



Johnson Matthey
Inspiring science, enhancing life

Tier 4 Solutions for Drilling Rigs

November 2020



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SCR Systems

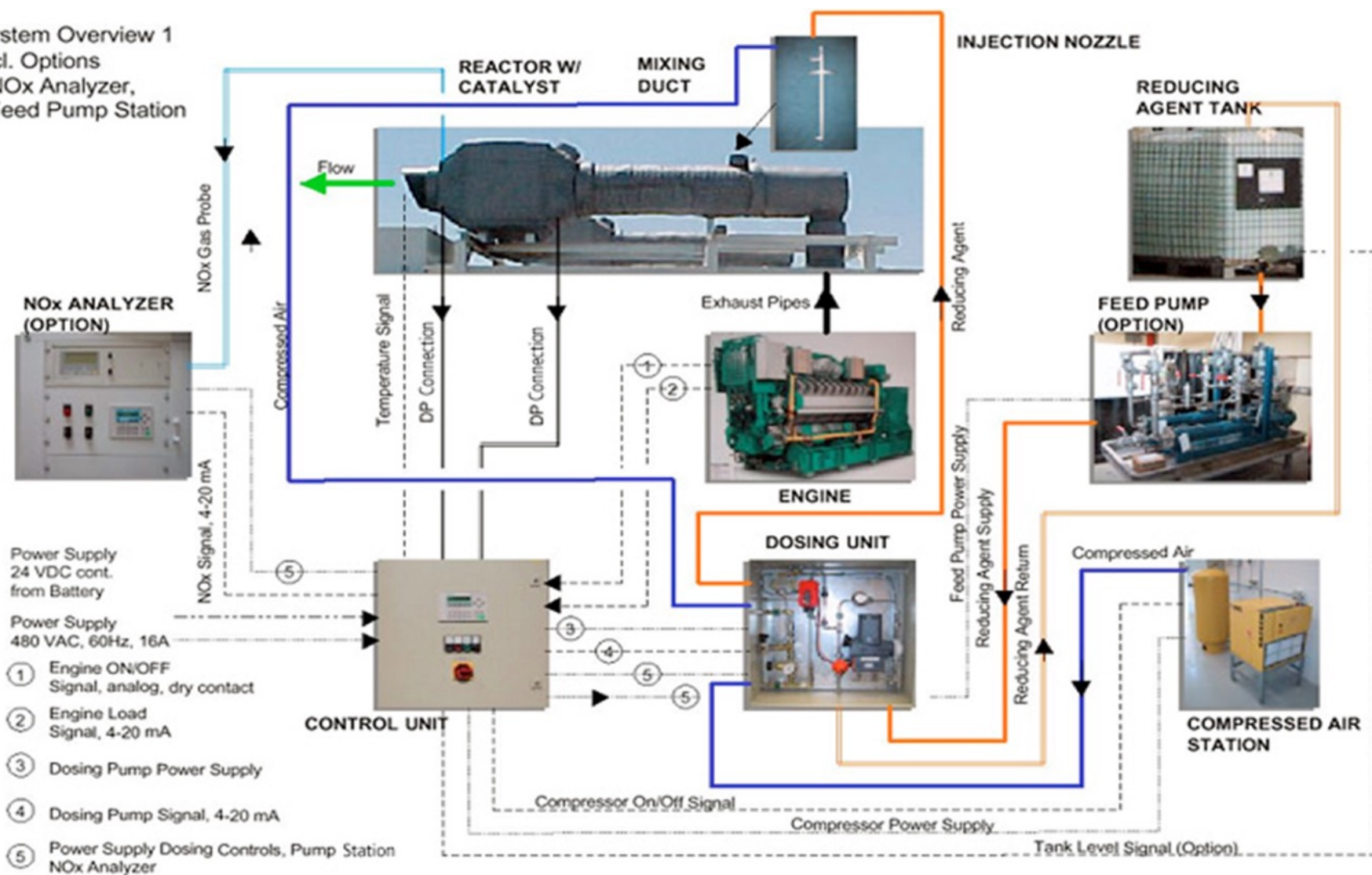
For Stationary Engines

Selective Catalytic Reduction (SCR)

- Reduce NO_x (NO + NO₂) emissions in oxygen atmosphere using a reducing agent and a catalyst:
 - Anhydrous NH₃
 - Aqueous NH₃
 - Urea
- Reduce NO_x by 95%+
- Temperature range ~550°F to ~900°F (perfect for reciprocating engines)
- Considered BACT

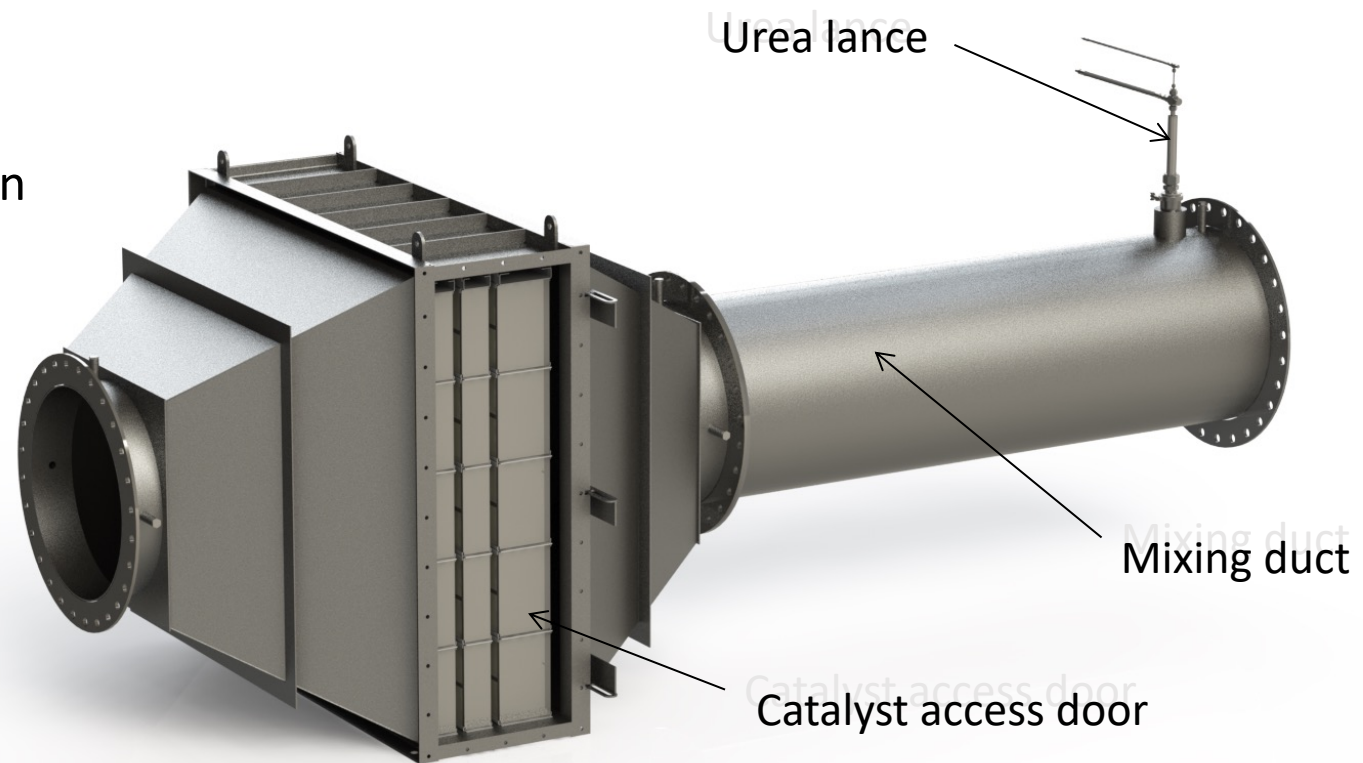
- Compare vs. Selective Non-Catalytic Reduction (SNCR)
- Reduce NO_x by 60%+
- Temperature range ~1600°F to 1800°F (too high for engines)

System Overview 1
incl. Options
- NOx Analyzer,
- Feed Pump Station



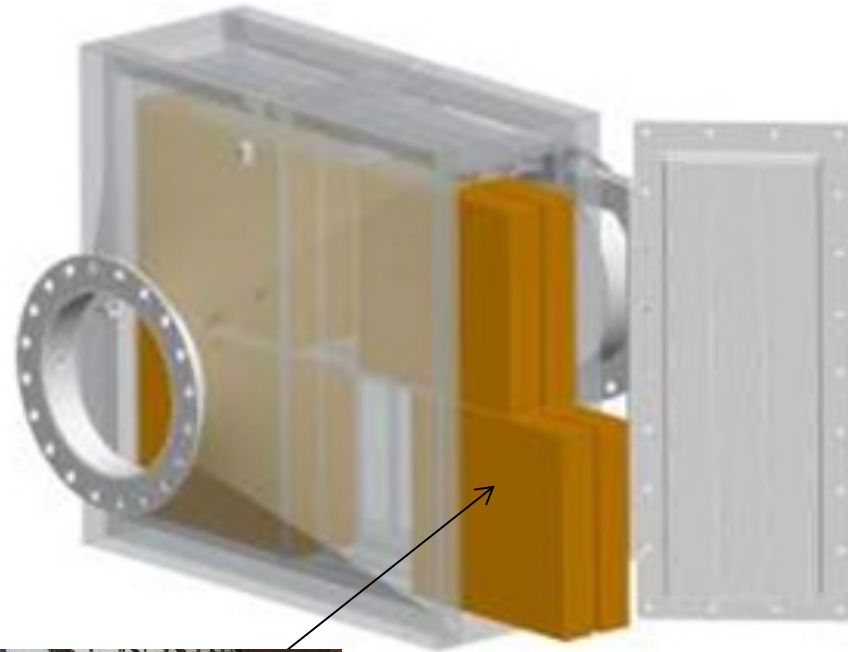
SCR Housing with Mixing Duct and Lance

Stainless Steel Construction



• Standard Specifications:

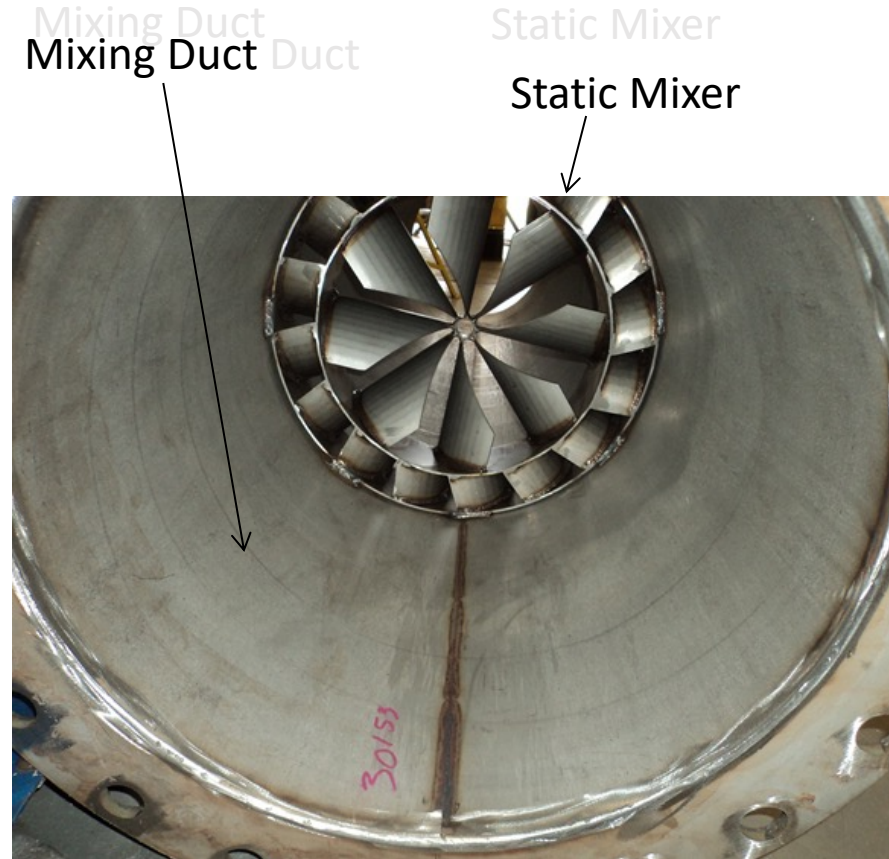
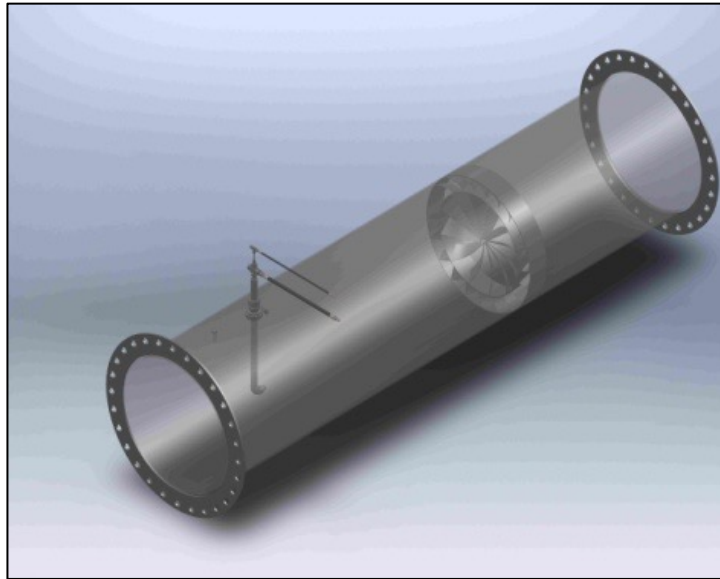
- Durable stainless steel construction
- Easy access door for inspection and maintenance
- Engineered for uniform flow distribution
- Instrumentation ports available for monitoring DP and T
- Internal catalyst tracks eliminate gasket requirements
- Extra tracks for additional catalyst for future expansion can be added



Catalyst Module and tracks

Mixing Duct

- Duct:
- **Mixing Duct:**
- Internal mixers promote uniformity
- Stainless steel for NH_3 compatibility
- Length to allow urea dissociation and proper mixing of NO_x & NH_3
- Injection lance fittings included
- Diameter varied for pressure drop



Permanent Tank →



Storage Tank Capacity is dependent on:

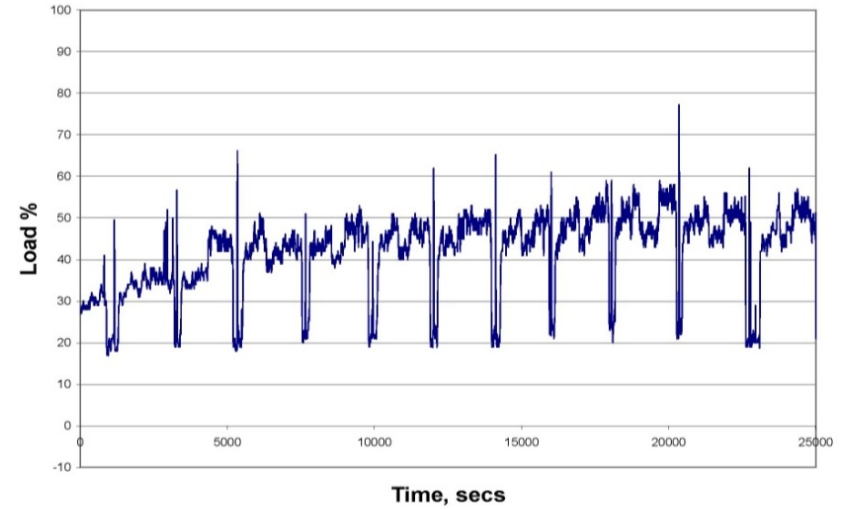
- Reducing agent usage which varies with engine load
- Allowable physical space
- Desired on-site capacity

55 Gallon Drum



← Tote Container

- Cat 3516 diesel engines
- Dynamic load following
- 90% NOx reduction
- Skid-mounted, portable
- Remote locations
- Turnkey application
- ULSD
- Predictive feed forward





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DPF Systems

For Stationary Engines

- **Verification Level:**

- Level 1: > 25% PM reduction
- Level 2: > 50% PM reduction
- Level 3: > 85% PM reduction or < 0.01 g/bhp-hr PM

- **Full Verification:** Engine test lab data and field data

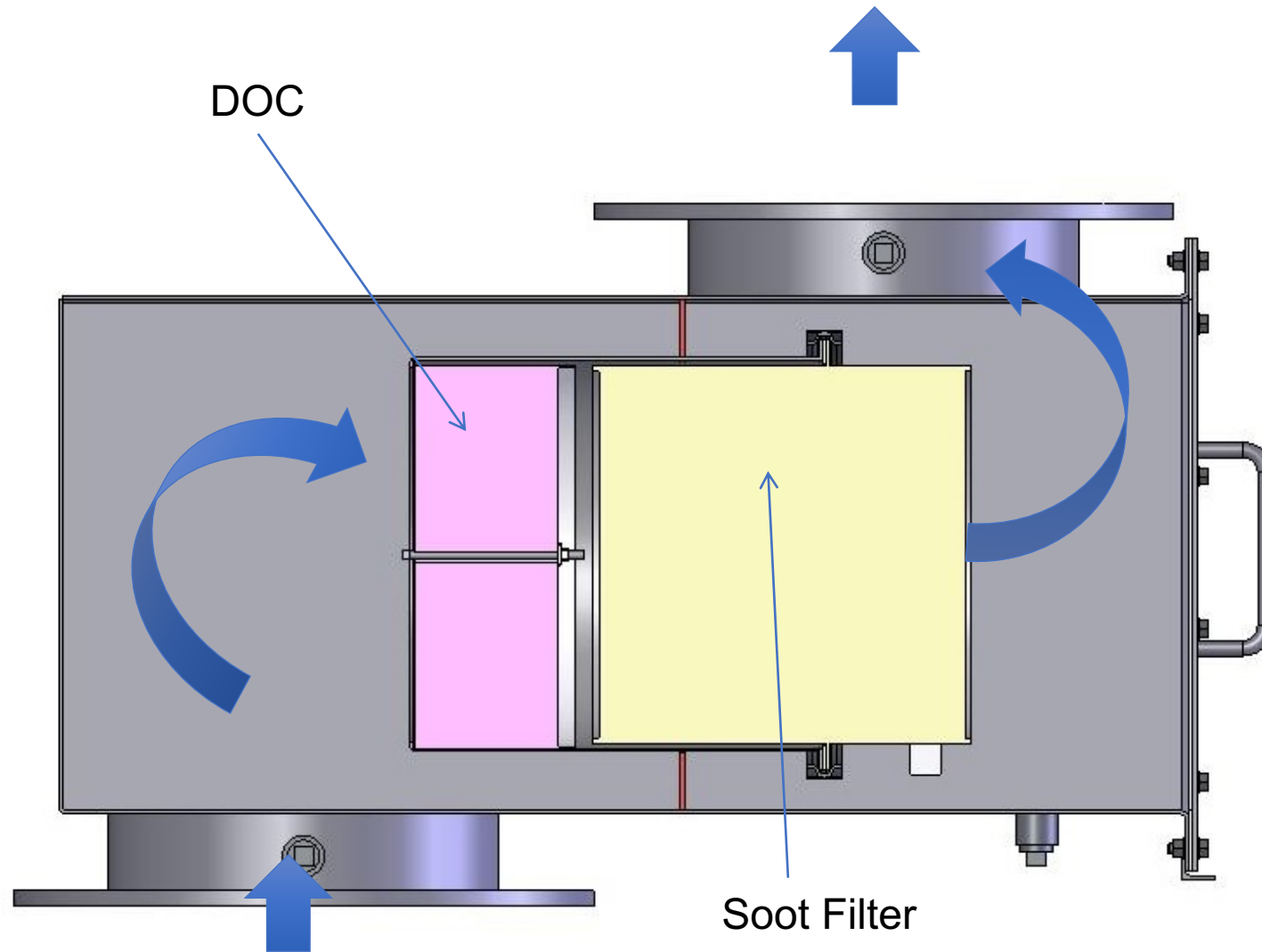
- **Conditional Verification:** Need field data

- **Engine Family Applicability:** Diesel engine families that are suitable for a CARB Verified technology

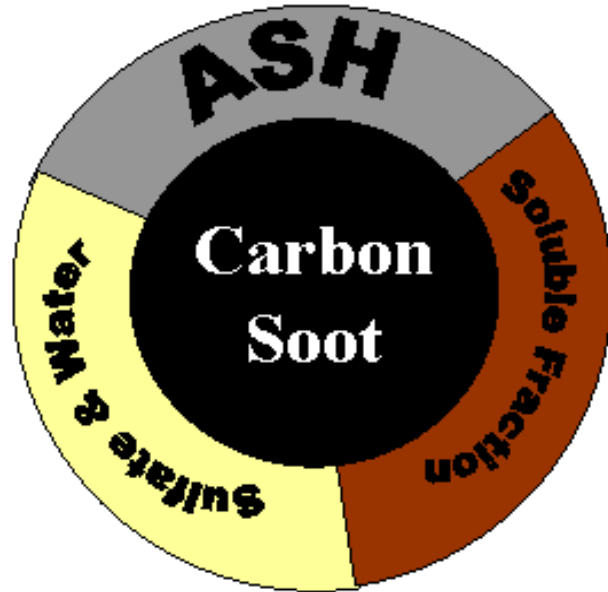
- **Cold Starts:** Number of times a standby engine is exercised before filter regeneration is required

- **Max. Idle Time:** The amount of time the engine is at idle before filter regeneration is required

- **Johnson Matthey CARB Verified CRT(+)** – Fully Verified Level 3 for prime and emergency generators with PM ≤ 0.2 g/hp-hr. Achieved 24 cold starts and idle time of 720 minutes. Largest verified engine family list.

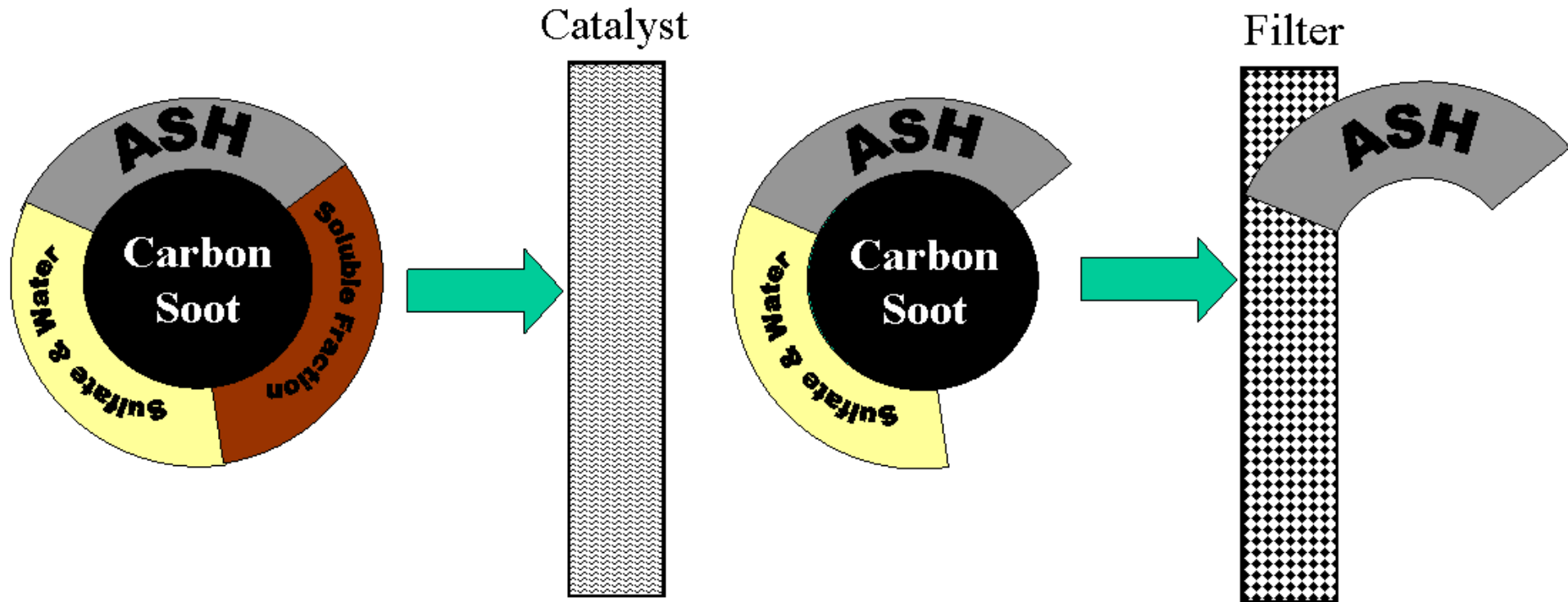


- Fine and ultra-fine particulate matter is emitted by diesel engines from incomplete combustion of the fuel. It is comprised of the following:

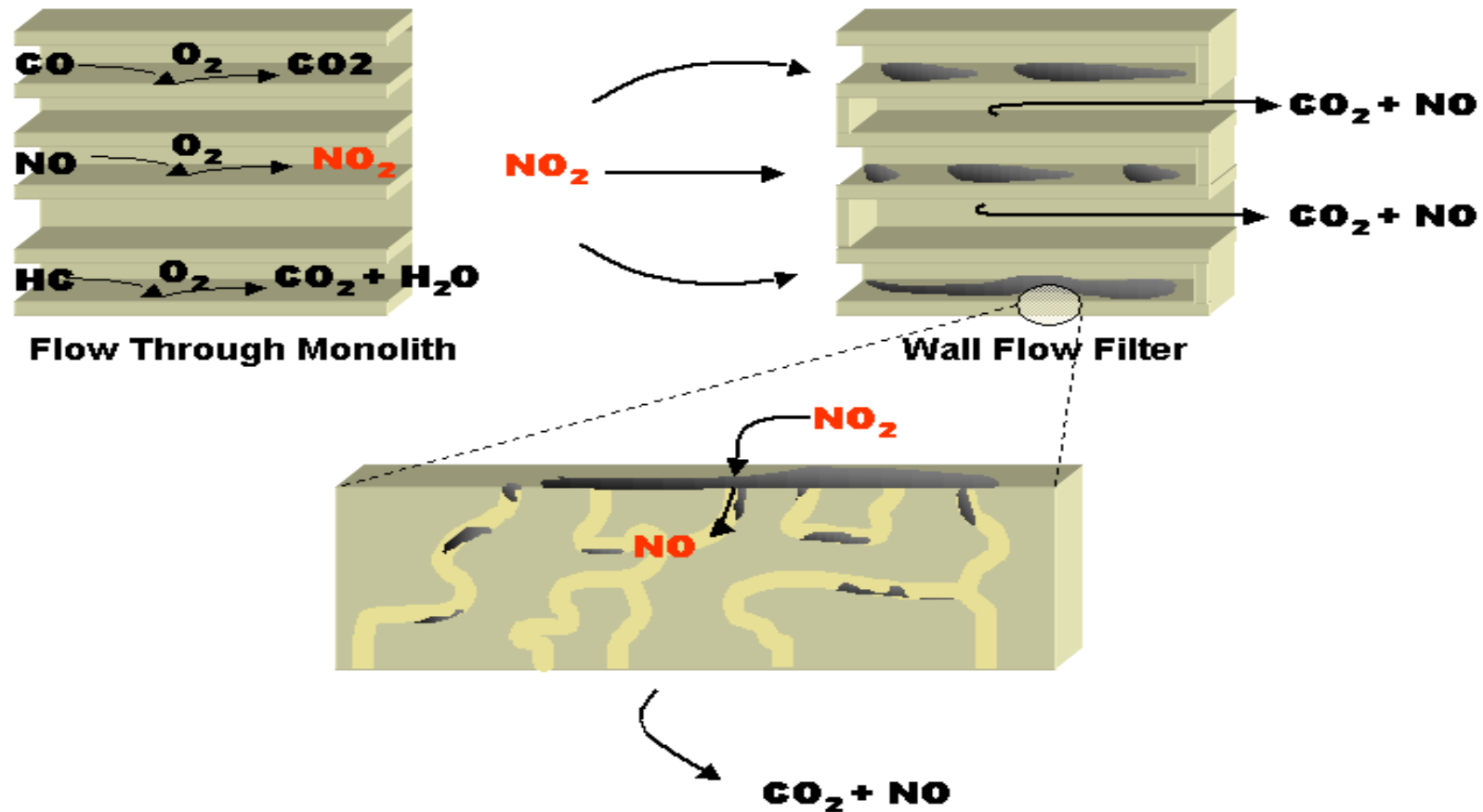


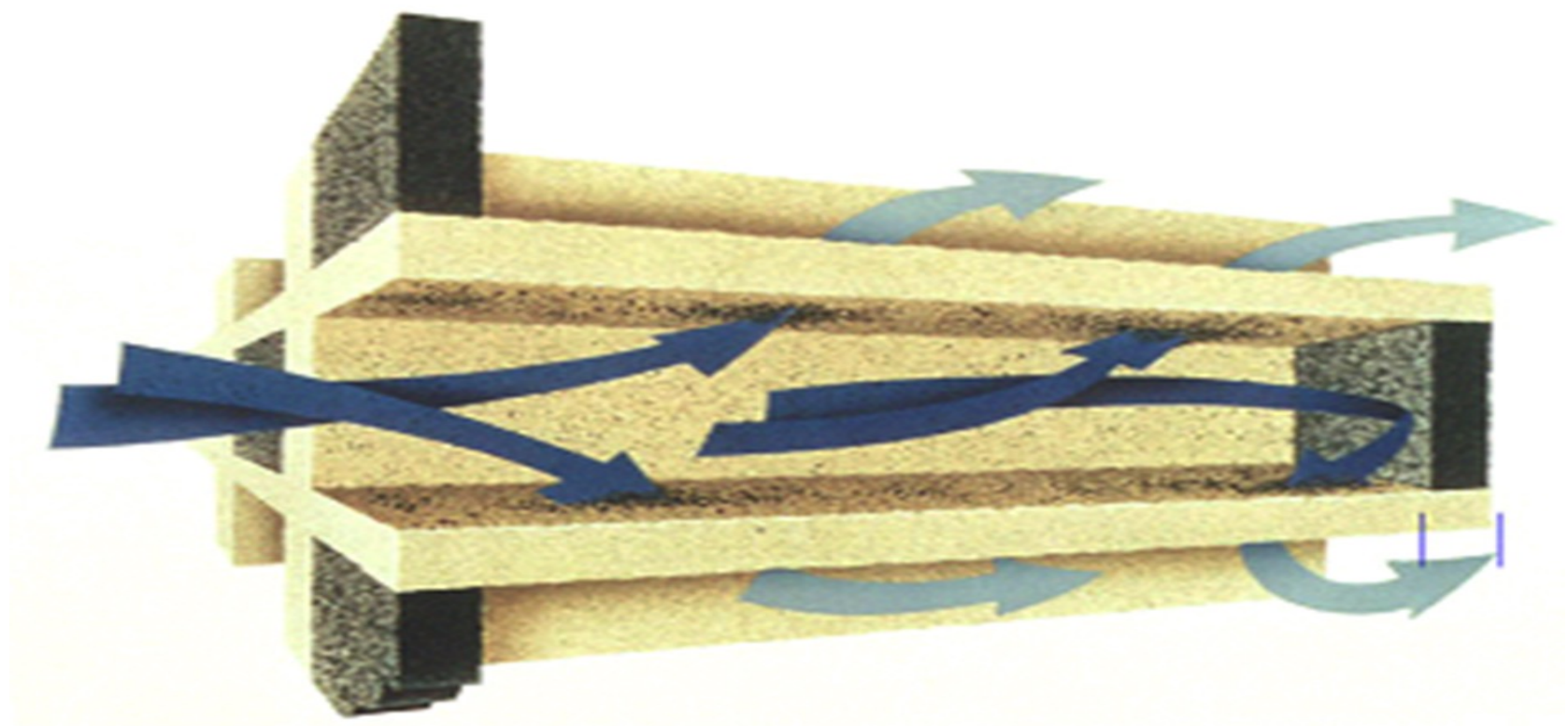
- Carbon soot
- Soluble Organic Fraction (SOF) – unburnt HC's
- Sulfate and water
- Ash (includes heavy metals)

1. DOC oxidizes the SOF to CO_2 and H_2O
2. DOC converts engine out NO to NO_2
3. Soot and ash are collected in the filter
4. The filter is regenerated by the NO_2 reacting with the soot
5. Filter is periodically cleaned to remove the ash

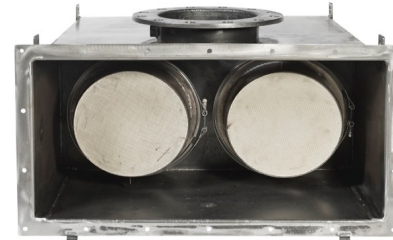


In the CRT[®], NO_2 is generated over a Diesel Oxidation Catalyst to oxidize the soot which has been trapped on the filter.





Number of DOC/Filters per DPF from 1 to 50+





Trade Names:
CRT[®], CCRT[®], L-CCRT[™]

