



**Evaluation of Advanced PM and/or Nox Aftertreatment for  
Small Off-Road Diesel Engines**

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## Outline

- Experimental Methods
- Modification of Mini Excavator
- Dosing System Specifications
- Modification Challenges
- Pending Results

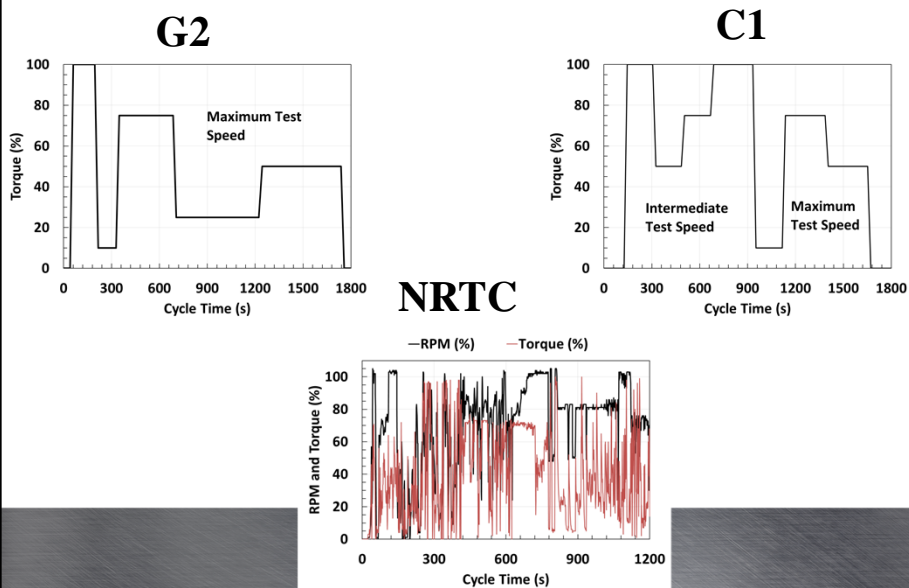


## Abstract

- Small Off-Road Diesel Engines comprise approximately 20-40% of all off-road diesels in California
- Were able to meet Tier 4 standards adopted in 2004 without aftertreatment for Nox below 75 hp and PM below 25hp
- Study designed to evaluate the potential effectiveness, feasibility, and cost effectiveness for implementing aftertreatment-based standards on mobile off-road engines



## Experimental Methods



## Experimental Methods

System	TRU	Riding Mower	Mini-excavator	Skid Steer
<b>System information</b>				
Engine Vendor	Yanmar	Yanmar	Kubota	Doosan
Engine Family	8YDXL1.11W3N	FYDXL1.64NDA	GKBXL01.5BCB	FDICL02.4LEA
Engine Model	TK376N	3TNV88C-DJMZ	V1505	
Engine Power (hp/kw)	20.3/15.1	37.4/27.9	24.8/18.5	49.0/36.5
Aftertreatment vendor	Proventia	BASF/Donaldson/ Continental	DCL	JM/Tenneco
Aftertreatment type	DPF	SCR	DPF	SCRT
Test Cycle	G2	NRTC;C1	NRTC;C1;G2	NRTC;C1



## Experimental Methods

TRU



Riding Mower



Mini Excavator



Skid Steer

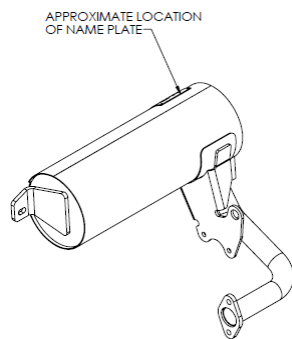


## Modification of Mini Excavator

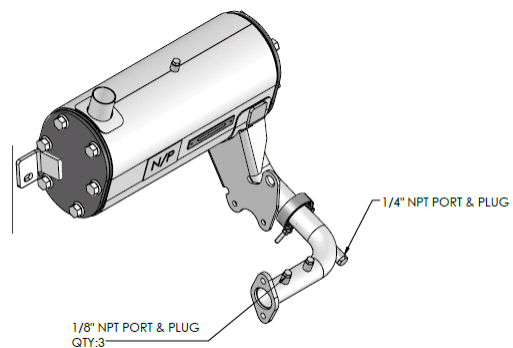
- Replace muffler with an active DPF dosing system
- Taps into fuel line to dose system, triggered by backpressure
- Injects fuel into muffler inlet
- Ignites on a PGM coated DOC to regenerate an uncoated DPF



## Modification of Mini Excavator



Original Muffler



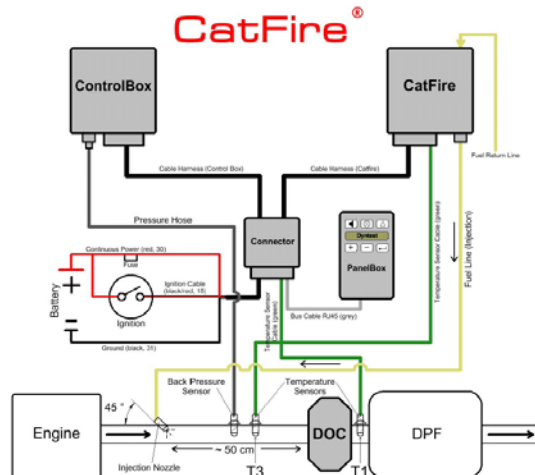
DPF Muffler



## Modification of Mini Excavator



## Dosing System Specifications



## Modification Challenges

- Muffler space too small to fit all required changes
- Original configuration had inlet and outlet on same side of muffler
- Need to tap into fuel line and reconfigure engine compartment



## Pending Results

- In field testing is still underway
- Lab testing completed for TRU and Mini-Excavator
- Preliminary results have not yet been released by the ARB

