

Retrofit Emission Controls for Off-Road Diesel Engines

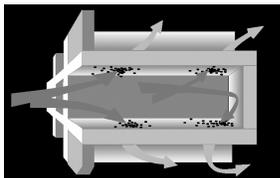
Joe Kubsh
 Manufacturers of Emission Controls Association [MECA]
 ARB Off-Road Fleet Workshops
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www.meca.org
www.dieselretrofit.org



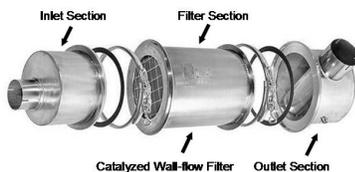
Retrofit Experience is Expanding to Off-Road Vehicle Applications



Wall Flow Filters Offer the Highest Filtration Efficiency



- > Level 3 PM reduction (>85%)
- > Large reduction in toxics from catalyzed filters
- > ARB Level 3 filters include passive & active regen.
- > > 200,000 retrofits worldwide
- > > 3 Million OE applications
- > Same technology as on 2007 OE trucks.



Passively regenerated filters employ catalysts and available exhaust heat to burn captured soot – specified exhaust temp. requirements



Horizontal and Vertical Filter Installations Possible



DPFs with Active Soot Regeneration Available for Retrofits



SOOT PARTICLE FILTER SYSTEMS
for mobile diesel engines.
(regeneration without NO_x)



- Example: uncatalyzed wall-flow filter with electrical regeneration – 1-8 hour regeneration cycle
- Example: uncatalyzed wall-flow filter with a fuel burner
- Suited for on- and off-road applications with low exhaust temperatures including locomotives & marine engines



Active DPFs in Materials Handling, Construction Equipment, and Locomotives



More Off-Road Retrofits with Active Filters



Backpressure Monitors / Loggers

- BP monitors emerging with added features
 - Extended datalogging capability (1-2 yrs)
 - BP and Temperature
 - Multi-light displays to indicate system faults, warnings and alarm conditions
 - Real time monitoring
- Systems come with software to allow data analysis

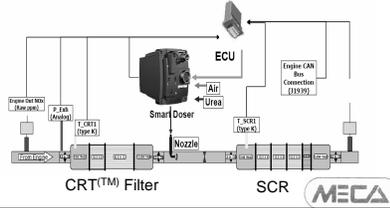


**Integrated Solutions for Combined PM/NOx Reductions
Emerging for Off-Road Retrofits**



**Lean NOx Cat. + DPF
25% NOx reduction**

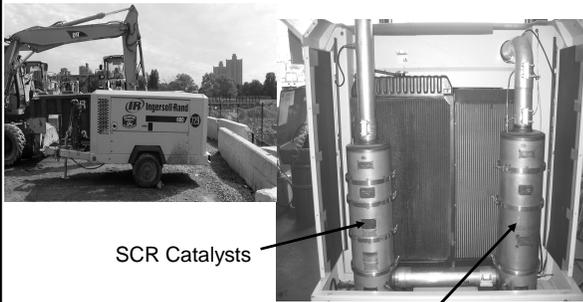
**Catalyst-based Filter +
Urea-SCR Catalyst
70+% NOx reduction**



**Off-Road Retrofit Installations of
Lean NOx Catalyst + Filter Systems**



**Air Compressor Retrofit Installation
of a Filter + SCR System**



SCR Catalysts

CRT™ Filter



**Off-Road Retrofit Experience Example:
NY City Croton Construction Project**



- \$1.5+ billion water treatment plant in the North Bronx; project extends through 2012
- 25-30 non-road machines (Tier 2 & Tier 3 engines)
- ARB or EPA verified retrofit technologies including passive & active DPFs, DPF+SCR system



“Flow-Thru” or “Partial” Filter Technologies Emerging for Diesel Retrofits



- 50-75% Level 2 PM reduction
- Can be catalyzed, used with a DOC
- Has applicability on older engines
- Resistant to plugging
- Verifications for off-road may depend on breadth of Level 3 application coverage



Challenges for Off-Road Retrofits

- More diverse engine/equipment application space than on-road
 - skewed toward older equipment
- Lack of preventative equipment maintenance
 - especially air filters, injectors and turbochargers
 - basic inspection and maintenance of installations
- Vibrations
 - can require extensive use of high grade vibration isolators especially in track drive equipment
- Maintaining driver visibility
- User interference with the installation process
 - taking short cuts to get machines done now



Key Considerations for Successful Retrofit Programs

- Application engineering – matching the right technology to the vehicle or equipment
- Proper professional installation
- On-vehicle monitors – provide important user feedback on performance
- Maintenance – vehicles & retrofit equipment require frequent inspections and maintenance; variety of filter cleaning machines available (see MECA Filter Maintenance White Paper at www.dieselfretrofit.org or www.meca.org)

➤ **Successful Retrofits Require a Team Effort Between Fleet Owners, Operators, and Technology Providers**



www.dieselfretrofit.org – your retrofit resource on the web



- Technology descriptions
- Contacts for retrofit suppliers
- Case study reports

