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Texas Commission on Environmental Quality
New Technology Research & Development (NTRD) Program
Monthly Project Status Report

Contract Number: 582-5-655-91-0007

Grantee: Converter Technology Inc

Date Submitted: June 6, 2005

Report for the **Monthly** period:

Starting Date May 1, 2005 Ending Date May 31, 2005

Section I. Accomplishments *(Please provide a bulleted list of project accomplishments as well as a description of their importance to the project.)*

- Investigated various options to address a new round of questions from CARB, primarily issues regarding the disposal and handling of collected soot from our system.
- Upgraded EGR control logic diagram based on issues raised by CARB addressing how EGR system deals with engine overheating conditions and high altitude performances.
- Conducted chassis dyno testing on simulated exhaust system using the CAT 3406 engine. Performed exploration tests for exhaust temperature profiles, calibration of mass flow meters, installation of data acquisition system and related activities.
- First round of work (scenarios) on how CTI's technology will play a role in the Texas State Implementation Plan.
- Design and testing for incineration/separation work on converters.

Indicate which part of the Grant Activities as defined in the grant agreement, the above accomplishments are related to:

1. Task #1 Texas Market assessment based on CTI's technology
2. Task #2 Potential Emission Reduction Compliance with SIP.
3. Task #3 Design of EGR System for CAT 3406 is in debugging stage
4. Task #4 Construction of converter EGR system design in progress
5. Task #5 EGR mapping for 50-60% NOx reduction
6. Task #6 EGR Mapping for 60-70% NOx reduction
7. Task #7 In-House emission testing
8. Task #8 On the road emission testing and durabilities
9. Task #14Verification program with EPA/CARB in progress

Section II: Problems/Solutions

Problem(s) Identified *(Please report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project)*	CTI received a second round of questions from CARB. Most questions are for clarification with the exception of: 1) CARB wants to declare diesel soot as a hazardous waste triggering a few regulations relating to storage, handling, shipping, disposal, etc. Complying with these regulations could delay the verification process and add expenses. 2) A question was raised about the effect of auxiliary emission devices on the engine on our emission system. This issue would slightly result in delays in the EGR development activities.
Proposed Solution(s) *(Please report any possible solution(s) to the problem(s) that were considered/encountered)*	Solutions to the above issues are: 1) We are declaring collected soot as a commodity, not a hazardous waste. Alternatively, we are accelerating the development of incineration hardware to burn soot and dispose of ashes (benign substances) 2) Upgrading our system logic control and add sensors to ensure proper engine performance at all possible operating conditions on the road.
Action(s) Conducted and Results *(Please describe the action(s) taken to resolve the problem(s) and its effect)*	We have been in negotiation with CARB on the issue of soot classification. CARB delegated the issue to the California Department of Toxic Waste, California Environmental Protection Agency. We have made a strong case and are waiting for a resolution to avoid any further delays. Alternatively, we initiated design and testing of incineration of soot (this is not the same as regeneration). This option is attractive since it extends maintenance intervals to over 100,000 miles, and is a backup for the soot collection option. Also, this option can extend the application to interstate on-highway trucks.

Section III. **Goals a. issues for Succeeding Period:** (*F. se provide a brief description of the goal(s) you hope to realize in the coming period and identify any notable challenges that can be foreseen)*

1. Conduct independent emission tests for PM only at Lotus Testing Lab in Ann Arbor, Michigan (still awaiting permission from CARB)
2. Conduct the test plan for EGR mapping for the CAT 3046 engine, 70% NOx reduction target. We are encountering challenges in instrumentation calibration, accuracies of equipment. We are sorting various sensor reliabilities for truck mobile data acquisition systems.
3. Begin EGR mapping.
4. Develop specific emission reduction plan based on the CAT 3046 engine and International 7.3L engines, taking into account age and localities, which can be accomplished through the outcome of this project.
5. Develop scenarios for how CTI's technology contributes to Texas State Implementation Plan for NOx reduction.

R. D. Kamm

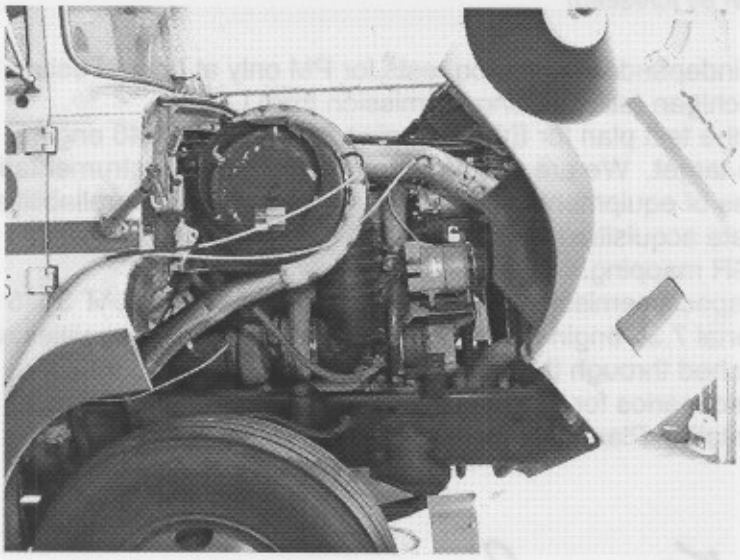
Date: 6/6/2005

Authorized Project Representative's Signature

NOTE: *Please attach any additional information that you feel should be a part of your report or that may be required to meet the deliverable requirements for tasks completed during this reporting period.*

Attached find a few of digital pictures for the CAT 3046 engine dyno set up showing in-house emission testing.

EGR/Air Intake Mixer

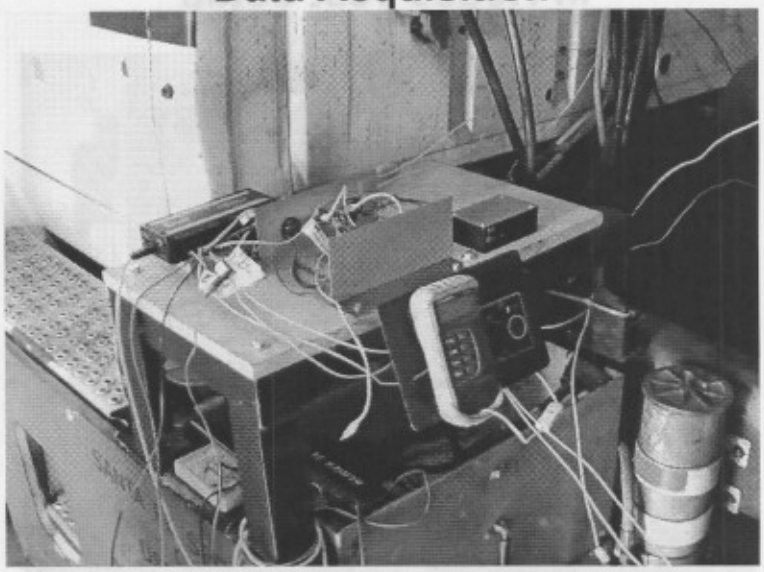


Digital photo of the CAT 3406B engine with EGR spiral all around the air intake filter. This arrangement provides good mixing of EGR flow with incoming air to the engine, a critical issue to ensure equal distribution of EGR flow to all cylinders. The spiral duct is a component of the retrofit kit.

Low-Pressure EGR Valve

Digital photo of the low-pressure EGR valve showing all components. Primary components are the housing, the valve and the Stepper motor. This valve is CTI's design and can deliver EGR ratios up to 90% if needed. The valve is being calibrated for EGR ratio vs. valve position vs. Stepper motor steps. Each step move the valve 0001", providing very accurate valve position to ensure precise EGR injection for each engine operation condition.

Data Acquisition

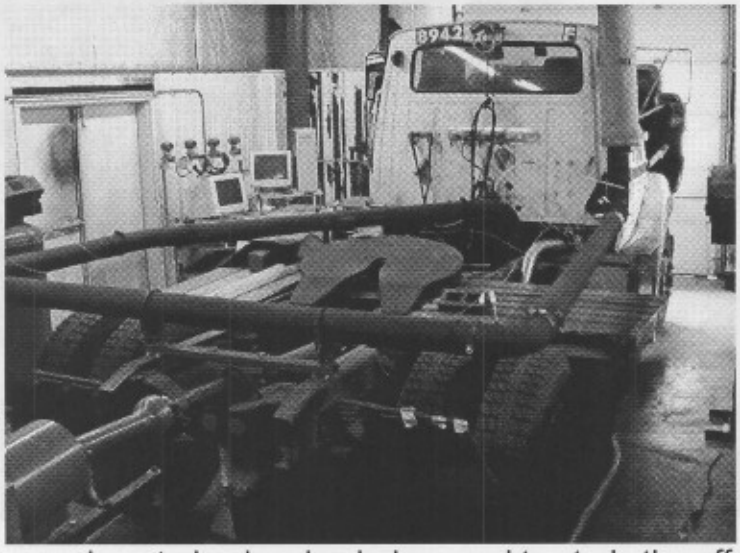


Data acquisition system showing all components with the exception of the Testo 350 analyzer which was returned to add dilution system. The small black box is a I/O Tech input/output module for processing all engine, exhaust system signals, both digital and analog.

Emission Test Stand

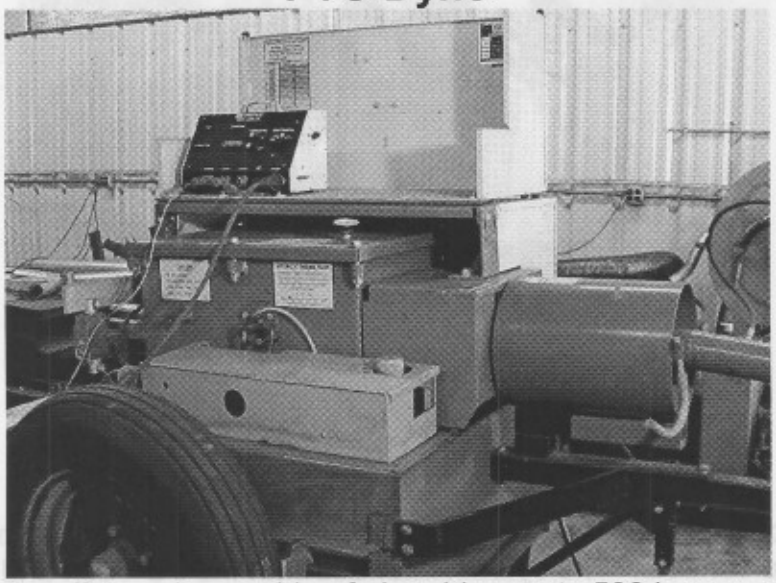
This test stand houses a computer and the related software for complete data acquisition and controls. The system interface with the I/O Tech and Testo analyzer can monitor emission concentration, emission mass, control EGR, pressure drop, temperature distribution and other related signals. The system will incorporate two chassis dynamometer test cycles, UDDS, and NY bus test cycles, both have been selected for verification testing. CTI will verify NOx reduction in-house before conducting emission testing in outside laboratories.

In-House Test Setup



This photo shows exhaust pipe looping being used to study the effect of radiation and convection cooing modes under different engine operation conditions. Reliance on a passive mode of cooling is the first choice and is the least expensive. In some trucks, air/exhaust heat exchanger would be needed due to space constraints. This study provides guidelines for the design of the exhaust system to accommodate converter and EGR operation at the highest performance.

PTO Dyno



This power-take-off dyno is capable of absorbing up to 500 horsepower. A replacement drive shaft on the tractor connects the transmission output directly to the dyno bypassing the rear drive axle. This arrangement allows chassis emission testing work without reliance on wheels, which is very convenient for our work and in-house testing. The PTO dyno and related setups allow for the testing of chassis test cycles such as the UDDS, and New York bus cycle.