where public fleet professionals connect

GOVERNMENT FLEET EXPO & CONFERENCE
June 12-15, 2017
Henry B. Gonzalez Convention Center, San Antonio, TX
Matthew Szuck
Technical Project Manager, Customer Management
FPT North America, a Brand of CNH Industrial
FPT Industrial
Global Results 2016

VOLUMES

ENGINES
537,000

NON-CAPTIVE VOLUMES
57%

TRANSMISSIONS
75,000

AXLES
190,000

EMPLOYEES
8,100

SALES BY APPLICATIONS

TOTAL SALES
3.700 billion $

ON ROAD
78%

OFF ROAD
19%

POWER GENERATION
2.7%

MARINE
0.3%
FPT, a brand of CNH Industrial, powers highly respected American heritage brands such as Case and New Holland, among others. FPT North America headquarters is located in Burr Ridge, IL, a Chicago suburb. For 100 years, this facility has been a testing facility and proving ground, beginning with 414 acres owned by International Harvester and continues as CNH Industrial. This is a Research & Design facility, where we engineer, test, and develop engine prototypes. Under CNH Industrial, FPT collaborates with Case and New Holland to ensure the engine and aftertreatment systems are carefully integrated into the equipment, and maintain the reliability and durability you require.

FPT North America has a strong commitment to partnership, providing customer focused tailored solutions. With over 100 years of experience in high-power engine development, we offer product excellence in engines ranging from 120 - 810hp. Globally, we have 7 R&D centers and 1,000 engineers dedicated to development of industry-leading technology.

Our focus on innovative technology and dedication to our customers, establishes FPT as a global leading powertrain producer for applications including Agriculture, Construction, Marine, and Power Generation. Service and technical support is available through an authorized FPT network consisting of dealers and distributors across North America. To learn more about customized solutions for your business, please speak with your FPT North America Regional Sales Manager.
### Engine Portfolio

Diesel: Off-Road, On-Road, Marine, Power Generation

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>On Road Diesel</th>
<th>CNG/LNG</th>
<th>Off Road</th>
<th>Power Generation</th>
<th>Marine</th>
</tr>
</thead>
<tbody>
<tr>
<td>R22 - 3 cyl</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>F1 - 4 cyl</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5 - 4 cyl</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S8000 - 3/4 cyl</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEF - 4/6 cyl</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cursor - 6 cyl</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Liter - 8 cyl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Power (hp)

- R22: 2.2L
- F1A: 2.3L
- F1C: 3.0L
- F5: 3.4L
- S8000: 2.9L (2.9L)
- S8000: 3.9L (3.9L)
- NEF 6: 6.7L
- NEF 4: 4.5L
- C8: 7.8L
- C9: 8.7L
- C10: 10.3L
- C11: 12.9L
- C13: 15.9L
- C16: 20L

Displacement (liters)

- R22: 2.2L
- F1A: 2.3L
- F1C: 3.0L
- F5: 3.4L
- S8000: 2.9L
- S8000: 3.9L
- NEF 6: 6.7L
- NEF 4: 4.5L
- C8: 7.8L
- C9: 8.7L
- C10: 10.3L
- C11: 12.9L
- C13: 15.9L
- C16: 20L

- NEW: Indicates new models added to the portfolio.
Off-Road Emission Legislation

**Emission standard**
- **2006**: Stage IIIA Tier 3
- **2011**: Stage IIIB Tier 4A
- **2014**: Stage IV Tier 4B

**NOx/PM management**
- **2006**: NO ATS needed
- **2011**: ATS introduction
- **2014**: SCR mandatory
  - Common Rail introduction, more complex Turbo
  - Needed to cope with emission limits reduction
- ATS efficiency improvement to cope with further NOx reduction

**Emission limits reduction**
- **2006**: PM -63%, NOx -57%
- **2011**: PM -90%, NOx -50%
- **2014**: PM 0%, NOx -80%

**FPT Technology**
- **P<56kW**: I-EGR
- **P>56kW**: ecEGR+DOC+DPF
  - I-EGR+DOC+PMCAT
- F5C: ecEGR+DOC+SCR (HI-Compact SCR)
- NEF/CURSOR: DOC+SCR (HI-eSCR)

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Technology Drivers for Tier 4 / Stage IV

- **High EGR rates** (→ high heat rejection)
- **DPF with active regeneration**
- **SCR (85% efficiency)**

- **High EGR rates** (→ high heat rejection)
- **DPF with active regeneration**
- **SCR (85% efficiency)**

- **Improved Operating Cost (Fuel + AdBlue)**

- **PM & BSFC optimized combustion**
- **Higher SCR efficiency due to no active DPF regen.**
- **Feasible with current displacements and turbo tech.**
- **No impact on vehicle cooling system**

<table>
<thead>
<tr>
<th>Tier</th>
<th>PM (g/kWh)</th>
<th>NOX (g/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 3</td>
<td>0.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Tier 4A</td>
<td>0.02</td>
<td>2.0</td>
</tr>
<tr>
<td>Tier 4B</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**High EGR** (to increase temperature for RGN)

- **High EGR rates** (→ high heat rejection)
- **DPF with active regeneration**
- **SCR (85% efficiency)**

- **Low temp flow**
- **High temp flow**
- **HCl** (to increase temperature for RGN)
FPT Aftertreatment Critical Components

Hi-eSCR

AdBlue/DEF

DOC

CO

HC

NOx

N2

CO2

H2O

Coolant connector

Valve keeper AdBlue connector

Electrical connector

cooling adapter

Heat shield

Pressure compensation membrane

Electrical connector Tyco

Cover

Coolant water connector

AdBlue connectors

Fixation points

Water heater

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Aftertreatment System Layout

New content for Tier 4F

Engine

ECU

NH₃ sensor

NOₓ sensor

intake air humidity & temp. sensor

Air filter

Exhaust flap

SCR+CUC

DOC upstream

temp. sensor

NOx sensor

temp. sensor

DOC upstream

temp. sensor

DEF mixer

Dosing Module

DEF quality sensor

DEF level & temp. sensor

DEF tank

3-way coolant shut-off valve

Exhaust Gas Flow Direction

Coolant line

AdBlue Line

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## Standard Tier 4F N67 Maintenance Intervals

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>hours (km)</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil drain interval</td>
<td>600 hrs or 1 year</td>
<td></td>
</tr>
<tr>
<td>Oil filter change</td>
<td>600 hrs or 1 year</td>
<td></td>
</tr>
<tr>
<td>Oil refilling time</td>
<td>Daily check to evaluate oil refill necessity</td>
<td></td>
</tr>
<tr>
<td>CCV filter change</td>
<td>1500 hrs 1 year</td>
<td></td>
</tr>
<tr>
<td>Fuel filter change</td>
<td>600 hrs 1 year</td>
<td></td>
</tr>
<tr>
<td>Fuel pre-filter change</td>
<td>600 hrs or 2 year</td>
<td></td>
</tr>
<tr>
<td>Belt replacement</td>
<td>1200 hrs</td>
<td></td>
</tr>
<tr>
<td>Valve lash check / adjustment</td>
<td>2400</td>
<td></td>
</tr>
<tr>
<td>AdBlue filter Change</td>
<td>1200 hrs</td>
<td></td>
</tr>
<tr>
<td>DPF filter service</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Coolant change</td>
<td>3000</td>
<td></td>
</tr>
</tbody>
</table>

*Serviceability for CE application

-100 hrs versus std application

### Oil Change Recommendations

- **0W-40 CJ-4 UNITEK to CNH MAT3521**
- **10W-40 CJ-4 UNITEK to CNH MAT3521**
- **15W-40 CJ-4 to MAT3522**

**H** = ENGINE OIL PAN OR COOLANT BLOCK HEATER RECOMMENDED IN THIS RANGE

* = REQUIRES A 50% REDUCTION IN OIL CHANGE INTERVALS

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**GFX**

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Tier 4 Final Mission Profiles
**FUTURE Off-Road Emission Legislation**

<table>
<thead>
<tr>
<th>Emission standard</th>
<th>Stage IIIA</th>
<th>Stage IIIB</th>
<th>Stage IV</th>
<th>Stage V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tier 3</td>
<td>Tier 4A</td>
<td>Tier 4B</td>
<td></td>
</tr>
</tbody>
</table>

**NOx/PM management**

- **PM** -63%
- **PM** -90%
- **PM** 0%
- **PM** -40%
- **PM** -40%
- **PM** -40%

- **NOx** -57%
- **NOx** -50%
- **NOx** -80%
- **NOx** 0%
- **NOx** 0%
- **NOx** 0%

**Emission limits reduction**

- Stage IIIA: Common Rail introduction, more complex turbo
- Stage IIIB: Needed to cope with emission limits reduction
- Stage IV: ATS efficiency improvement to cope with further NOx reduction
- Stage V: PM further reduction and Particulate Number (PN) limit introduction

**FPT Technology**

- **P<56kW**
  - I-EGR
  - ecEGR+DOC+DPF
  - ecEGR+DOC+PMCAT
  - ecEGR+DOC+DPF

- **P>56kW**
  - I-EGR
  - SCR
  - F5C: ecEGR+DOC+SCR (HI-Compact SCR)
  - NEF/CURSOR: DOC+SCR (HI-eSCR)
  - F5C: ecEGR+DOC+SCRoF
  - NEF/CURSOR: DOC+SCRoF (HI-eSCR 2)

Stage V PM reduction requires the adoption of a particulate filter.

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<table>
<thead>
<tr>
<th>Power Range</th>
<th>Stage IV</th>
<th>Stage V</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&lt;56 kW</td>
<td>R22</td>
<td>EGR+DOC+DPF</td>
</tr>
<tr>
<td></td>
<td>F5</td>
<td>• Replace PMCat with particulate filtration device</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New ECU</td>
</tr>
<tr>
<td>56&lt;P&lt;560 kW</td>
<td>F5</td>
<td>EGR+DOC+SCR</td>
</tr>
<tr>
<td></td>
<td>NEF, CURSOR</td>
<td>• Add particulate filtration device</td>
</tr>
<tr>
<td></td>
<td>DOC+SCR (HI-eSCR)</td>
<td>• New calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New ECU</td>
</tr>
<tr>
<td>P&gt;560 kW</td>
<td>None</td>
<td>SCR</td>
</tr>
<tr>
<td></td>
<td>CURSOR</td>
<td>• Add SCR device</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New ECU</td>
</tr>
</tbody>
</table>
Stage IV to Stage V Target Technology Path

High Efficiency SCR on Filter

is the FPT TARGET SOLUTION for Stage V compliance, allowing NEF and Cursor engines (up to 560 kW) to keep competitive advantage on the market

- SAME ATS DIMENSIONS, EASE OF INSTALLATION
- UNAFFECTED ENGINE PERFORMANCE
- MAINTENANCE FREE SYSTEM FOR MAXIMIZED VEHICLE UPTIME
- LOW FLUID CONSUMPTION & OPERATING COSTS
- NO COMPROMISES IN VEHICLE PRODUCTIVITY

<table>
<thead>
<tr>
<th>EGR+DOC+DPF</th>
<th>Stage V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace PMCat with particulate filtration device</td>
<td></td>
</tr>
<tr>
<td>New calibration</td>
<td></td>
</tr>
<tr>
<td>New ECU</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EGR+DOC +SCRoF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add particulate filtration device</td>
</tr>
<tr>
<td>New calibration</td>
</tr>
<tr>
<td>New ECU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DOC+SCRoF (HI-eSCR 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add SCR device</td>
</tr>
<tr>
<td>New calibration</td>
</tr>
<tr>
<td>New ECU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add SCR device</td>
</tr>
<tr>
<td>New calibration</td>
</tr>
<tr>
<td>New ECU</td>
</tr>
</tbody>
</table>

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Stage V technology will require:

- new ATS SCRoF (new technology)
- new ECU to manage SCRoF

ATS: SCRoF
ATS: SCR (P>560kW)

DOC (Diesel Oxidation Catalyst) → oxidation of CO and HC
SCR (Selective Catalytic Reduction) → NOx reduction
CUC (Clean-Up Catalyst) → Residual ammonia oxidation
SCRoF (SCR on Filter) → NOx reduction, PM trapping and regeneration
Stage V Solution – High Efficiency SCRoF
FPT target technology for NEF & Cursor engines (P>56 kW)

Stage IV
- SCR

Stage V
- SCRoF

Ceramic substrate with open channels and SCR coating
Ceramic substrate with alternatively closed channels and SCR coating

SCR (Selective Catalytic Reduction) \(\rightarrow\) NO\(_x\) reduction
CUC (Clean-Up Catalyst) \(\rightarrow\) Residual ammonia oxidation
SCRoF (SCR on Filter) \(\rightarrow\) NO\(_x\) reduction, PM trapping and regeneration

DEF
HI-eSCR
SCR+CUC
DOC
CUC