode

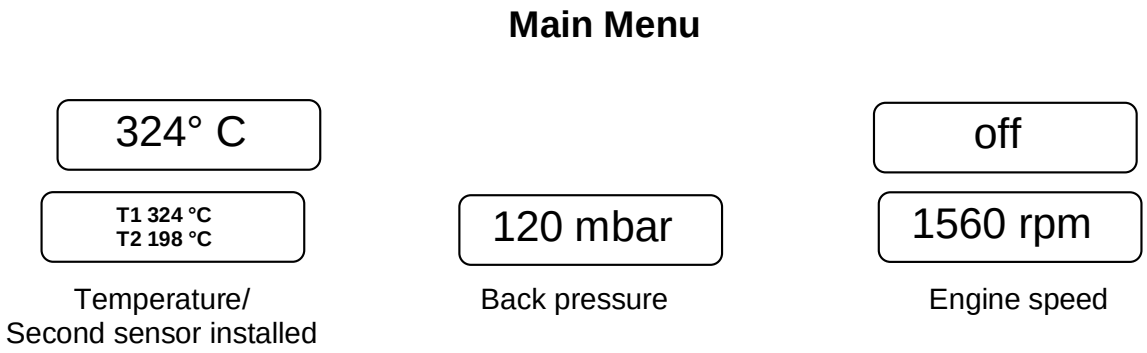
When the vehicle is in normal service, the particle-filtering monitoring system is in **OPERATING MODE**. The "visual alarm" (⊗) key and the "audible alarm" (◖) key are pressed to acknowledge the corresponding alarm signals. The Special Programs (△) key is not activated. The (+) and (-) keys are used to display current temperature, pressure and engines-speed values. **Settings cannot be changed when the system is in the normal operating mode.**

Maintenance Mode

Operating parameters can be changed when the system is in **MAINTENANCE MODE**. The bottom row of keys is used to adapt the system configuration. In the normal operating mode the ↵ key is deactivated. It can be activated by pressing all three keys in the top row simultaneously; however, this operation should be performed by **service technicians only**. Once the ↵ key has been activated, "UNLOCKED" appears on the display, and the background illumination of these keys becomes brighter when they are pressed. The normal operating mode is restored by pressing all three keys in the top row simultaneously. "LOCKED" will then appear in the display in confirmation of this step, and if the ignition is switched off, the monitoring system is automatically restored to **OPERATING MODE** when it is switched on again.

5 Operating Mode

5.1 Displays and Alarm Functions



In the operating mode, the **(+)** and **(-)** buttons can be used to select the display of the current temperature value, back-pressure value, or rpm value.

It is not possible to enter settings or make changes in the operating mode.

In the event of a fault, "ERROR: XX" appears in the display (XX standing for the fault-status number).

If an alarm is triggered, it can be acknowledged; the acknowledgement will suppress the buzzer and the flashing alarm signal. However, the activated alarm will be indicated by the brighter illumination in the *Audible alarm* and *Visual alarm* buttons. If the ignition is then turned off, the alarm is not reset, but remains activated when the engine is next started.

When "OFF" appears in the rpm display, and after the ControlBox has been connected up to terminal W, the user can switch over to maintenance mode and define the generator frequency for the revs (i.e. rpm) display (see page 16) in SETUP. Please note that rpm-related functions will either be of no use whatsoever (e.g. Filter Check), or their usefulness will be limited (Special Program 2) unless the ControlBox is connected to terminal W, and the appropriate generator-frequency factor has been entered (see page 24).

Alarm functions are described on page 30.
Error Codes (Fault-Status Numbers) are listed on page 32.

6 Maintenance mode

The maintenance mode is unlocked by pressing the ⊗,◀, **and** △ buttons simultaneously. After entering the maintenance mode, press the **(+) and (-)** buttons (if necessary several times) until the desired submenu can be accessed by confirming the item shown on the display.

6.1 Main Menu

Display	Action (Press key)	Commentary	
324° C	+	Display of the current temperature(s)	Page 19
120 mbar	+	Display of current pressure Access the Pressure submenu with the ↵ key	Page 20
1560 rpm	+	Display of current engine speed (preset at OFF!)	
FILTER CHECK	+	FILTER CHECK Test routine to establish if there is minor damage to the filter	Page 21
SETUP	+	Setting of generator-frequency factor, memory type, time, date, and configuration of the alarm outputs	Page 22

6.1.1 Temperature Submenu

(Display in main menu xxx°C)

Important: Settings in this menu are required for the programming of the **OFF ROAD** display only. Appropriate instructions are supplied together with the OFF Road display.

250 °C	↵	Temperature submenu (i.e. menu for the current temperature) For the programming of the OFF ROAD display	
T (L): 300°C	+	Lower temperature limit Parameter for OFF ROAD display only	See OFF ROAD instructions
T (U): 750°C	+	Upper temperature limit Parameter for OFF ROAD display only	See OFF ROAD instructions

6.1.2 Pressure Submenu

(Display in main menu: xxx mbar)**:**

Display	Commentary		
120 mbar	Pressure submenu (current pressure)	Page	20
L(L): 30 mbar	Lower-pressure-limit submenu L (L) Limit (Lower)	Page	20
L(U): 150 mbar	Upper-pressure-limit submenu L (U) Limit (Upper)	Page	20
1200..1600rpm L(R)= 90mbar	Reference-pressure L(R) /rpm Limit (Reference) submenu	Page	21
ΔP_Ref= 30 %	Tolerance-range submenu (i.e. tolerance range for pressure loss as measured against a reference value)	Page	21
F_Ref: 1500rpm	Reference engine speed	Page	22
[←]	End of the submenu, back to main menu		

6.1.3 Filter Check

FILTER CHECK?	Test for minimal or moderate damage to the filter system (see page 3)

In maintenance mode, the Filter Check option can be started direct from the main menu. The service technician must first increase or decrease the engine revs until the preset reference engine speed (see *Initial Operation, p. 23*) is reached, and then hold this speed as constantly as possible for at least 5 seconds.

REF= [False] P:50 < S: 84	If a deviation of, say, > 30% below the reference value is established for a period of more than 5 seconds, a fault message is generated. The test findings, together with the value actually measured and the desired value, appear in the display and are written to the alarm memory.
ERROR: 38	The display fields shown on the left flash on and off alternately until the ↵ key is pressed to acknowledge the test findings.
REF= [OK] P:120 < S: 84	**OK**, **P**: [current pressure], and **S**: [desired value] will appear in the display if the values measured are within the preset range.

6.1.4 Setup Submenu

(display in main menu: SETUP)

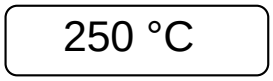
Display	Commentary		
SETUP	Setup submenu		
FRQ/10:OFF	Engine-speed submenu (generator-frequency factor)	Page	22
M: vehicle	Memory-model submenu (stationary / mobile =vehicle)	Page	23
Time: 13:42:32 Date: 25.04.04	Time-and-date submenu	Page	23
P:24/2 L:24/4 23.04.04/04654	Display of program version, installation date and serial number	Page	24
A1|off	Configuration of Alarm-output-1 submenu	Page	24
A2|off	Configuration of Alarm-output-2 submenu	Page	24
A1Delay/PulseTi	Programming of alarm output 1 for a pulsed or delayed signal output	Seite	26
A2Delay/PulseTi	Programming of alarm output 2 for a pulsed or delayed signal output	Seite	26
SPECIAL1:off	Special programs for Alarm-output-1 submenu	Page	28
SPECIAL2:off	Special programs for Alarm-output-2 submenu (examples)	Page	28
DEVICES[ACTIVE]	Activation of additional bus-system modules	See separate instructions	
DEVICES_VALUES	Display of the current settings for additional modules that have been activated	See separate instructions	
SYS_VALUES	Overview of actual measured values (Temperature(s), pressure, rpm)		
[←]	End of the submenu, back to the main menu		

All setup values and changes are stored in the alarm memory.
The menu position is not written to memory. Entries that have not been confirmed are not written to memory; they are automatically discarded after 10 minutes.

6.2 Entering settings by means of the Temperature submenu

Only settings for the **OFF ROAD** display need be entered by means of this submenu (see page 19).
With the "Off Road" display, the temperature display can be dynamically programmed via the ControlBox. The programming is performed with the aid of the PanelBox or a PC/Laptop.

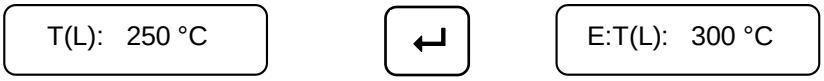
Press the **+/-** key (if necessary, several times) until the temperature currently prevailing is displayed.



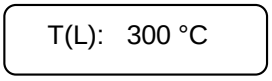
Press the ↵ key to access the "Temperature" submenu. This is the submenu that is used to set the following parameters:

6.2.1 Settings for the lower temperature threshold

(See page: 3): T(L) = Limit (Lower)

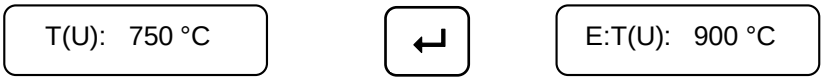


Press the ↵ key to activate editing mode **E:**. Use the + and – keys to set the required value. Confirm the setting you have entered by pressing the ↵ key. The editing mode will now be deactivated, and after a brief delay, the new values are displayed in the submenu.

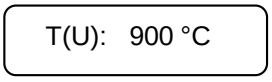


6.2.2 Settings for the upper temperature threshold

(See page: 3): T(U) = Limit (Upper)

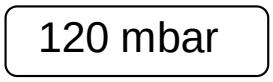


Press the ↵ key to activate editing mode **E:**. Use the + and – keys to set the required value. Confirm the setting you have entered by pressing the ↵ key. The editing mode will now be deactivated, and after a brief delay, the new values are displayed in the submenu.



6.3 Entry of settings via the Pressure submenu

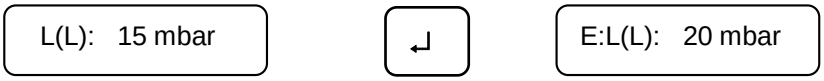
After having entered the maintenance mode by pressing the ◖,⊗, and △ keys simultaneously, press the **(+) or (-)** keys (if necessary, repeatedly) until the current pressure is displayed.



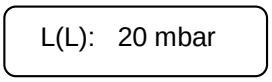
Access the PRESSURE submenu by pressing the ↵ key. With this submenu, you can determine the following parameters:

6.3.1 Switch Point for the Lower Pressure Limit

(see page 3): L(L) = Limit (lower)



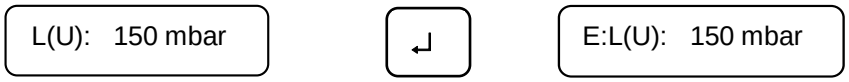
Enter editing mode **E:** by pressing the ↵ key. The desired value may be set by means of the (+) key and/or the (–) keys. Confirm the setting chosen with the ↵ key. The editing mode is now terminated, and after a short space of time the changed values appear in the submenu display.



The first measurement is performed 60 s after the engine is started (engine speed > 300), or, if rpm measurement is not yet activated (i.e. if the display is showing FRQ/10:off), 5 minutes after the ignition is switched on. An alarm will be triggered 5 s after the engine speed drops to (or below) the switch point.

6.3.2 Switch Point for the Upper Pressure Limit

(see page 3) L(U) = Limit (upper)



Settings are entered in the same way as for the lower pressure limit.

See page 30 for alarms triggered.

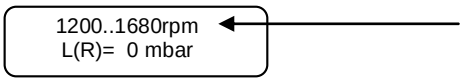
6.3.3 How to Ascertain the Reference Pressure

The reference pressure is the reference value for the **Filter Check** function (see page 3). It is ascertained when **a filter is brought into use for the first time**, and thus after every change of filter. The back pressure of the unloaded system is measured at a predetermined engine speed (factory presetting: 1500 rpm), and the value thus ascertained is written to memory and stored as the reference pressure.

Important note: The generator-frequency factor (engine speed in rpm) must be entered in the SETUP menu (see page 24) before the reference pressure is ascertained. The ControlBox must be connected to terminal W.

*The presetting of the acceptable-loss-of-pressure value (see **4** below) and the reference engine speed of 1500 rpm (see **5** below) can be adjusted before the measurement is made.*

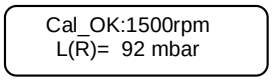
To ascertain the reference pressure, call up the pressure submenu and scroll until the display



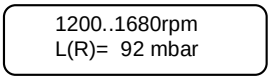
appears. Begin the measurement procedure by pressing the ↵ key. The current engine speed will appear in the display; during the measurement, this speed must be held within the tolerance range for 5 seconds.

A plausibility check is performed in the course of the measurement. If the engine speed is not within the tolerance range, or if the measured values do not meet the plausibility criteria for other reasons, the entire procedure is abandoned and a new measurement has to be made.

After the measurement has been made and accepted, the average engine speed and the average pressure based on 5 measured values are displayed.



The measurement is accepted and stored by pressing the ↵ key.

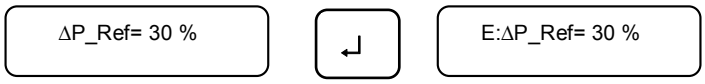


The tolerance range is displayed together with the reference pressure that has been defined as valid.

The reference pressure is stored permanently in the alarm memory.

6.3.4 Display/Input of Pressure-Loss Tolerance

A permissible deviation from the reference value is determined as a % value at this menu location. Deviations from the preset value should only be entered if there are good reasons for doing so.



Setting procedure as for the Lower Pressure Limit

6.3.5 Display/Input of the Reference Engine Speed

The engine speed desired as the reference value is preset at this menu location.

F_Ref: 1500rpm	↵	E:F_Ref: 1500rpm	Setting procedure as for the Lower Pressure Limit

6.4 Entry of Settings via the SETUP Submenu

After unlocking the maintenance mode (see page 17), press the **(+) or (-)** keys (if necessary, repeatedly) until "SETUP" appears in the display. Enter the SETUP submenu by pressing the ↵ key. You will then be able to perform the operations set out below:

6.4.1 Entry of the generator pulse rate (frequency)

(in order to **set the engine speed)**

To ascertain the engine speed, the number of pulses per minute is measured at terminal W on the generator; this figure is then converted into engine revs per minute (rpm).

Terminal W is a generator output which, as a rule, outputs 6 (or, in exceptional cases, 4, or 8) pulses per revolution of the generator. The generator-frequency factor must be entered so that the correct number of revs can be ascertained and displayed.

FRQ/10:OFF	↵	E:FRQ/10:OFF	FRQ/10:270

To enter this factor, access editing mode **E:** by pressing the ↵ key. The appropriate value is then entered by means of the + key and/or the – key. Confirm the entry with the ↵ key.

If the generator factor is not known, and cannot be obtained by consulting vehicle documents, it must be ascertained as follows:

First the diameter of the V-belt pulley on the crankshaft (d1) is measured, and then the diameter of the V-belt pulley on the generator (d2).

The generator factor is $\frac{d1}{d2} \times 6$ (or, in exceptional cases, 4, or 8).

Example:

Factor: diameter (d1) 36 cm, diameter (d2) 8 cm, pulses 6 = $\frac{36}{8} \times 6 =$ **27**

When setting the factor, enter the first decimal place for greater accuracy. That means if the factor is, say, 27, the figure entered in the editing mode is 270.

As a rule, the generator frequency factor will lie between 1 and 40. That means the number entered will be in the range from 10 to 400.

The rpm value is only written to memory if an alarm is triggered; it is not generally logged in the memory for measured values.

6.4.2 Entry of the memory type

In the editing mode, the user can freely choose a storage interval between 1 and 250 seconds.

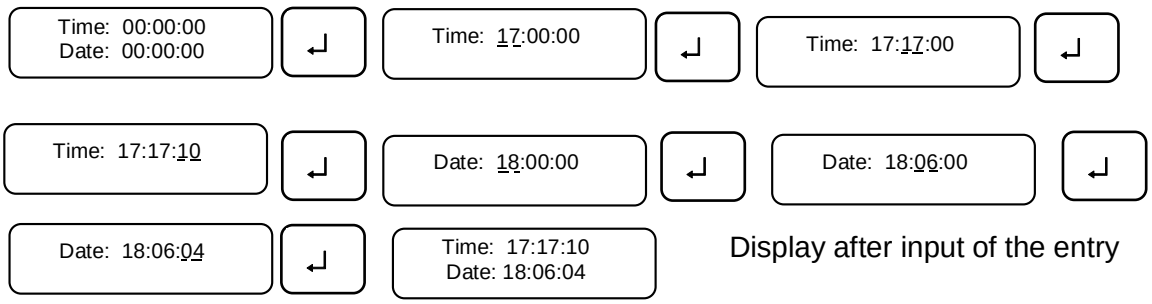
In order to determine the **required storage frequency** for stationary engines (30Sec), or the frequency required for engines in vehicles (10Sec; see page 4), the selection between these two operating modes is made with the + key or the – key in the editing mode.

6.4.3 Entry of the time and date

The time-and-date module is located in the Control Box, and is supplied with power even after the engine has been switched off (current consumption: 1 mA). The date and time is preset (power supply by internal battery) and can be entered or changed within 8 hours of the system having been put into operation for the first time, or after the voltage supply has been interrupted for more than one hour. The values that are underlined in the display can be changed with the + key and/or the – key. The new values entered are confirmed with the ↵ key. As this is done, the next parameter to be changed is underlined.

Important note: Ensure that the time and date are correct before confirming, because if changes have to be made, no values that are older than the last value stored will be accepted.

The time and the date can be brought forward if the power supply has been interrupted for more than an hour. If the time and date have to be set back, the only change that will be accepted is a period of one hour (change from summer to winter time). Otherwise, setting back the time is only possible after a reset of the entire system.



If no new time is entered following an interruption of the power supply, all further time values will follow on from the last time value to have been properly stored.

6.4.4 Soft- Hardware Version and Installation Date Display

Viewing of the hardware- and software-version displays; viewing of the installation-date display – inputting of entries is not possible. **Example**:

P:24/2 L:24/4
00.00.00/004654

P: Panel Box
Software Vers. 24
Hardware Vers. 2

P:24/2 L:24/4
18.06.04/004654

L: Control Box (Logger)
Software Vers. 24
Hardware Vers. 4

(00.00.00) = installation date, which is automatically displayed and stored **8 operating hours** after the system has been set to work for the first time (e.g. 18.06.04).

The **serial number** (e.g. 004654) is displayed to the right of the installation date.

6.4.5 Configuration of the alarm outputs

The SYSTEM has 3 separate switchable alarm outputs.
The output of a signal can be controlled by pressure, temperature or engine speed.
In the display,

>T< stands for temperature,
>P< for pressure, and
>F< for engine speed (in rpm).

The system programming requires the presetting of desired values, **S (**for **T, P** or **F)**, which are then compared during operation with the values actually measured **(X)**. The following **operating modes** are integrated in the system programming:

- **Threshold values (X< S**, or **X>S)**; **entry of S and Ti**
  When threshold values are entered, a hysteresis time **Ti** of between 1 and 10 seconds or between 1 and 120 minutes must also be entered. **Ti** is the period within which the specified condition must be fulfilled/must not be fulfilled for a signal to be released/switched off (hysteresis).
- **Switching ranges (Δ S) = entry of the mean desired value S with a deviation range D.** (Example: S= 400, D= 100 = range of 400 ±100 = range of between 300 and 500. The maximum value that can be set for D is 250.) The signal is sent if the values measured are in the range from 300 to 500. It is not possible to set a hysteresis value. The hysteresis is preprogrammed at 2 seconds.
- **Kickdown/time (Δ Ti**); **entry of kickdown S, and of the time Δ Ti (in seconds)** in which the kickdown must have taken place.
  (Example: **S**=200, Δ **Ti** = 5 sec.: kickdown of 200 within 5 seconds.)

Important note: In the kickdown/time mode, a switching pulse lasting between 1 and 10 seconds is generated. This pulse can be further processed, either internally or externally.

The appropriate values are entered in the SETUP submenu under A|1 for alarm output 1, and under A|2 for alarm output 2.

Access to the menu location for configuring the desired alarm output is obtained by confirming the A1|off display or the A2|off display with the ↵ key. The desired function is displayed by pressing the + key or the – key.

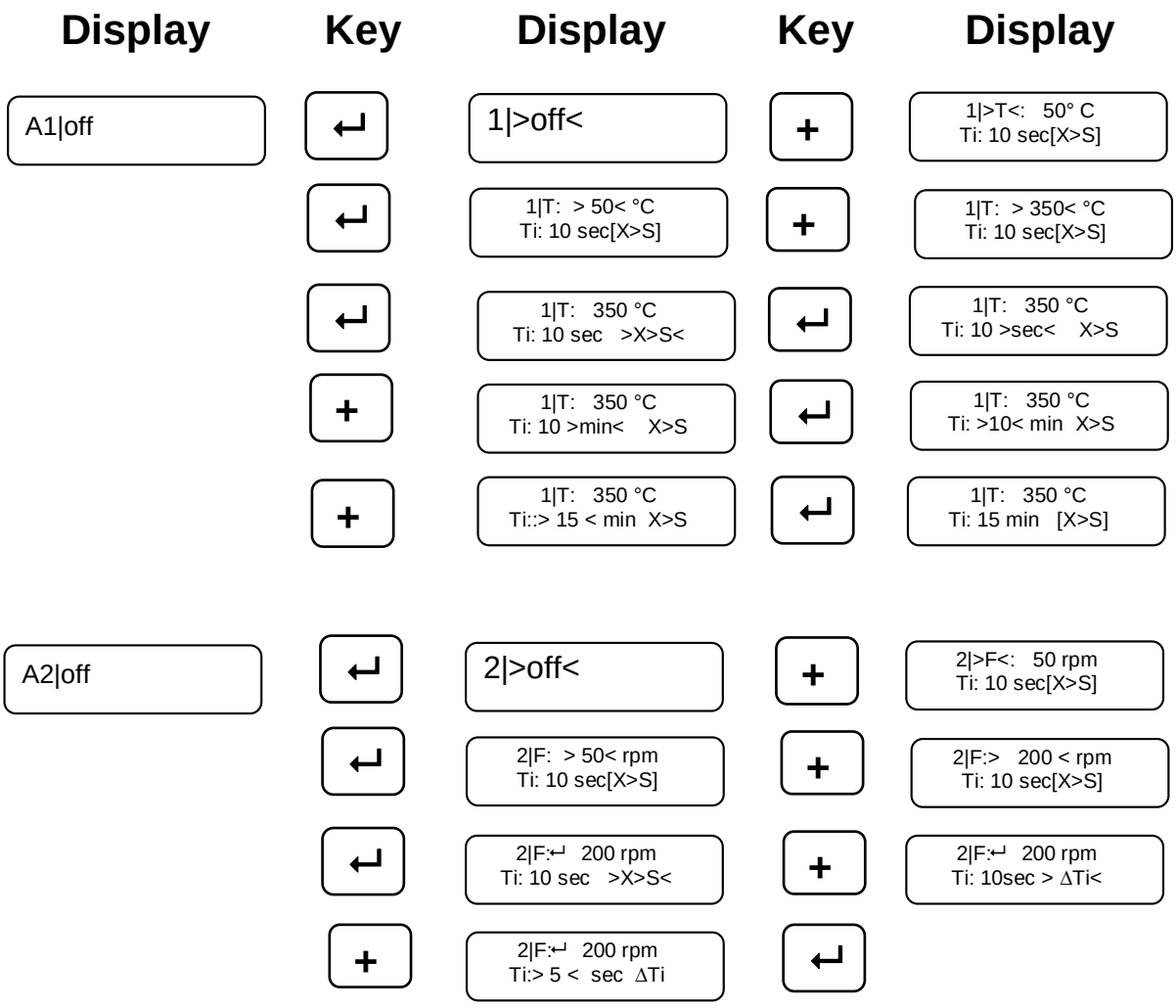
The selection of the function enclosed within inward pointing angle brackets (i.e. **>T<**, **>P<**, or **>F<)** is confirmed by pressing the ↵ key.

After selecting the appropriate menu, and confirming this selection with the ↵ key, the **(S)** values can be set using the + key and/or the – key. Once entered, the setting is confirmed with the ↵ key.

The operating mode (threshold value, switching range or kickdown) can then be selected with the + key and/or the – key, and confirmed with the ↵ key. The next step is the setting of the **D, T**i or Δ **Ti** value with the + key and/or the – key. When the values entered are confirmed with the ↵ key, they are automatically written to memory. The program then returns to the SETUP submenu.

By way of example, the programming of an **Alarm output 1** switching signal that will be released in the temperature range between 300° C and 400° C is set out below. A second example is also provided to illustrate the programming of an **Alarm output 2** switching pulse; in this example, the switching pulse will be triggered if there is a kickdown of 200 rpm within a space of 5 seconds. The duration of the switching pulse is always exactly the same as the preset time period Δ **Ti.**

Examples of the programming of the alarm outputs:



After the final confirmation, the new values are displayed within a short space of time, and then the SETUP menu is once again displayed.

A2|F:↵ 200 rpm
Ti: 5sec [ΔTi]

Each time the engine (ignition) is switched off, the signal is reset.

6.4.6 Programming the signal mode of the alarm outputs

The output signals of the separately-switchable alarm outputs (**see page 2**) of the DYNTEST system can either be driven delayed or pulsed. These settings require the activation and programming of the respective alarm output (**see chapter 6.4.5**).

The input of the values is made in the SETUP submenu “A1Delay/PulseTi” for alarm output 1 and “A2Delay/PulseTi” for alarm output 2. Enter editing mode **E:** by pressing the ↵ key. The desired function (>Delay< oder >PulseTi<) may be set by means of the + key and/or the - keys. Confirm the setting chosen with the ↵ key.

In the next step, either the duration (delay) of the output signal after a signal causing situation will be determined, or the pulse frequency (PulseTi) of the output signal is entered. In this step, the time values can be set from 1 to 60 seconds/minutes for delay and 1 to 128 milliseconds (500 to 4 Hz) for PulseTi with the + and - buttons. By the input of the value 0 a deactivation of the respective function is reached. When the desired value has been selected, it must be confirmed by pressing the ↵ key.
For the function Delay it can be chosen between seconds or minutes by means of the + and - keys. After the confirmation with the ↵ key, the values are stored automatically. The program is then put back into the SETUP menu, whereby the mode set last and the appropriate time value are indicated now.

Examples for programming a delayed or pulsed signal output

Example 1: For illustration exemplarily programming is represented for a switching signal on **alarm output 1**, which is to be spent for an extended duration by 30 seconds.

Display	Key	Display	Key	Display
A1Delay/PulseTi	↵	A1>Delay< 0min	↵	A1Delay> 0<min
	+	A1Delay> 30<min	↵	A1Delay= 30>min<
	+	A1Delay= 30>sec<	↵	A1Delay: 30sec

Example 2: The second example shows the programming of a pulsed signal on **alarm output 2**, which will be issued with a frequency of 60 milliseconds.

Display	Key	Display	Key	Display
A2Delay/PulseTi	↵	A2>Delay< 0min	+	A2>PulseTi< 0
	↵	A2PulseTi> 0<	+	A2PulseTi> 60<
	↵	A2PulseTi: 60ms		

6.4.7 Use of Special Programs

Special 1 – Calling of special-purpose programs for alarm output 1 (see page 6)

If more complex functions are required than can be realized by configuring the alarm outputs, it is possible to call up customer-specific programs for special purposes. These pre-prepared programs are allocated consecutive numbers.

Calling of special-purpose program No. 2 for alarm output No. 1. Confirm with the ↵ key.

SPECIAL1:off	↵	E:SPECIAL1:= 2

Signals for programs activated under "Special 1" are released via alarm output No. 1.

If a special-purpose program has been activated, the assigned alarm output cannot be used for other applications. The configuration menu for this alarm output cannot be edited until the special program remains is no longer activated.

Special 2 – Calling of special-purpose programs for alarm output 2 (see page 6)

See Special 1

6.4.8 Examples of Preinstalled Special Programs

Permanently Installed Special-Purpose Programs

No. 1: Lower Pressure Limit

Limiting value defined in accordance with the setting in the Lower Pressure Limit menu (*Severe damage to the filter, to the exhaust-gas supply pipe, or to the hose connection to the pressure sensor*).
The signal release is activated at the output that has been called up.

Nr. 2: Throttle

Throttle closed (output HIGH); temperature: 0…320 °C
Throttle open (output LOW); temperature: >350 °C
Kickdown > 200 rpm in 1 second and held for 5 seconds => (output1 LOW for 2 minutes) = driving uphill, or overtaking, but not during double de-clutching.
Note: kickdown monitoring is activated after >= 3 seconds with engine ON (engine speed > 0).

Note:
In order to complete the parameterization process, the system must be restarted after the programming of individual outputs or the entering of settings for special-purpose programs.

7 Alarm Functions

7.1 Audible alarm

If an audible warning is triggered, the buzzer can be switched off by pressing the ◂ key (e.g. if the buzzer tone becomes too distracting). If the audible alarm is switched off, the key remains lit up red so that a visible alarm signal is maintained.

In all such cases, the acknowledgement of the audible alarm is recorded in the alarm memory in the Control Box. The time and date of the acknowledgement are also logged.

The next time the DYNTEST System is started, the buzzer will once again sound if the exhaust-gas back-pressure level is still outside the permissible pressure range.

7.2 Visual alarm

If a visual warning is triggered, the keys will light up orange. The warning can be switched off by pressing the visible-alarm confirmation key. This key will then change its illumination colour to red, and the alarm event will be written to the alarm memory in the ControlBox.

7.3 The alarm logic integrated in the DYNTEST System

Upper pressure limit (see page 4)

- If the value set as the upper exhaust-gas back-pressure limit (the standard presetting is 150 mbar) is exceeded **for more than 5 seconds**, the visual-alarm key and the audible-alarm key on the PanelBox are illuminated. If the exhaust-gas back pressure then falls below the value of the upper limit for more than 5 seconds, the lamps are extinguished.
- If the value set as the upper exhaust-gas back-pressure limit is exceeded **for more than 60 seconds**, both alarm lamps flash, and the buzzer sounds at set intervals. If the back pressure then falls below the upper limit for more than 5 seconds, the lamps are extinguished, and the audible alarm is switched off.
- If, however, the value set as the upper exhaust-gas back-pressure limit is exceeded **for a further 2 minutes**, both warning lights will flash and a continuous buzzer tone will be sounded as an audible alarm.

  At the same time, the **current back-pressure value** and **ERROR 36** will alternatively flash off and on in the display.

The warning display described above indicates that an excessive level of exhaust-gas back pressure has been caused by a build-up of particles in the filter. Such a build-up could eventually damage the filter and also the engine. The alarm lamp may, however, light up in the course of standard driving procedures – for example, when the driver accelerates. This is normal, and the driver is not required to take any special measures in response.

The driver is only required to increase the exhaust-gas temperature by increasing the motor load (i.e. the mechanical, hydraulic, electrical or pneumatic load) in an appropriate manner when both an audible and a visual alarm have been activated. When the temperature of the exhaust gas is raised, the particle filter can burn off more soot, with the result that the exhaust-gas back pressure returns to normal levels, and the illuminated displays are extinguished.

To check that increasing the engine load has had the desired effect on the temperature of the exhaust gas, the driver should switch over to the temperature display on the PanelBox by pressing the **(+) or (-)** keys until the temperature is displayed in °C. The time required for the regeneration of the filter can be restricted to 2 to five minutes if a high temperature (320-400 °C) is maintained at as constant a level as possible.

Care must be taken during this procedure to ensure that neither the vehicle engine nor the hydraulic system overheats.

If the exhaust-gas back pressure cannot be reduced in the manner described above, the filter should be checked as soon as the journey is completed; if necessary, it should be removed from the vehicle and cleaned. Observe the maintenance instructions for the filter and the temperature probe during the cleaning process

Lower pressure limit (see page 4)

If the pressure level falls to the level of the lower pressure limit (or beyond) **for longer than 5 seconds**, the warning lamps will flash, and a continuous buzzer tone will be sounded.

At the same time, the **current back pressure value** and **ERROR 35** will alternatively flash on and off in the display.

If the pressure rises above the switch point for more than 5 seconds, the alarm will be deactivated.

It is recommended that special-purpose program No. 2, LOWER PRESSURE LIMIT, be activated (see page 29). This program releases a signal which can be used to disconnect the supply of additive, or to initiate some other appropriate measure.

7.4 Alarm Codes

Error 11 **One of the keys on the PanelBox has jammed**
Press the keys (if necessary, repeatedly) until the fault is corrected.

Error 12 **Display**
Check the display for damages

Error 21 **No communication between the ControlBox and the PanelBox**
Check the plug connectors and the cable harness; switch off the ignition and then switch it on again

Error 22 **12C-Bus/Pointer Search**
If the alarm appears permanently, please contact your dealer

Error 23 **Parameterization incorrect/unreadable**
If the alarm appears permanently, please contact your dealer

Error 31 **Break in the pressure hose or pressure pipes, or damage to the filter**
Check the pressure connection. If the pressure hose and pipes are undamaged, send the Control Box to an authorized dealer for inspection.

Error 32 **No pressure 10 minutes after the ignition has been switched on**
Possible error sources: (1) Engine is not running → Switch on engine; (2) Faulty connection, or pressure pipe blocked → Reconnect and secure pressure pipe, or clean out pressure hose as per maintenance instructions.

Error 33 **Temperature unchanged 10 minutes after the ignition is switched on**
Make sure engine is running and probe is still correctly attached to the filter.

Error 34 **Damaged temperature-sensor probe T1**
Install replacement cable harness with new temperature probe.

Error 35 **Switch point for the lower pressure limit has been reached**
Serious error! Additive supply is cut off. The filter can no longer function!

Error 36 **Switch point for the upper pressure limit has been reached**
Raise the exhaust-gas temperature by increasing the engine load in an appropriate manner. Or start regeneration procedures (e. g. AR) The higher exhaust-gas temperature will enable the particle filter to burn more soot; the exhaust-gas back pressure will then sink to a normal level, and the illuminated displays will be extinguished. **Important note:** Do not allow the engine to overheat!

Error 37 **No signal from terminal W**
If this error report is generated while the engine is running, check the connection between the Control Box and terminal W, and repair if necessary. **Serious error!** The alarm outputs will not function until the error is rectified.

Error 38 **Filter check produces unsatisfactory result**
Switch off the report by confirming with the ↵ key. Return the filter to the factory to have it checked. If necessary, replace.

Error 39 **Additive Tank Low**
Refill additives for FBC (Fuel Borne Catalyst)

Error 41 **Measured Data cannot be recorded** Contact your authorized dealer.

Error 42 **Memory Error** Data structure is damaged, contact your authorized dealer.

Error 49 **Damaged temperature-sensor probe T2**
Install replacement cable harness with new temperature probe.

Error 51 **The date could not be verified and logged**
Repeat the procedure. If the problem persists, contact an authorized dealer.

Error 52 **Time could not be verified and logged**
Repeat the procedure. If the problem persists, contact an authorized dealer.

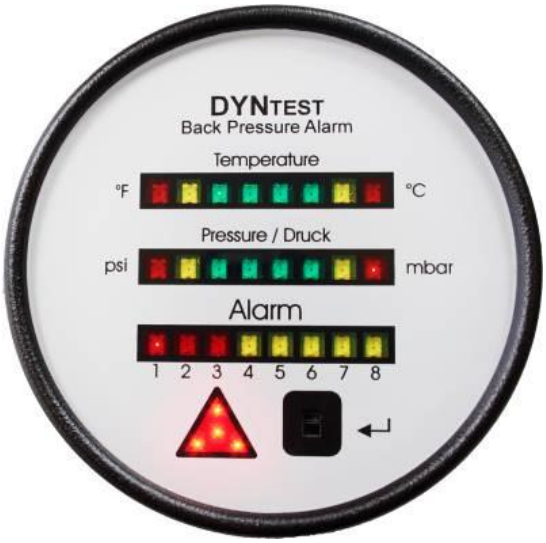
Error 61 **PLC activated, no communication**
Module connected?

Error 62 **GPS activated, no communication**
Module connected?

Error 63 **CAN I/O activated, no communication**
Cables connected?

Note: After the engine is switched off (by turning the ignition key in the lock), all the data are stored in the ControlBox within 10 seconds. If the main voltage supply to the ControlBox has been interrupted, the most recent measured values will be lost. Of course, all the values stored before the last engine switch-off prior to the interruption will be safely retained in the memory.

7.5 Alarm Codes (Off Road Display)



Any error will easily be detected and promptly displayed. The error codes correspond to those of the on-road display.

In the lower bar the alarms 1 – 8 will be displayed while an additional LED will allow additional information in respect to temperature or back pressure.

In case of an alarm a triangle beamer will start flashing. By just touching the reflection sensor the error will be acknowledged and the beamer will be stopped.

In case an alarm will be acknowledged only without any actions to eliminate the problem, the alarm will be repeated two more times at intervals of 10 minutes. After the third acknowledgement the beamer will be extinguished while the corresponding alarm LED will be continuously lighted.

Error Codes:

Error	Display	Description
21	No LED, Beamer flashes	No Communikation between CB and PB
22	Temperature 4, 5 / Pressure 4, 5 flash	12C-Bus/Pointer Search
23	Alarm 1, 2 and 3 flash	Faulty Parameterization
31 + 35	Pressure 1 / Alarm 2 flash , Beamer flashes	Lower Pressure Limit
32	Pressure 1 / Alarm 4 flash Beamer flashes	No change of pressure within 10 minutes.
33	Temp. 1 / Alarm 5 flash , Beamer flashes	No change of temperature within 10 minutes.
34	Temp. 1 / Alarm 6 flash , Beamer flashes	Damage of temperature probe
36	Pressure 8 / Alarm 1 flash , Beamer flashes	Upper Pressure Limit
37	Alarm 3 flashes, Beamer flashes	No RPM-Signal from the generator
41, 42, 51, 52	Alarm 7 flashes, Beamer flashes	Date and Time not correct, no recording of data
38	Alarm 1 flashes, Beamer flashes, (Pressure 8 off)	Error Additive-Dosing
39	Alarm 8 flashes, Beamer flashes	Level Additive-Tank
42	Alarm 1-8 flash	Memory Error
61	Alarm 4 flashes, Beamer flashes, (Pressure 1 off)	Error PLC (Slave)
62	Alarm 5 flashes, Beamer flashes, (Temp.1 off)	Error GSM (Slave)
Glass Cover	Alarm 4-8 flash, Beamer flashes	Glass Cover needs to be claened

Explanation: SW - Software, CB - ControlBox, PB - PanelBox (Display)
Dimensions: Housing ø 73 mm, Collar ø 85 mm

8 Download and Analysis of Stored Data

The values stored in the Control Box can be read out and analysed at a PC. In order to perform such analyses, you will need the DYNTEST Analyser Set, which can be obtained from your authorized dealer.

The downloaded data are stored in 2 files. One of these is freely accessible; the other, which contains the data retrieved from the memory where the measured values are stored, and from the alarm memory, is ZIP formatted, password-protected, and intended for use by your authorized agent.

9 Maintenance

1. Temperature sensor

The temperature probe(s) must be removed once a year (or after 100,000 km at the latest), cleaned with an agent which will remove oil and grease, and then refitted. We also recommend that the temperature probe be inspected at the same time as the filter, and, if necessary, cleaned.

2. Pressure connection set

The pressure hose and pipes must be thoroughly cleaned once a year, after all ERROR 32 fault reports, or at the very latest after 100,000 km. To release the connection pipe for cleaning, slacken the clamp-ring connector connecting the pipe to the filter. Next, cut open the cable tie which holds the moisture separator in place, and pull out the pressure hose. Begin cleaning the pressure connection set by removing deposits of soot etc. from the pressure pipe. Next, rinse out the pressure hose with cleaning solvent (benzene), and afterwards blow-dry with compressed air. The pressure hose is then reattached to the system. Ensure that all the connections are pressure-sealed, and that a new cable tie is used to hold the moisture separator securely in place.

No further maintenance measures are required.

10 Resetting the System

If the wrong date is entered and cannot be corrected, the system must be reset. This means that all **data and settings will be erased.**

A reset should only be performed after the data stored in the system memories has been downloaded and sent to the supplier. Otherwise, the guarantee for the filter will no longer be valid.

Resetting of the Control Box

Ask your supplier for the password required to perform the reset, and make sure that you have the Control Box serial number close to hand, and that you know how many resets have already performed or attempted!

You can obtain the information your supplier requires by pressing the bottom row of 3 keys **while in maintenance mode**:

SN: display of the serial number TR: display of the number of resets performed
Code: password prompt

If you would like to test this function first, do **not** confirm the display by pressing the ↵ key. Wait thirty seconds, and the original display will reappear. Confirming the display with the ↵ key would make the test entry count as a reset, and raise the number of resets by 1.

Your supplier will tell you the password you need to perform a reset; this password must be entered after the "Code:" prompt (see above). Now confirm your entry by pressing the ↵ key. If you do not confirm with the ↵ key, your entry will be discarded.

If the reset has been performed successfully, "RESET" will appear in the display.
If the attempted reset has been unsuccessful, "ERROR" will appear in the display, and the number of resets will be raised by 1.

11 Technical Data and Specifications

ControlBox (ECU)

Temperature

Ambient temperature:	-15 … 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:	IP64
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

PanelBox On Road (Display)

Protection type:	IP44
Dimensions:	106 x 65 x 35 mm
6 illuminated keys (2 with signalling functions)	
Buzzer	
Interface :	RJ 45 connector (Western type)

PanelBox Off Road (Display)

Protection type	IP67 (round shaped instrument)
Dimensions	85 mm ∅, T = 44 mm
Interface :	Deutsch Plug

Voltage supply via the ControlBox

Cable harness

Temperature probe: K type	measuring range max. 1100 °C
Oil- and water-resistant	

Muenster, January 2013

12 Claims for Repairs

If you are submitting a claim for the performance of repairs, we would ask you to fill out this form and return it, together with the faulty product, to your dealer.
In order to process your claim, we need to know the serial number of the product, and we also require a description of the fault that has developed.
We must expressly point out that it is our company policy to charge a processing fee of EUR 25.00 (plus postage and packing) if the fault(s) detected have been caused by incorrect operation, or if the claim for the performance of repairs is unfounded.

Customer: _____

Contact Person: _____

Street: _____

Post Code / City: _____

Country: _____

Ph.: _____

Fax: _____

Claims Sheet

Claim No.:

Please do not fill out!

Claimed Parts (Ser.No.):

_____

_____

Description (e.g. error code,…):

_____

_____

_____

Dealer: _____

Contact Person: _____

_____

Date, Signature

420 S. 145th E. Ave
Tulsa, OK 74108-1305