



ADEC-II System for NOx and PM Control of In-Use Off-road Equipment

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Extengine Transport Systems

- Based in Southern California.
- Designs, assembles, and installs retrofit systems for older diesel-powered vehicles and off-road equipment.
- Developed SCR/DPF system that reduces NOx and PM emissions up to 90 percent with minimal performance or fuel consumption penalty.
- Provides field service and technical support to users.
- Presently has the only CARB-verified SCR system with NOx reduction of 80% (ADEC-1)
 - Applicable to selected Tier 0 off-road engines
 - Nearly 100 installed systems



Advantages of SCR for NO_x Reduction Combined with PM Controls

- Achieves very low emission levels
- Relatively easy retrofit installation on large equipment
- Very cost-effective for continuous duty equipment
- Additional operating cost is <5% of current fuel cost
- NO_x emission reductions may be surplus with cost of system off-set by emission credits
- Low emission levels facilitate local agency permitting



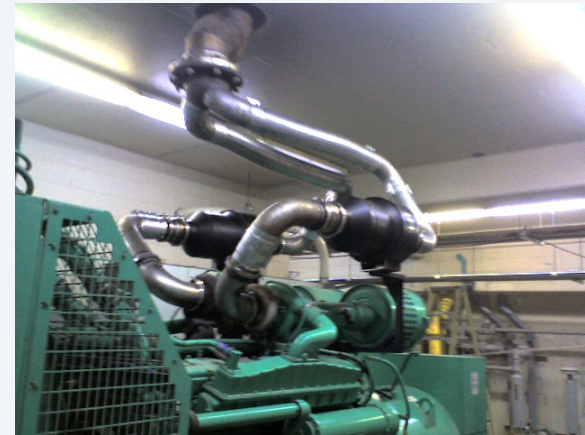
Typical Extengine Technology Performance

	PM Level	PM	NOx	HC	CO	Fuel Consumption
ADECI	I*	-28%	-88%	-97%	-95%	+1%
ADECII	III	-95%	-75%	-98%	-80%	+1%

*Verified at 25% PM and 80% NOx for selected off-road applications



Extengine ADECI DOC/SCR System





Technology Summary

ADEC II (Urea SCR system with Actively Regenerated PM Filter)

- Oxidation catalyst for NO₂ formation and PM reduction
- Precise urea injection system based on mass flow and NO_x ppm
- Non-vanadium SCR catalyst
- NO_x sensor to adjust urea injection rate
- Precise diesel fuel injection
- Fuel oxidation catalyst creates heat to regenerate filter
- Conventional silicone carbide filter element
- Production hardware used in Europe
- Verification application submitted for on-road applications and being prepared to submit for off-road applications
- Potentially universal application due to self adjustment to different engine conditions - PM >95% (Level III); NO_x >75%
- Price ranges from about \$25,000-\$40,000 for 200-500 HP engines



Typical Off-Road Emissions (175-300hp)

	NOx	PM	HC	CO
	----- g/kw-h -----			
Tier 0	11	0.5	1.3	3
Tier 1	9	0.3	0.5	2
Tier 2	6	0.2	0.1	1
Tier 3	3	0.1	0.1	1

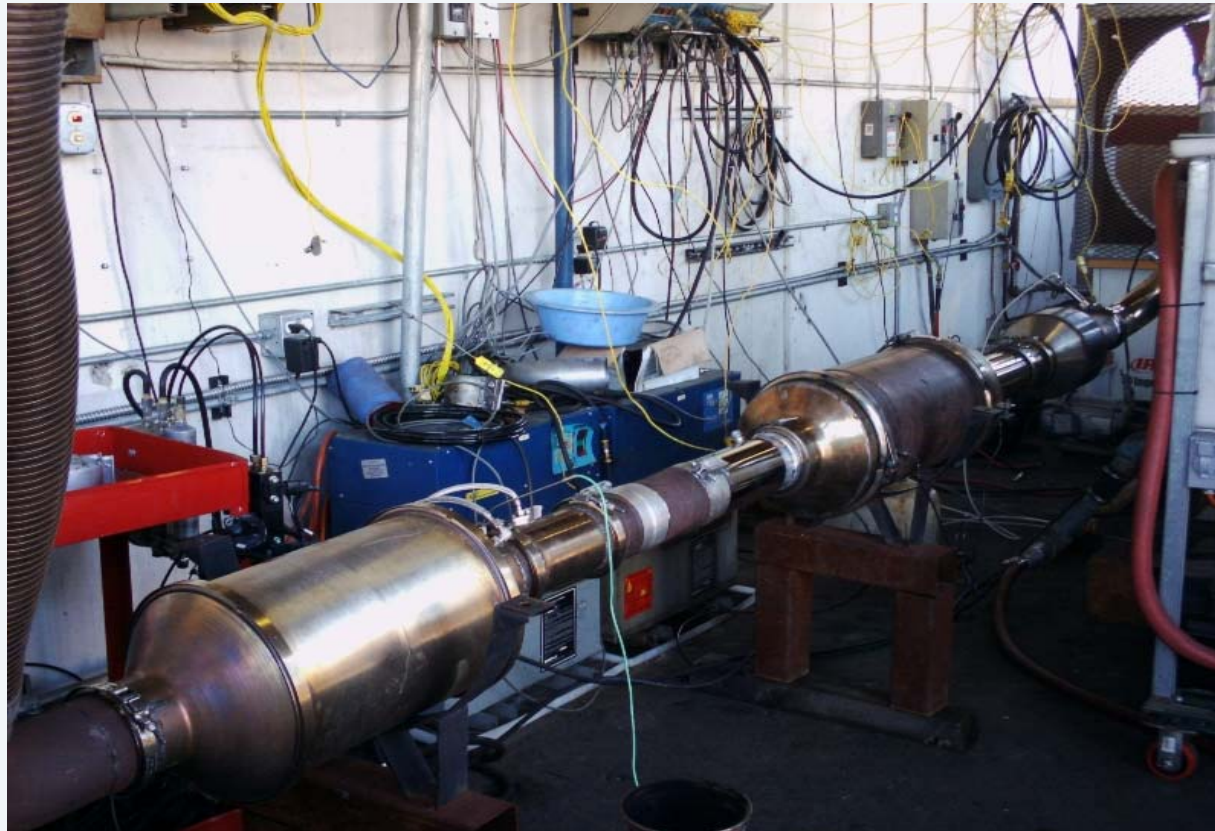


Typical Off-Road Emissions with ADECI (175-300hp)

	NOx	PM	HC	CO
	----- g/kw-h -----			
Tier 0	2.0	0.025	0.065	0.15
Tier 1	1.8	0.015	0.025	0.10
Tier 2	1.5	0.010	0.005	0.05
Tier 3	0.9	0.010	0.005	0.05

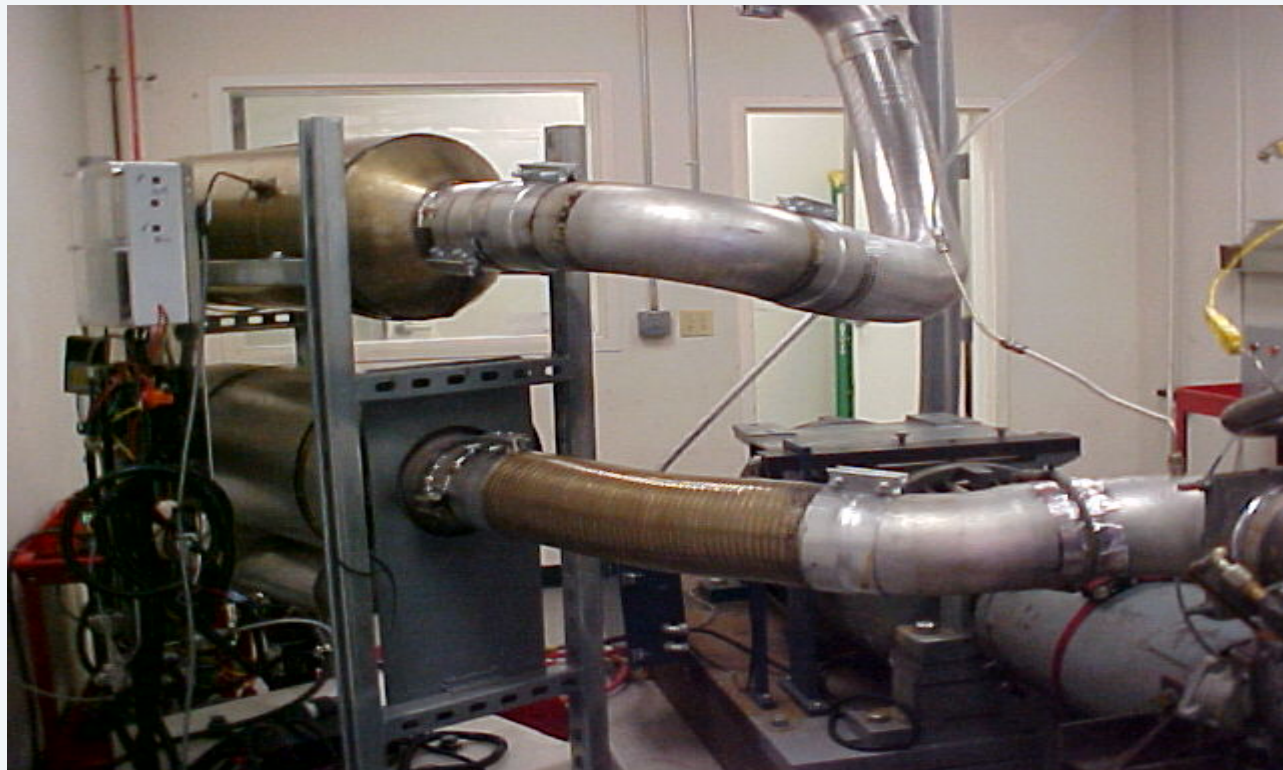


ADECII SCR/Active DPF System During Off-Road Test Procedure



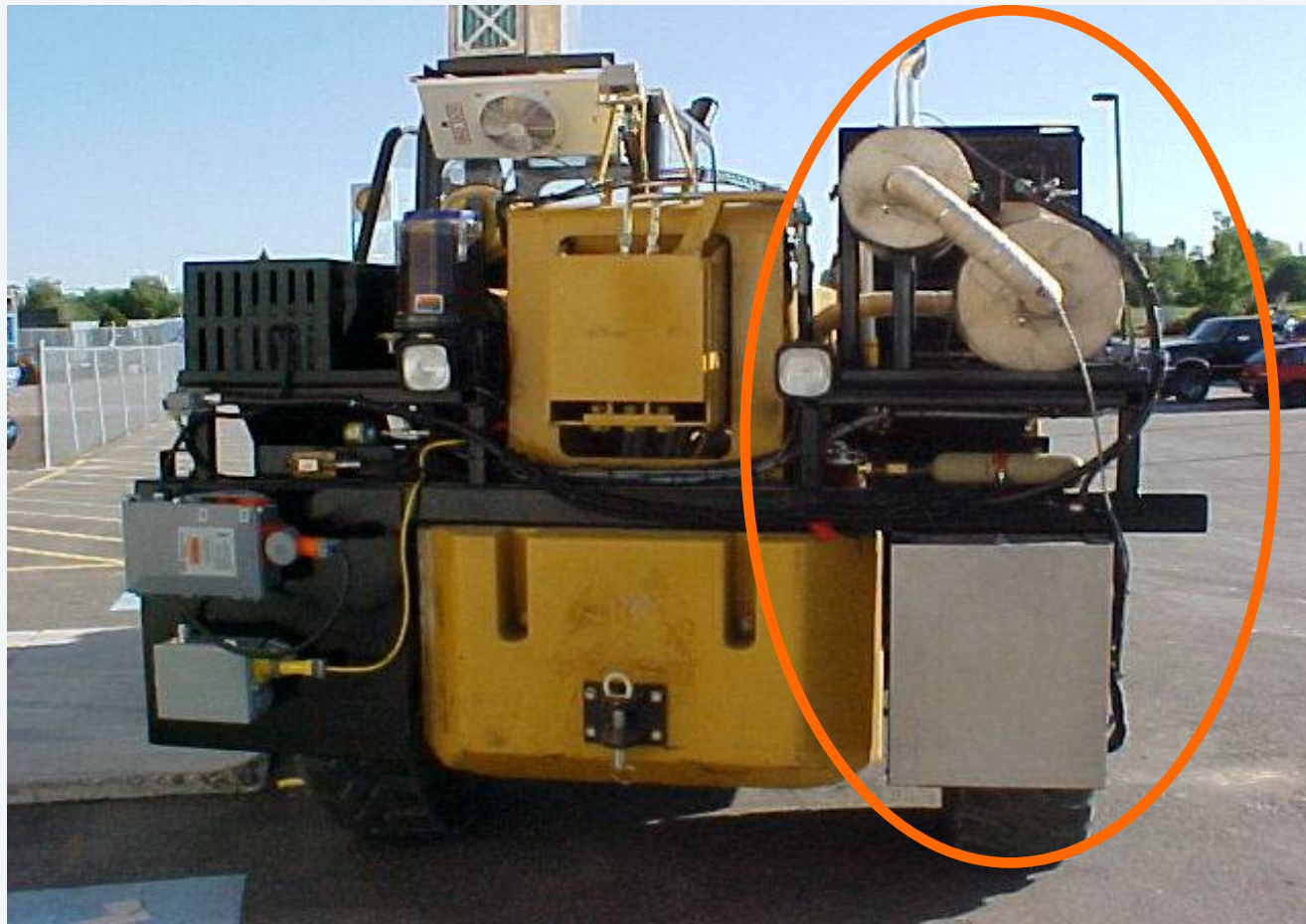


ADECII SCR/Active DPF System During On-Road Transient Test Procedure





Extengine ADECII SCR/Active DPF System Installed on Typical Front Loader





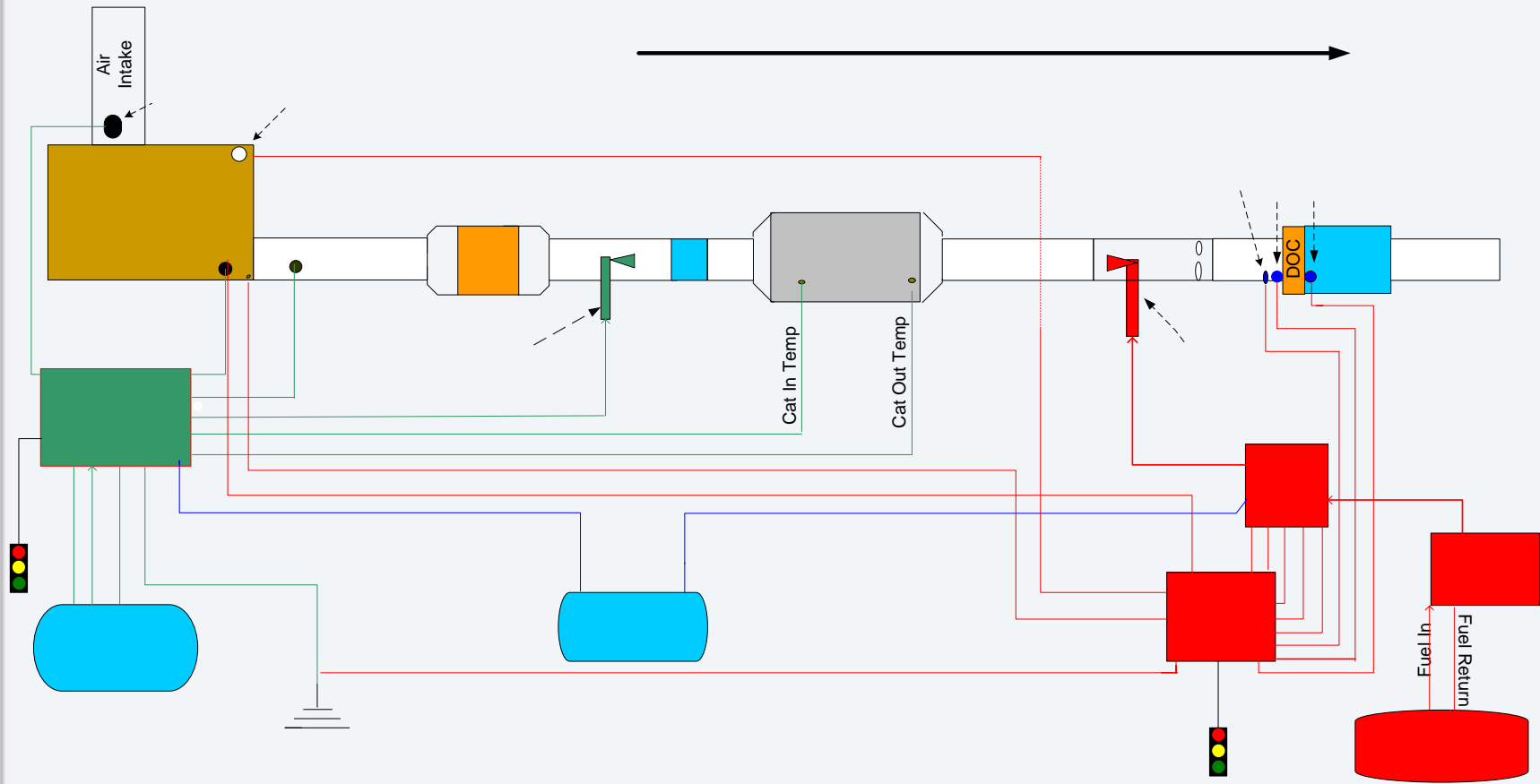
Principal ADECII SCR System Components





ADECII MaxTRAP DPF Components





MAF Sensor

Boost Pressure & Temperature Sensor



Summary

- SCR/DPF emission retrofit systems are practical for NOx and PM reduction from in-use equipment
- ADECII can be retrofitted to >150 HP equipment in 1-2 days
- Very cost-effective for continuous duty equipment
- Minor additional operating cost (fuel+urea+filter cleaning)
- Verification application in preparation for off-road equipment