

SCRT[®] Technology for NO_x reduction



Public Transport Buses

HJS at a Glance



HJS Emission Technology GmbH & Co. KG, medium-sized and privately-owned. Founded in 1976. Headquarters: 58706 Menden, Germany. Employees: 500. Business fields: Exhaust-gas after treatment. Design, development, production and marketing of modular systems for reducing pollutant emissions.

The innovative environmental protection technologies are used either as original equipment or for retrofitting in passenger cars, commercial vehicles as well as in a wide range of non-road applications. In addition to systems for spark-ignition engines, HJS specializes in systems for diesel engines, predominantly for reducing the emissions of soot particles (PM) and (NO_x) nitrogen oxides.

All systems meet the statutory requirements and are certified in accordance with the valid licensing regulations. URL: www.hjs.com

An eventful history

1975	1982	1992	1995	1996	1998	1999	2000	2001
Established by Hermann Josef Schulte	Three-way catalytic converters for petrol engines	Emission reduction technology for diesel engines	Market launch in cooperation with Johnson Matthey of the UK	Retrofit catalytic converter KAT-2000	Acquisition of silencer manufacturer Schmid / Donzdorf	Market launch of closed-loop catalytic converters for retrofit applications in Beijing, China	Founding of joint venture with PUREM for development of diesel exhaust reduction systems for commercial vehicle applications (DaimlerChrysler / HJS)	SCRT® patent co-owned with (HJS/ Johnson Matthey)
Installation materials Exhaust systems			filter systems (Continuous Regeneration Technology) for reducing diesel emissions	"Automechanika Preis" award for innovative automotive technology developments	Presentation of SCRT® system (SCRT® = particulate reduction + NO _x reduction for diesel engines)			
					„BDI-Preis“ for SCRT® system (Selective Catalytic Reduction Technology)			

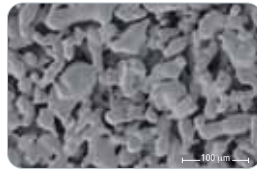
Core Competence SMF® – Sintered Metal Filter



Step 1: For further processing the high alloy metal powder is mixed with a binder



Step 2: The pourable powder mix is applied to reinforcing expanded metal



Step 3: After the sintering process the powder particles are bonded with each other and the expanded metal



Step 4: Sheets are punched out of the porous metal foil and reinforced with a hem band

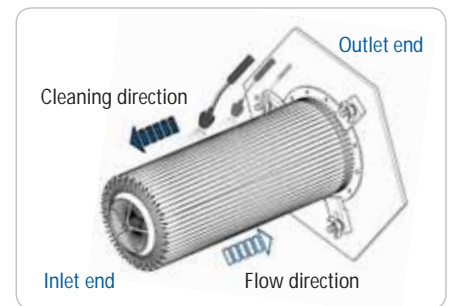


Step 5: A spacer is inserted into the filter pocket for stabilization purposes



Filter cleaning easy "DIY"

Filter system must not be replaced. Only filter units have to be demounted and to be cleaned with a normal steam blower. (10 minutes)



2002

Launch of sintered metal diesel particulate filter (Jetfilter®) - HJS grants licence for passenger car applications to Robert Bosch

2003

Deutscher Umweltpreis 2003 (German Environmental Award)

2005

Founding of subsidiary Diesel Exhaust Systems – diesel emission reduction technologies for commercial vehicle and non-road applications.

2006

"Germany – Land of Ideas" initiative sponsored by German government selects HJS as a landmark in the "Land of Ideas" for development of innovative and efficient Diesel Particulate Filter (DPF®) made of sintered metal. Sales cooperation between DES and MANN+HUMMEL – diesel emission reduction technologies for multiple non-road applications in international markets.

2008

Non-road exhaust systems – HJS patent

2010

Launch of autarkic "Standalone Exhaust-gas Afertreatment" for mobile machinery and stationary applications at bauma 2010

2011

Founding of Indian subsidiary HJS India, Pvt. Ltd.

2012

MAN Truck & Bus Supplier Award

SCRT® for public transport buses

Soot particles have been able to be filtered from diesel exhaust gases, down to the limit of detection, with the aid of an HJS sintered metal filter (SMF®) for some time now. But it's not just particulate matter that pollutes the environment and damages people's health: gaseous substances such as nitrogen oxides are also harmful. In order to reduce the levels of these gases, HJS has contributed to the development of the SCRT® (Selective Catalytic Reduction Technology) system. SCRT® combines a diesel particulate filter with an SCR unit for controlling nitrogen oxides. New buses that are already fitted with particulate filters can be retrofitted with an SCR unit to create an SCRT® system. Likewise, older vehicles without an exhaust treatment system can be retrofitted with an SCRT® system. SCRT® is currently the most effective and state-of-the-art exhaust-gas after treatment technology available.

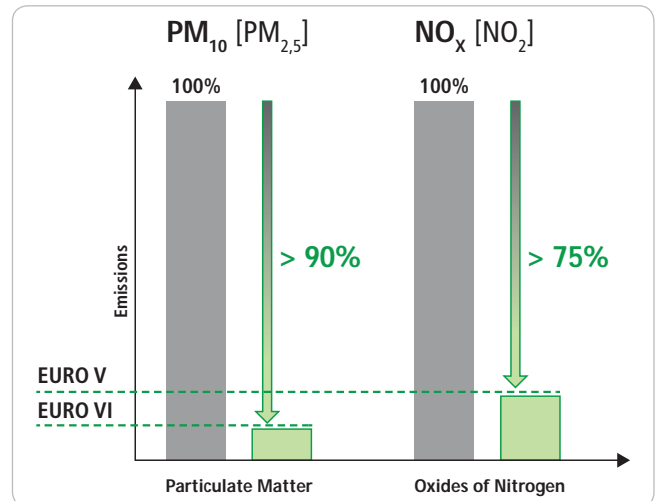
Better emission class – from Euro III to Euro V and EEV with SCRT®

The SCRT® system reduces not only soot and fine particulate matter in diesel exhaust emissions right down to the detectability threshold, but also nitrogen oxide emissions by up to 90 per cent, as well as emissions of the remaining gaseous pollutants. Euro-III buses, for example, that have undergone an SCRT® retrofit comply with the Euro-V and even the EEV standard.

This new generation of exhaust-gas after treatment systems enables bus manufacturers and local authority fleet operators to comply with the globally applicable exhaust emissions legislation of the future right now.

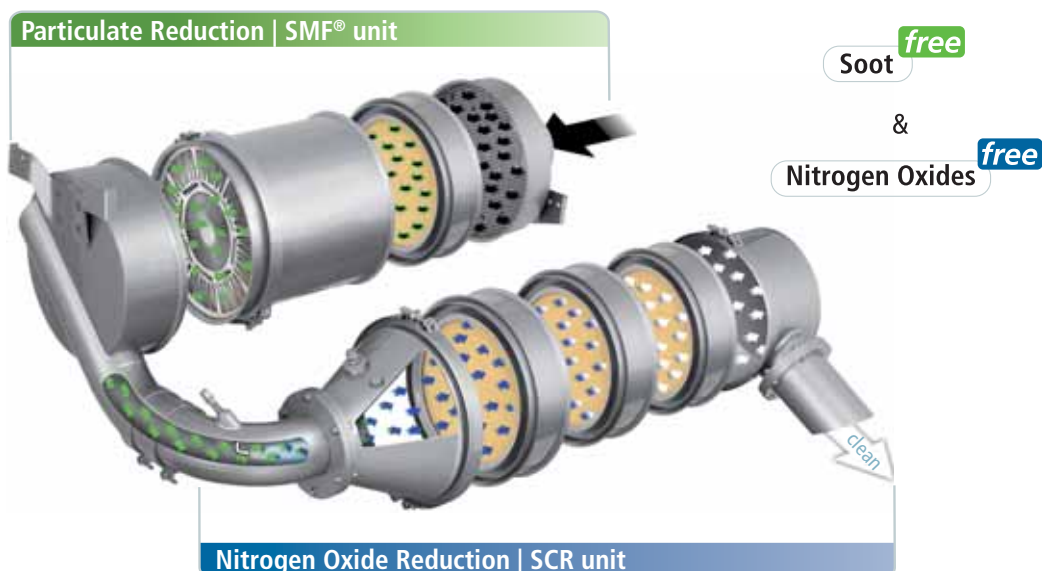


Retrofit – Efficiency SCR + DPF® Systems



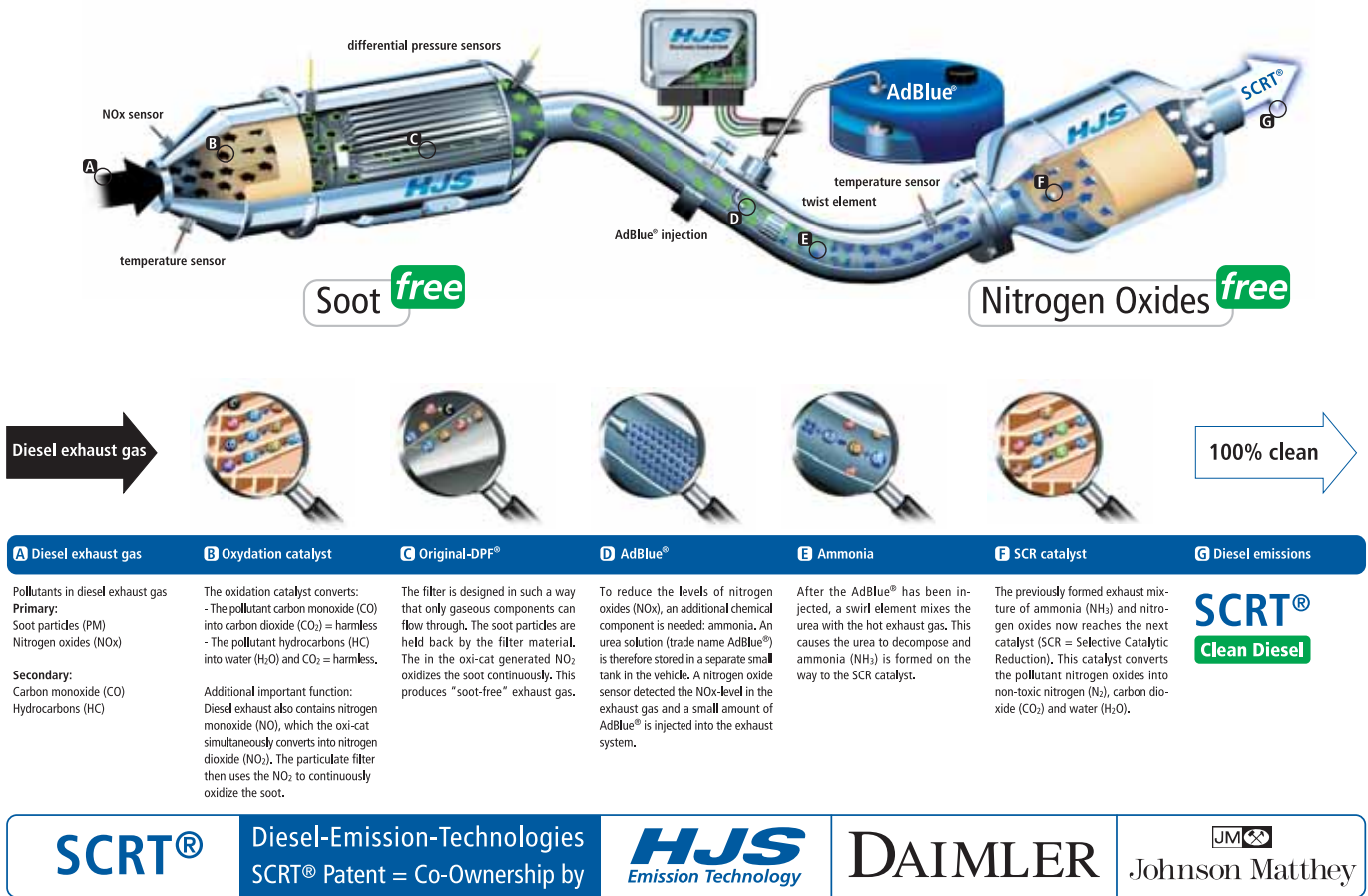
SCRT® benefits at a glance

- ✓ Retrofitting of EURO II and EURO III city buses
- ✓ SCRT® satisfies emission classifications Euro V and EEV
- ✓ Modular design with SMF® and SCR unit
- ✓ Absolutely low-maintenance and economical



The World's cleanest Diesel!

Engineering - SCRT® (Selective Catalytic Reduction Technology) (Technology for PC- and CV-applications)



References SCRT®

Customers	Units	Type
Connexxion, NL	230	Citaro, Volvo, VDL
TfL, London	10	Dennis, Scania, Volvo
Arriva	100	King Long, Citaro, MAN
Berlin	100	MAN A39 Duppel Deck
Puplic Transport Germany	210	Citaro, MAN, Solaris
EMT, Madrid	485	Citaro, MAN, Iveco, Scania



Euro III → EEV / Euro V

Delivery range HJS

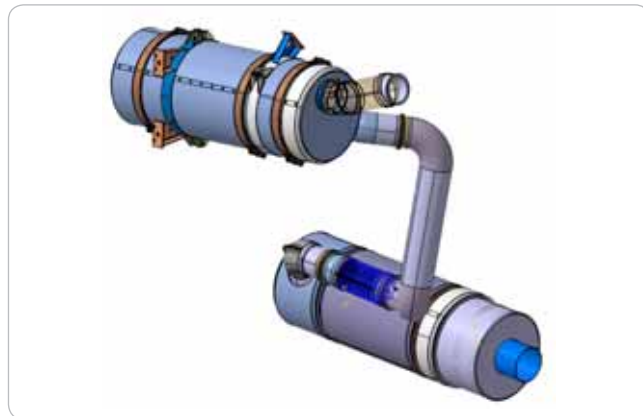
EEV-BUS-Solutions with 100% SMF® - Sintered Metal Filter

- ✓ EvoBus Citaro G – 457 hLA
- ✓ EvoBus Citaro S – 906 hLA / 906 LA
- ✓ MAN A 23 (D2866)
- ✓ Volvo 8700 BLE – DH12D340
- ✓ VDL Ambassador SB 200 – ISBe 22030
- ✓ SOLARIS URBINO (D2866)
- ✓ Dennis Dart – Cummins ISBe 4
- ✓ Dennis Trident – Cummins ISBe 6
- ✓ SCANIA Omnicity
- ✓ IVECO City class Cursor

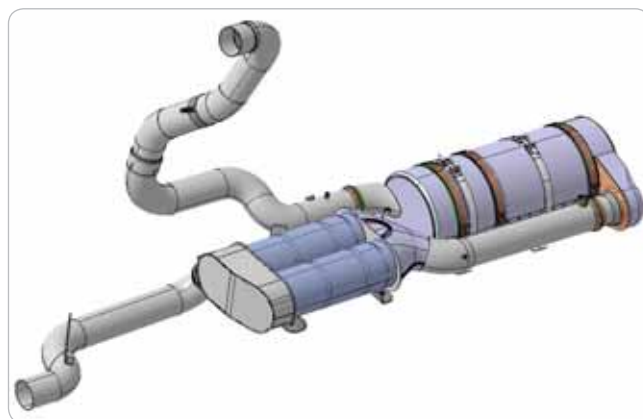
Dennis Dart Euro III with Cummins 4 Cylinder



Dennis Trident Euro III with Cummins 6 Cylinder



Volvo Gemini B7TL



Certificates

MLTB CYCLE DIESEL	
EMISSIONS TEST SUMMARY SHEET	
Customer:	HJS Emission Technology
Customer Address:	Dieselweg 12, 58706 Menden, Germany
Test Purpose:	SCRT System Demonstration on Wrightbus Volvo B7TL. SCRT Injection: 0.9
Vehicle No:	LF52 USU
Site No:	2
DYNAMOMETER SETTINGS:	
Vehicle Type:	Wrightbus Volvo B7TL
Engine:	Volvo
Transmission:	Auto
Fuel Type:	Diesel
Fuel Batch No:	EN590 Compliant
Millbrook Project No:	PT0204-002-03

Test No.	ML02012456	10-Jul-12								Fuel Cons
Odo	368141	UNITS	HC	CO	NOx	CO ₂	PM			(Carb Bal)
Phase 1	Outer London	g/km		1.269	1.185	1295.0	0.013	48.99		
Phase 2	Inner London	g/km		3.002	1.553	1703.7	0.015	64.51		
Combined result		g/km		1.748	1.287	1408.0	0.014	53.28		

Test No.	ML02012457	10-Jul-12								Fuel Cons
Odo	368153	UNITS	HC	CO	NOx					(Carb Bal)
Phase 1	Outer London	g/km		0.986	1.348					
Phase 2	Inner London	g/km		3.056	1.708					
Combined result		g/km		1.559	1.447					

Test No.	ML02012460	10-Jul-12								Fuel Cons
Odo	368165	UNITS	HC	CO	NOx					(Carb Bal)
Phase 1	Outer London	g/km		1.179	1.365					
Phase 2	Inner London	g/km		1.942	1.826					
Combined result		g/km		1.394	1.495					

Average of Combined Tests (g/km)		1.567	1.410
Standard Deviation/Mean x100		9.24	6.31

Comments:

Compiling Engineer: *Signature* Date: 11-July-2012 Approving Engineer: *Signature*

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Issue No. 3 Effective Date: 07-Jun-11

MLTB CYCLE DIESEL	
EMISSIONS TEST SUMMARY SHEET	
Customer:	HJS Emission Technology
Customer Address:	Dieselweg 12, 58706 Menden, Germany
Test Purpose:	SCRT Demonstration on Wrightbus Volvo B7TL. Baseline Data. OEM fitted
Vehicle No:	LF52 USU
Site No:	2
DYNAMOMETER SETTINGS:	
Vehicle Type:	Wrightbus Volvo B7TL
Engine:	Volvo
Transmission:	Auto
Fuel Type:	Diesel
Fuel Batch No:	EN590 Compliant
Millbrook Project No:	PT0204-002-03

Test No.	ML02012461	10-Jul-12								Fuel Cons
Odo	368189	UNITS	HC	CO	NOx	CO ₂	PM			(Carb Bal)
Phase 1	Outer London	g/km		9.801	9.806	1229.7	1.016	47.03		
Phase 2	Inner London	g/km		13.973	13.998	1642.0	1.447	62.85		
Combined result		g/km		10.974	10.984	1345.6	1.137	51.48		

Test No.	ML02012462	10-Jul-12								Fuel Cons
Odo	368190	UNITS	HC	CO	NOx	CO ₂	PM			(Carb Bal)
Phase 1	Outer London	g/km		9.801	9.806	1229.7	1.016	47.03		
Phase 2	Inner London	g/km		13.973	13.998	1642.0	1.447	62.85		
Combined result		g/km		10.974	10.984	1345.6	1.137	51.48		

Average of Combined Tests (g/km)		11.051	1351.4	1.141	51.70
Standard Deviation/Mean x100		0.61	0.43	0.37	0.43

Compiling Engineer: *Signature* Date: 11-July-2012 Approving Engineer: *Signature*

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Issue No. 3 Effective Date: 07-Jun-11

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MILLBROOK VEHICLE EMISSIONS LABORATORY MK45 2JQ

TfL NOx Abatement Trial Results Summary Sheet

Customer:	HJS Emission Technology		
Test Purpose:	SCRT System Demonstration on Dennis Dart		
Vehicle No:	RD02 BJX	Baseline Vehicle	Dynamometer Settings
Vehicle Type:	Dennis Dart	Dennis Dart	Inertia 8,488 kg
Engine:	Cummins ISBe	Cummins ISBe	F ¹ 220.94 N
Transmission:	Auto	Auto	F ² 9.121 N/km/h
Fuel Type:	Diesel	Diesel	F ³ 0.03120 N/km/h
Millbrook Project No:	PT0204-002-04	PT0204-002-04	F ⁴ 0.000630 N/km/h

Test No.	112032,033,035	Baseline Test								
Date	17/12/12	NOx	NO ₂	N ₂ O	CH ₄	CO ₂	CO _{2eq}	NH ₃		
Units	g/km	g/km	g/km	g/km	g/km	g/km	g/km	ppm (max)		
Analysed	Modal	FTIR	FTIR	FTIR	Modal	Calculated	FTIR			
Phase 1	Outer London	9.67	0.49	0.00	0.00	890.1	1.21	0.6		
Phase 2	Inner London	18.02	0.85	0.01	0.00	1194.7	1.59	0.5		
Combined result		12.03	0.60	0.00	0.00	976.1	1.32	0.6		

Test No.	112032,033	With NOx Abatement Device								
Date	17/12/12	NOx	NO ₂	N ₂ O	CH ₄	CO ₂	CO _{2eq}	NH ₃		
Units	g/km	g/km	g/km	g/km	g/km	g/km	g/km	ppm (max)		
Analysed	Bag	FTIR	FTIR	FTIR	Bag	Calculated	FTIR			
Phase 1	Outer London	3.23	0.24	0.07	0.00	869.8	22.77	26.5		
Phase 2	Inner London	5.50	0.37	0.10	0.00	1175.2	32.01	7.0		
Combined result		3.87	0.28	0.08	0.00	956.0	25.38	26.5		
Change vs Baseline		-67.8%	-53.7%	1821%	0.0%	-2%	1821.5%	4573%		

	NOx	NO ₂	N ₂ O	CH ₄	CO ₂	CO _{2eq}	NH ₃
Units	g/km	g/km	g/km	g/km	g/km	g/km	ppm (max)
Analysed	Bag	FTIR	FTIR	FTIR	Bag	Calculated	FTIR
Target	-70%	-50%					
Relative Limit	3.608	0.30					
Combined result	3.867	0.28					
Pass/Fail	Fail	Pass					

Baseline FTIR data measured during test ML02012035, baseline CO₂ equivalence factors: CO₂ : 1 - N₂O : 310 - CH₄

Compiling Engineer: *Signature* DATE: 21-Feb-2012

MLTB CYCLE DIESEL	
EMISSIONS TEST SUMMARY SHEET	
Customer:	HJS Emission Technology
Customer Address:	Dieselweg 12, 58706 Menden, Germany
Test Purpose:	SCRT System Demonstration. Baseline Data
Vehicle No:	RD02 BJX
Site No:	2
DYNAMOMETER SETTINGS:	
Vehicle Type:	Dennis Dart
Engine:	Cummins ISBe
Transmission:	Auto
Fuel Type:	Diesel
Fuel Batch No:	EN590 Compliant
Millbrook Project No:	PT0204-002-04

Test No.	ML02012032	17-Feb-12								Fuel Cons
Odo	14581	UNITS	HC	CO	NOx					(Carb Bal)
Phase 1	Outer London	g/km	0.283	4.139	9.556					
Phase 2	Inner London	g/km	0.357	7.195	17.598	1201.9	n/a	45.85		
Combined result		g/km	0.304	4.998	11.818	977.6	n/a	37.24		

Test No.	ML02012033	17-Feb-12								Fuel Cons
Odo	14591	UNITS	HC	CO	NOx	CO ₂	PM			(Carb Bal)
Phase 1	Outer London	g/km	0.242	1.178	9.790	890.5	n/a	33.72		
Phase 2	Inner London	g/km	0.345	1.928	18.436	1187.4	n/a	44.98		
Combined result		g/km	0.271	1.385	12.237	974.5	n/a	36.91		

Average of Combined Tests (g/km)	0.287	3.191	12.028	976.1	n/a	37.07
Standard Deviation/Mean x100	5.75	56.62	1.74	0.15	n/a	0.45

Comments: NOx abatement baseline data by integrated engine-out modal sample

No particulate results possible due to engine out measurement

Compiling Engineer: *Signature* Date: 21-Feb-2012 Approving Engineer: *Signature* Date: 22-Feb-2012

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Issue No. 3 Effective Date: 07-Jun-11

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MLTB CYCLE DIESEL	
EMISSIONS TEST SUMMARY SHEET	
Customer:	HJS Emission Technology
Customer Address:	Dieselweg 12, 58706 Menden, Germany
Test Purpose:	SCRT System Demonstration on Dennis Dart, SCRT Injection 0.92
Vehicle No:	RD02 BJX
Site No:	2
DYNAMOMETER SETTINGS:	
Vehicle Type:	Dennis Dart
Engine:	Cummins ISBe
Transmission:	Auto
Fuel Type:	Diesel
Fuel Batch No:	EN590 Compliant
Millbrook Project No:	PT0204-002-04

Test No.	ML02012032	17-Feb-12								Fuel Cons
Odo	14581	UNITS	HC	CO	NOx	CO ₂	PM			(Carb Bal)
Phase 1	Outer London	g/km	0.017	0.086	3.270	869.0	0.044	32.82		
Phase 2	Inner London	g/km	0.014	0.097	5.580	1183.4	0.104	44.70		
Combined result		g/km	0.016	0.076	3.920	957.5	0.061	36.16		

Test No.	ML02012033	17-Feb-12								Fuel Cons
Odo	14591	UNITS	HC	CO	NOx	CO ₂	PM			(Carb Bal)
Phase 1	Outer London	g/km	0.006	0.027	3.181	870.6	0.032	32.88		
Phase 2	Inner London	g/km	0.009	0.098	5.419	1167.0	0.080	44.08		
Combined result		g/km	0.004	0.047	3.814	954.5	0.046	36.65		

Average of Combined Tests (g/km)	0.010	0.062	3.867	956.0	0.053	36.11
Standard Deviation/Mean x100	57.86	23.86	1.37	0.15	14.36	0.16

Comments: SCRT System active - Injection: 0.92

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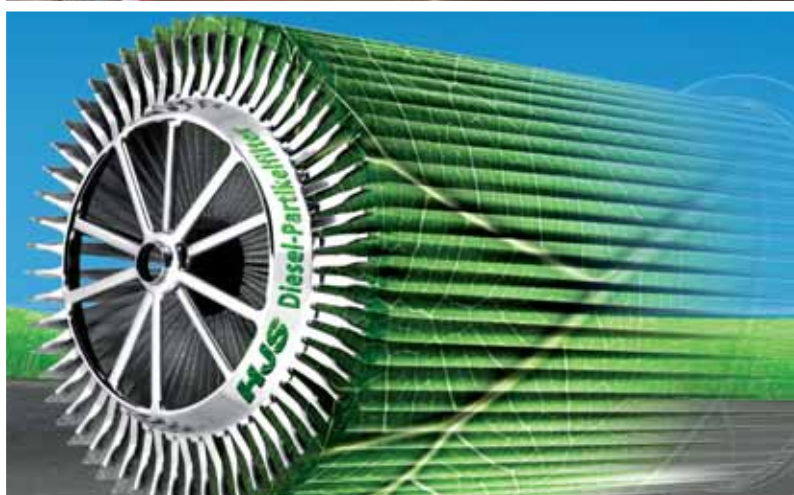
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The solution for clean coaches!

Put your trust in HJS DPF® and benefit from our many years of experience in the business

- ✓ Minimal downtime
- ✓ Extremely low-maintenance
- ✓ Low servicing costs
- ✓ Active protection of health and the environment



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