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Tier 4 Industrial Engine Technology

Andrew Suda
MTU Detroit Diesel – Sr. Manager, Industrial, Mining and Rail Sales Engineering
October 5, 2010




Power. Passion. Partnership.

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Today's Agenda

- 01 Tognum / MTU History
- 02 T4 Emission Strategy
- 03 MTU Detroit Diesel Engine Line



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Tognum History

mtu

Airship

Maybach Motorenbau

Railroad engine

MB series 836

series 60

S149 Heavy Hauler

1938

Worldwide World engine

Tognum

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Tognum – Production Facilities Worldwide

Plant I - Friedrichshafen

Plant II - Friedrichshafen

Mannheim

Detroit

Suzhou


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Today's Agenda.

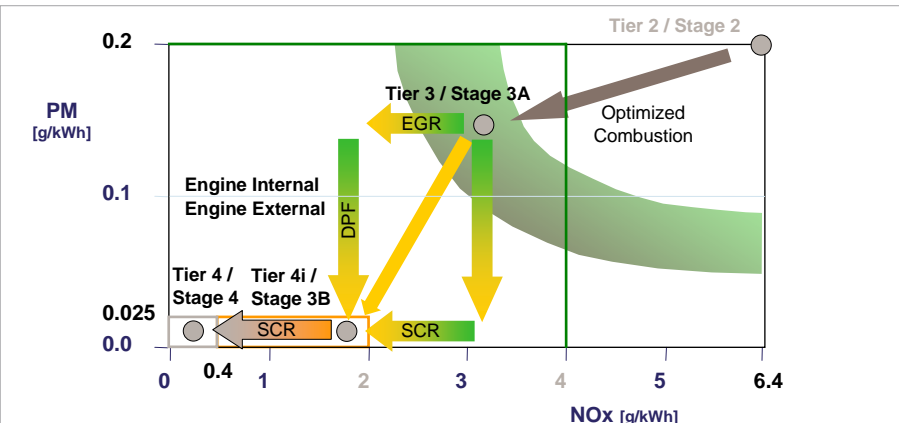
- 01 MTU History
- 02 T4i Emission Strategy
- 03 MTU Detroit Diesel Engine Line

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Exhaust Emission Reduction Strategies for NO_x and Particulate Matter



❖ For engines < 750hp

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Emission Design Variables

This strategy results in SCR requirement
Fuel consumption remains lower

The chart displays three vertical bars representing different emission variables. The first bar, 'Fuel Consumption', is blue and is the shortest. The second bar, 'Particulates', is purple and is also short. The third bar, 'NOx', is yellow and is the tallest, with a black upward-pointing arrow inside it. The bars are set against a background of horizontal grid lines. The label 'T4i' is positioned to the right of the bars.

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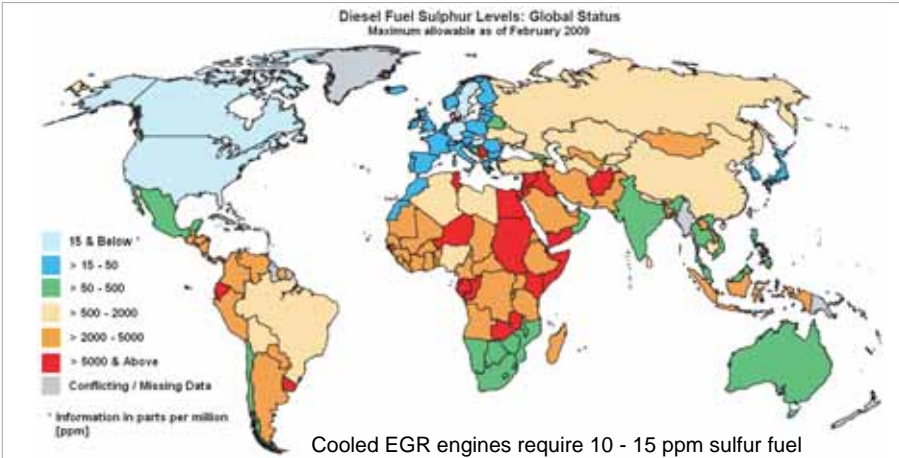
SCR and EGR Pros and Cons

SCR System	EGR with DPF
<div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-right: 5px;">+</div> <ul style="list-style-type: none"> Improved fuel efficiency (reported up to 5%) Minimal increase in heat rejection Passive operation All worldwide fuels acceptable Maintenance friendly </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-right: 5px;">-</div> <ul style="list-style-type: none"> DEF requirement Compressed air requirement </div>	<div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-right: 5px;">+</div> <ul style="list-style-type: none"> EGR already in use No DEF necessary </div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-right: 5px;">-</div> <ul style="list-style-type: none"> Greater than 20% increase in heat rejection = new higher-volume radiator design needed DPF Regen strategy different for individual applications = potential down time Ultra Low-sulphur diesel requirement Reduced oil change intervals due to higher soot content Potential DPF maintenance Potential Fuel Consumption Increase </div>

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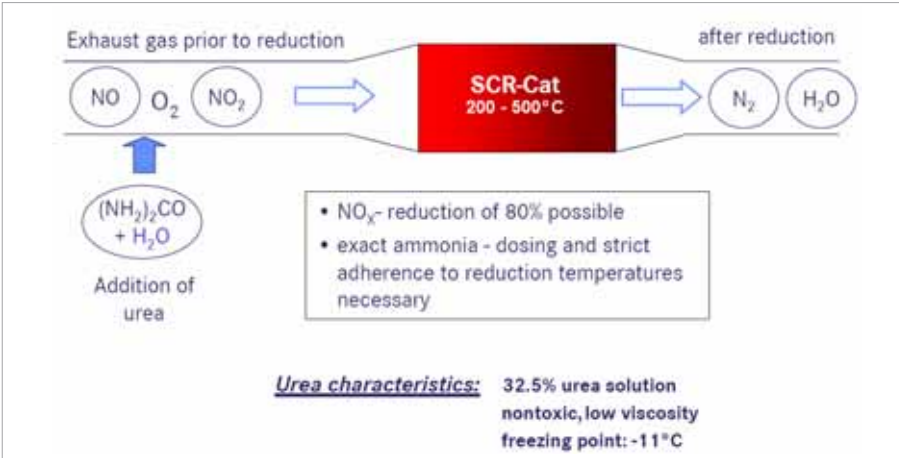
Diesel Fuel Quality



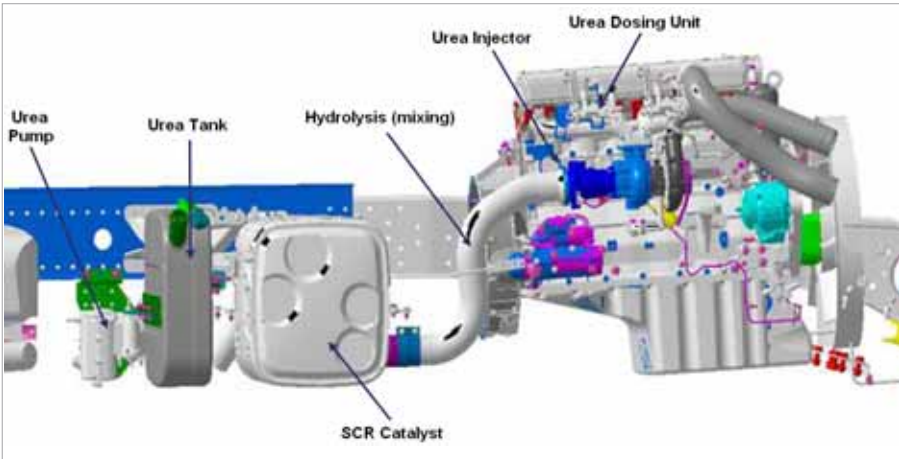
DEF Market Proliferation North America Today



Selective Catalytic Reduction (SCR)




SCR Typical Components



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T4 Interim

- S900 SCR
- S460 SCR
- S500 SCR
- S60 (Tier 2 MSHA or Tier 3 EPA)

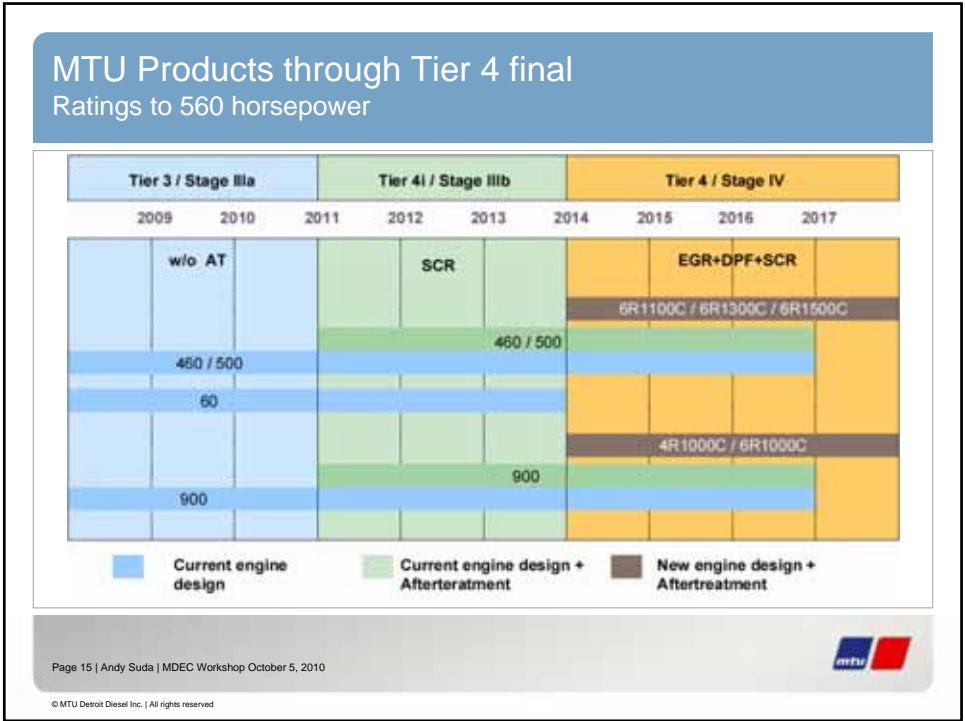
T4 Final

- S1000 SCR + EGR / DPF
- S1100 SCR + EGR / DPF
- S1300 SCR + EGR / DPF
- S1500 SCR + EGR / DPF

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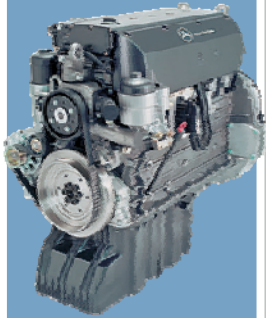


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Series 900


Tier 2 + MSHA
Tier 3 + MSHA
Tier 4 interim



101 to 322 hp


- Inline 4 and 6 cylinder
- Over 500,000 engines in service worldwide
- Over 125,000 engines in North America
- Proven in UGM applications
- No EGR or aftertreatment for off-highway engines (Tier 3)
- SCR only for Tier 4 interim
- T4i catalyst - multiple variations available
- No additional operator training required
- FAME (DIN EN14214) approved

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Series 460
Tier 3
Tier 4 interim



323 to 483 hp


- Inline 6 cylinder
- 70,000 Engines in Service Worldwide
- Utilized in Combines, Cranes, etc
- No EGR or aftertreatment for off-highway engines (Tier 3)
- SCR only for Tier 4 interim
- No additional operator training required
- FAME (DIN EN14214) approved

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Series 500
Tier 3
Tier 4 interim



308 to 660 hp

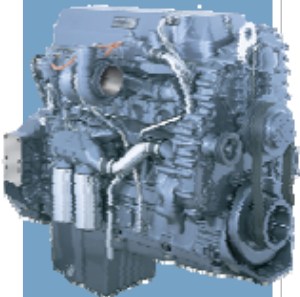
- V6 and V8 configuration
- 70,000 Engines in Service Worldwide
- Utilized in Combines, Cranes, etc
- No EGR or aftertreatment for off-highway engines (Tier 3)
- SCR only for Tier 4 interim
- No additional operator training required
- FAME (DIN EN14214) approved

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Series 60
Tier 2 + MSHA
Tier 3



300 to 575 hp


- Inline 6 cylinder
- Extremely Popular in North America
- Proven in UGM applications
- 12.7L and 14L for Tier 2 + MSHA
- 14L Tier 3
- DDEC V Electronics

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Series 1000
Tier 4 final



134 to 348 hp


- Inline 4 and 6 cylinder
- New engine design
- Common rail fuel system
- EGR with controlled recirculation rate
- DPF
- SCR
- Single or dual stage turbocharging (depends on rating)
- Wastegated fixed geometry turbos
- FAME (DIN EN14214) approved up to 7%

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Series 1100
Series 1300
Series 1500
Tier 4 final



375 to 620 hp







- Inline 6 cylinder
- 10.6 ltr, 12.8 ltr, 15.6 ltr
- New engine design
- 4 ½ years of testing and development
- 5.6 million miles of testing (on-highway)
- Engineered for 2010 on-highway emissions
- EGR with electronically controlled recirculation rate
- DPF
- SCR
- FAME (DIN EN14214) approved up to 7%

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Catalyst Changes – Tier 4 interim to Tier 4 final 6 Cylinder

Change Tier4 → Tier4i		DEF injection in catalyst		DEF injection in catalyst		DEF injection in catalyst	
Emission	Engine Type	Standard	Variant 1	Variant 1	Variant 2	Variant 2	Variant 2
Tier4i	926	 24.4 x 24 x 19.9 125 ltr	 19.3 x 13.1 x 44.7 100 ltr	 43.4 x 18.6 x 13.9 100 ltr			
Tier4	6R 1000 C	 43.2 x 33 x 22.4 ~ 340 ltr	 42.9 x 34.2 x 22.4 ~ 340 ltr	 42.9 x 32.2 x 20.5 ~ 340 ltr			

Tier 4 interim = Catalyst is ~ 27% of engine size
Tier 4 final = Catalyst is ~ 45% of engine size
L x W x H dimensions in inches

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