



CITA-Appplus+ Urea Emulator Emission Tampering

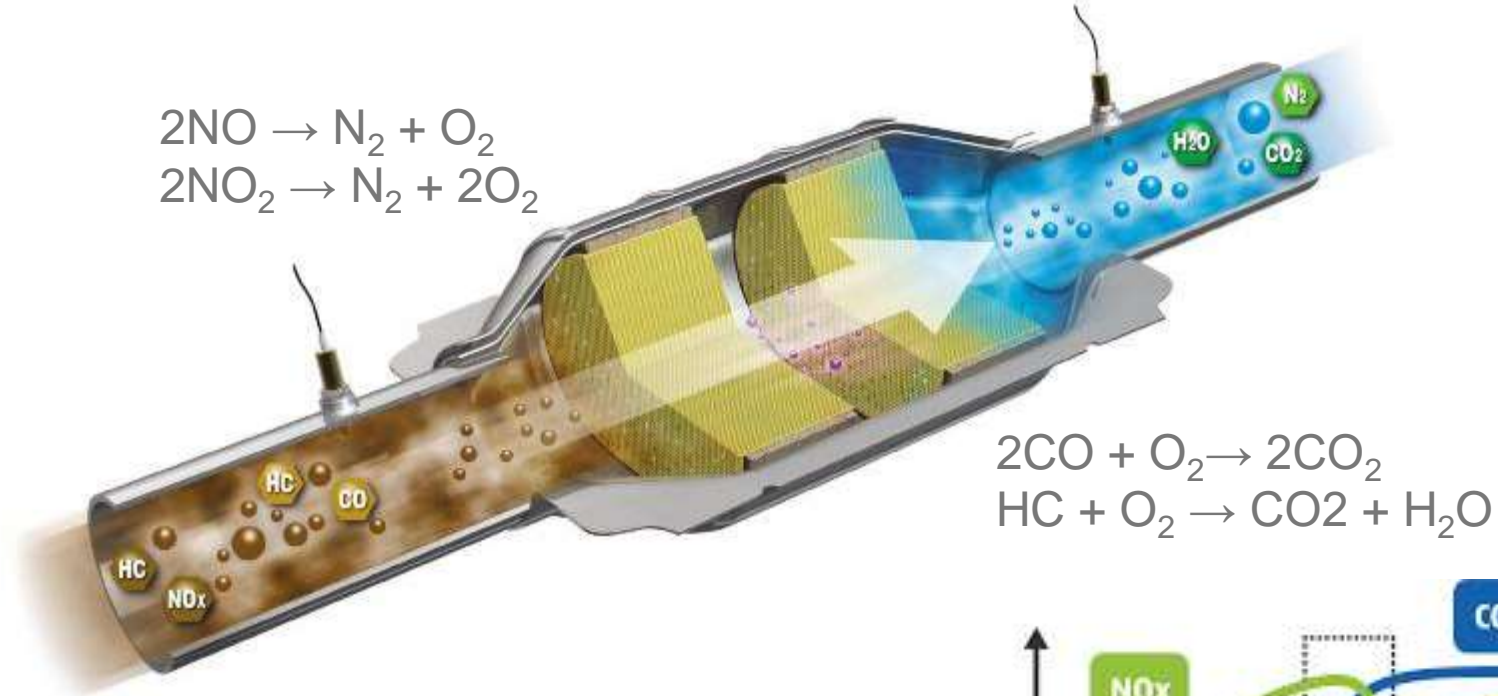
September 9th, 2021

Víctor Salvachúa, Topic Area Chairperson, R + D Vehicle Compliance

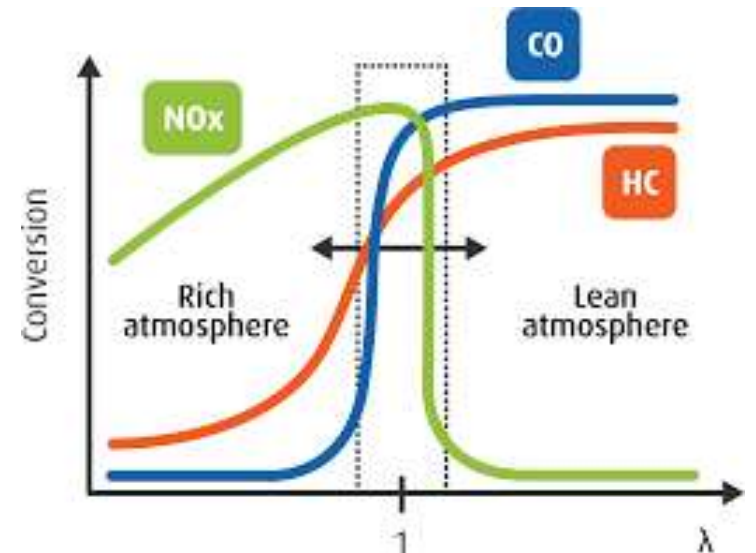
- ▶ SCR SYSTEMS
- ▶ AD BLUE EMULATORS
- ▶ TESTS
- ▶ RESULTS
- ▶ CONCLUSIONS
- ▶ Q&A / OPEN DEBATE

SCR BASICS

Gasoline: 3wcc



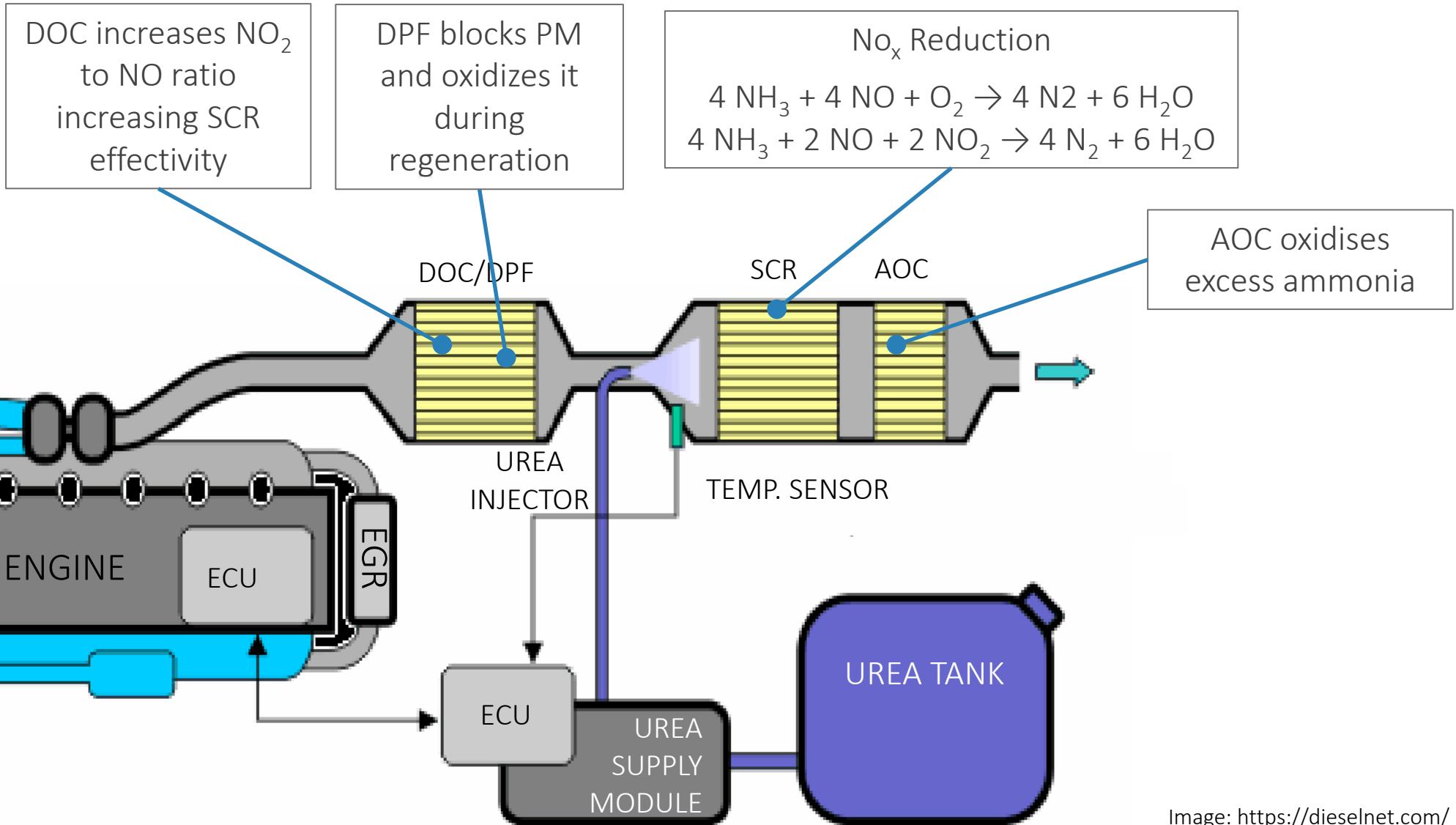
- ▶ SEMI-PASSIVE SYSTEM
 - ▶ CORRECT TEMPERATURE
 - ▶ NEAR TO STOICHIOMETRIC MIXTURE
 - ▶ CATALYTIC REACTION (NO CONSUMABLE)
 - ▶ INOPERATIVE DEVICES ARE EASY TO DETECT



SCR BASICS



SCR

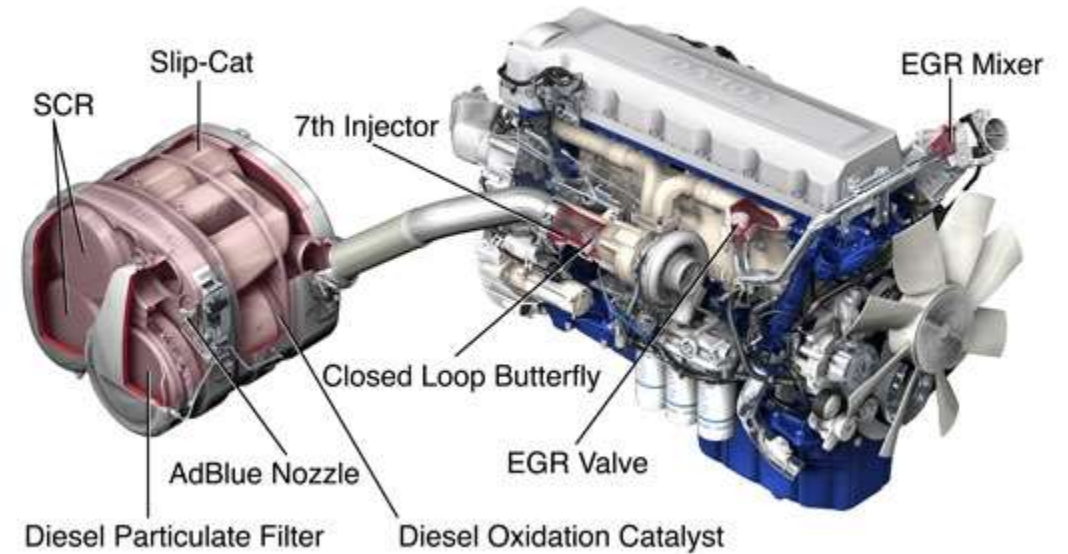


SCR BASICS



SCR

- ▶ UREA NEEDED AS AN ADDITIVE
 - ▶ ADBLUE / DEF (DIESEL EXHAUST FLUID)
- ▶ EGR / SCR BALANCE NEEDED
- ▶ COMPLEX SYSTEM THAT INCREASES VEHICLE INITIAL AND OPERATION COST
- ▶ NO_x REDUCTION STRATEGIES HAVE BECOME AN IMPORTANT INDUSTRIAL SECRET
- ▶ DUE TO THE COMPLEXITY OF THE INJECTION STRATEGY IS NOT EASY TO DO A QUICK SYSTEM FUNCTION TEST



SCR vs 3WCC

	3WCC	SCR
Initial Cost	Medium	Very High
Operation cost	None	UREA
Repair cost	Medium	High
Enforcement	Easy	Very complex

AD BLUE EMULATORS



<https://www.canbusemulator.com/en/>

CAN-BUS EMULATOR

We ship worldwide! +90 530 937 46 36

TR EN ES PT FR DE IT
RU BG RO FA AR HE

LOGIN / REGISTER CART MENU

Adblue Removal Emulator

- Compatible with all Euro 4 - 5 and 6 engines
- 2 year warranty
- 30 day Money Back Guarantee
- Best NOx sensor fault solution.
- Easy and quick installation
- VIP support
- Made in Turkey

with **PayPal**

BUY NOW

2 Year Warranty
30 day Money Back Guarantee

Adblue Emulators - DTC Erasers - NOx Sensors Emulators

made in Turkey

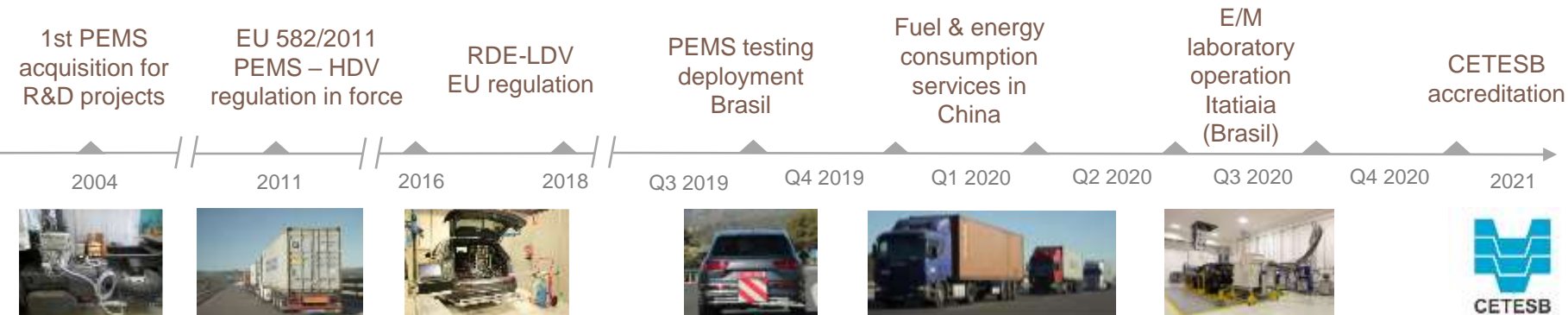
TEST LAB



- ▶ VEHICLE TESTED BY APPLUS IDIADA IN SPAIN
- ▶ CREDENTIALS
 - ▶ ISO 17025 ACCREDITED LABORATORY
 - ▶ DESIGNATED TECHNICAL SERVICE SPAIN
 - ▶ > 15 YEARS ON-BOARD FUEL/ENERGY CONSUMPTION AND EMISSIONS

Applus⁺
IDIADA

YOUR DEVELOPMENT PARTNER



TEST LAB



- ▶ OFFERING F/E & EMISSIONS ABROAD FOR HDV
- ▶ REGULATED AND NON-REGULATED TESTS
 - ▶ *SORT, R.49, EU582/2011, VTP*
- ▶ BENCHMARKING PROGRAMS
- ▶ *CUSTOMISED TESTS*
- ▶ *VEHICLE & SYSTEM LAYOUTS*
- ▶ ENGINE DYNO & VEHICLE TESTING

Applus⁺
IDIADA

YOUR DEVELOPMENT PARTNER

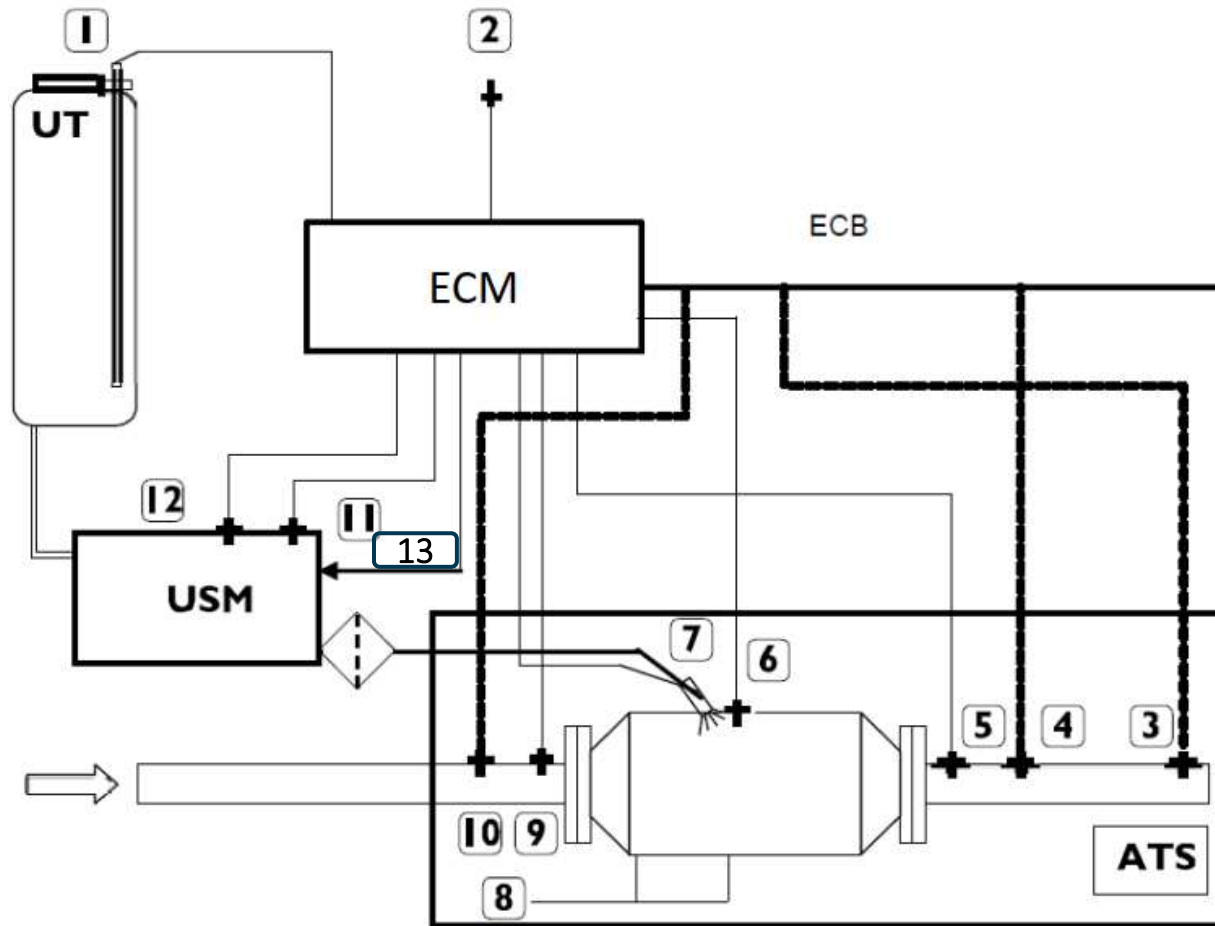


TEST VEHICLE



Truck	
Model	
VIN	
Engine Fuel	Diesel Euro VI A
Test weight (kg)	38818Kg
Trailer	
VIN	VSRSP3M06ML068738
Tyres - Pressure (bar)	1 st and 2 nd axle: Bridgestone R164 160K 158L 285/65 R22,5 – 8,0 3 rd axle: Dunlop SP 244 160k 158L 285/65 R22.5 – 8,0

TEST VEHICLE



UT: UREA TANK

USM: UREA SUPPLY MODULE

ECM: ENGINE CONTROL MODULE

1: LEVEL AND TEMPERATURE UREA TANK

2: HUMIDITY SENSOR

3: NH₃ SENSOR

4: AFTER CATALYST NO_x SENSOR

5: AFTER CATALYST TEMPERATURE SENSOR

6: BEFORE SCR TEMPERATURE SENSOR

7: UREA INJECTOR

8: DPF DELTA-P SENSOR

9: BEFORE CATALYST TEMPERATURE SENSOR

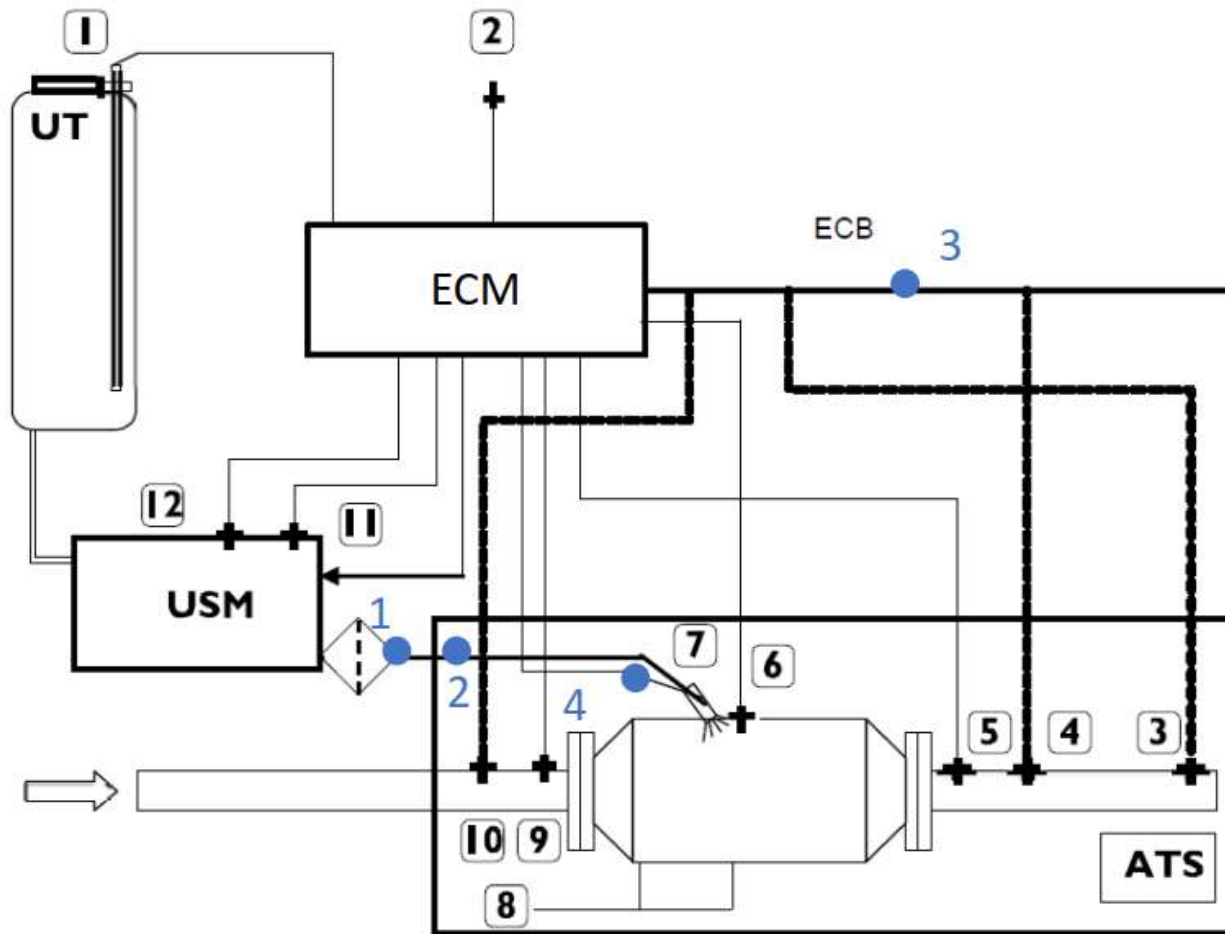
10: BEFORE CATALYST NO_x SENSOR

11: UREA TEMPERATURE SENSOR

12: UREA PRESSURE SENSOR

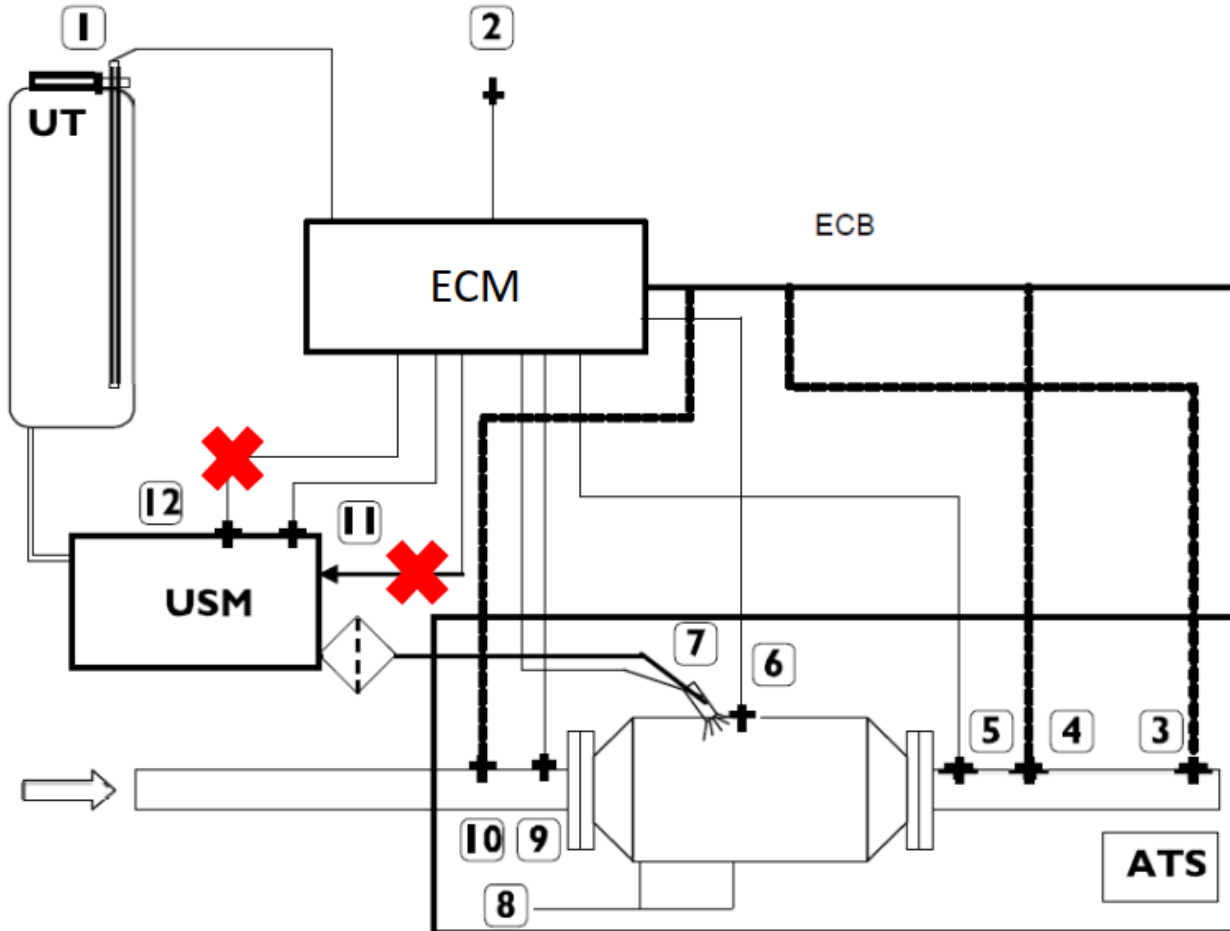
13: UREA PUMP CONTROL SIGNAL

TEST INSTRUMENTATION



- 1: UREA MASS FLOW (g/s)
- 2: UREA PRESSURE SENSOR (kPA)
- 3: CAN_H AND CAN_L
- 4: UREA INJECTOR CURRENT (A)

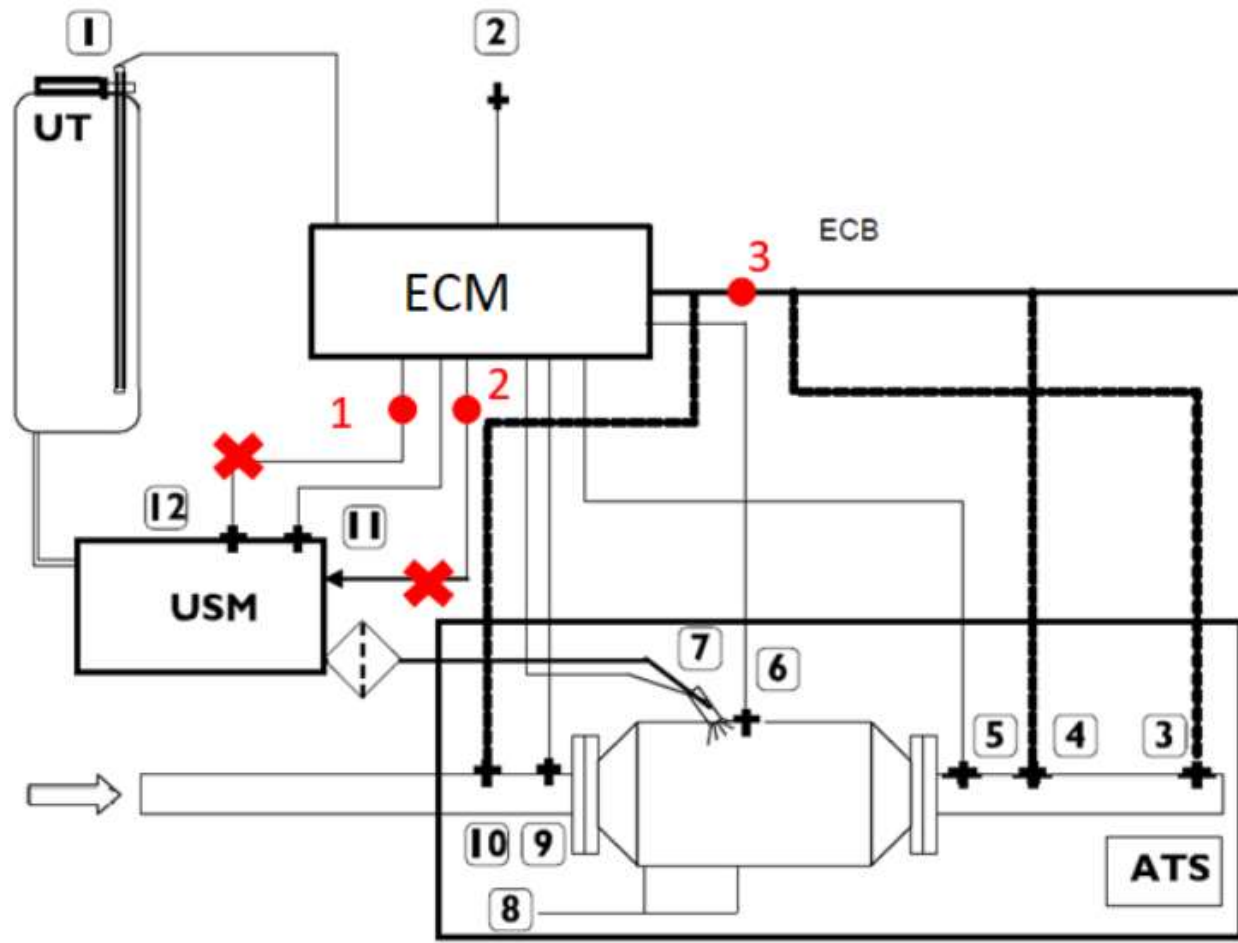
TEST OBD VALIDATION



12: UREA PRESSURE SENSOR

13: UREA PUMP CONTROL SIGNAL

TEST AD BLUE EMULATOR

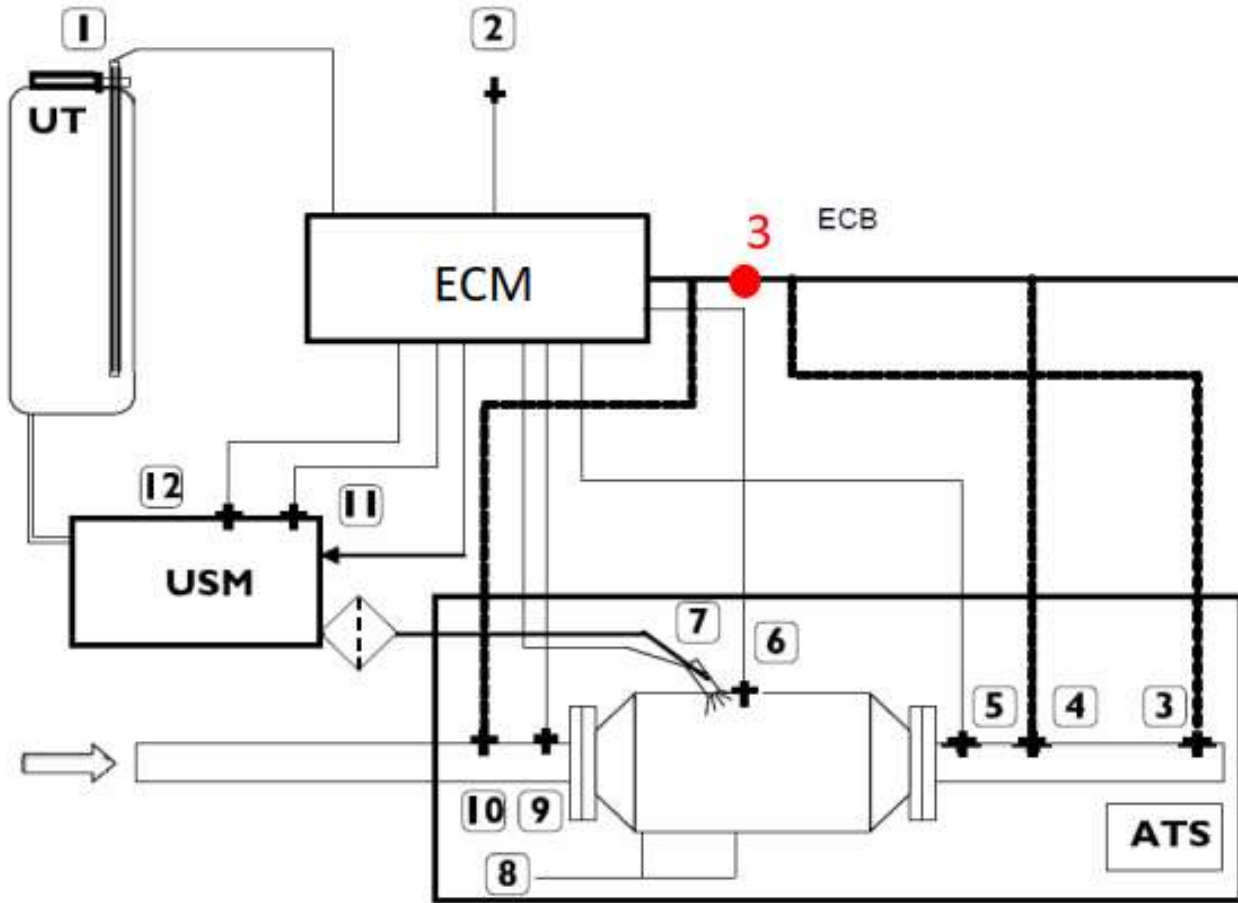


Urea emulator installation connection points:

- 1 Urea pressure sensor signal, ○
- 2 Urea pump control signal. ●
- 3 CAN_H and CAN_L ● and ●
- Vehicle 24V Fuse ●
- Vehicle GND ●



TEST AD BLUE PARALEL MODE



INCA - Urea pressure sensor signal, ○

INCA – Urea pump control signal. ●

3 CAN_H and CAN_L ● and ●

Vehicle 24V Fuse ●

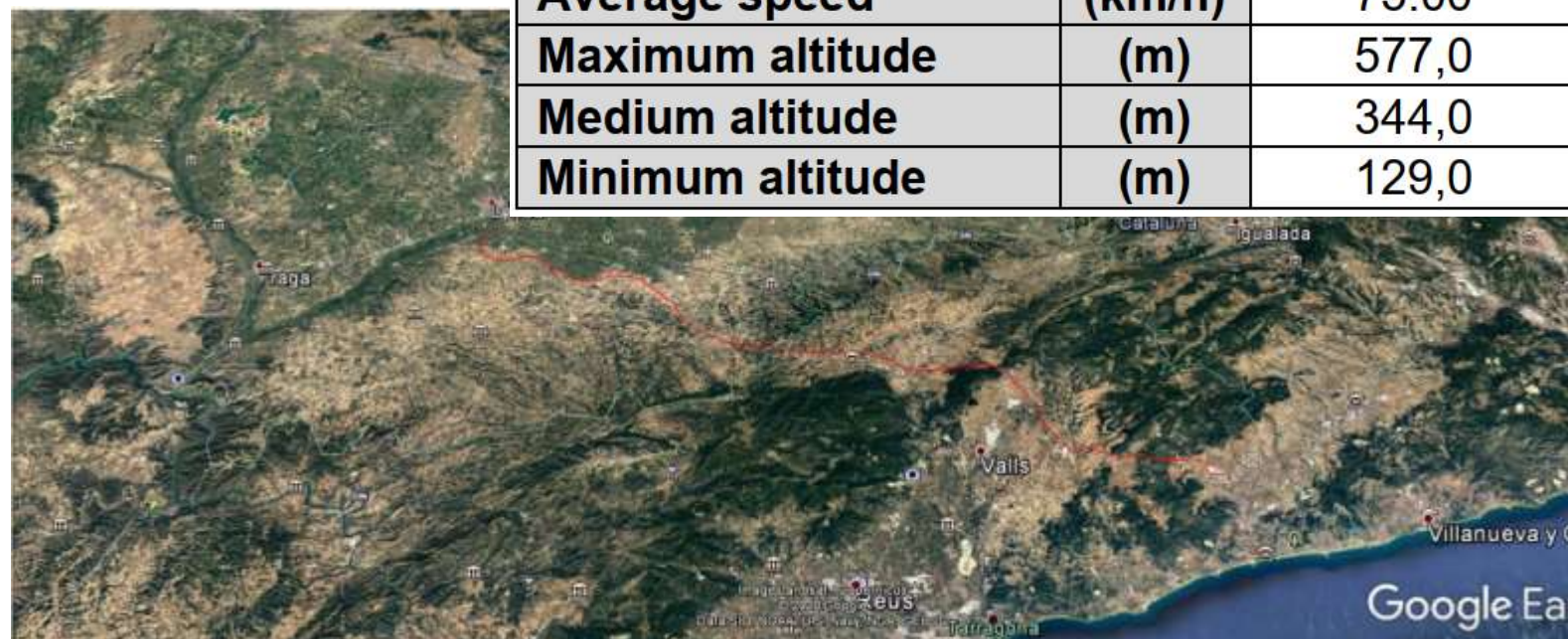
Vehicle GND ●



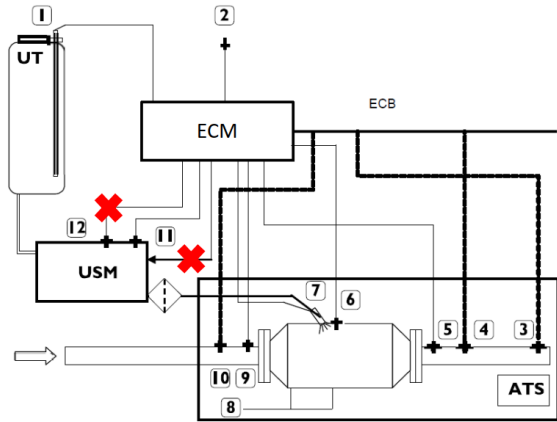
TEST ROUTE



Test duration	(s)	9.700
Distance	(km)	194
Average speed	(km/h)	75.00
Maximum altitude	(m)	577,0
Medium altitude	(m)	344,0
Minimum altitude	(m)	129,0



RESULTS OBD VALIDATION



- ▶ MIL ACTIVATED AND COUNTER INCREASES
- ▶ TORQUE REDUCTION AFTER 10 HOURS
- ▶ 2 DTC PRESENT
 - DTC2012 = P208B Reductant Pump "A" Control Performance/Stuck Off
 - DTC2012 = P208A Reductant Pump "A" Control Circuit/Open
- ▶ VEHICLE BEHAVES AS EXPECTED

Step	Date	Time	Emulator installed? (Y/N)	Driven mileage (km)	Driven hours (h)	Comments	Reagent quality counter (h)	Reagent consumption counter (h)	Dosing counter (h)	EGR valve counter (h)	Monitoring system counter (h)	NOx Warning System	Level One Inducement	Ad Blue ON?	Torque reduction? (Y/N)	MILON?
0	08/04/2021	8:00	No	0	0	Original Conditions	0h	0h	0h	0h	0h	Inactive	Inactive	YES	NO	NO
1	08/04/2021	13:52	No	239.12	3.52	USM Isolated	0h	0h	0-3h	0h	0h	Active	Inactive	NO	NO	NO
2	08/04/2021	18:19	No	271.58	4.56	USM Isolated	0h	0h	3-7h	0h	0h	Active	Inactive	NO	NO	NO
3	09/04/2021	13:03	No	134.64	2.28	USM Isolated - Torque reduction 10h	0h	0h	7-10h	0h	0h	Active	Active	NO	YES	YES
4	09/04/2021	17:26	No	101.2	1.71	USM Isolated - Torque reduction	0h	0h	10-12h	0h	0h	Active	Active	NO	YES	YES

RESULTS AD BLUE EMULATOR



- ▶ NO MIL ACTIVATED NOR COUNTERS STARTED
- ▶ NO TORQUE REDUCTION
- ▶ COMPLETE UREA SYSTEM OVERRIDE
- ▶ NO UREA INJECTED

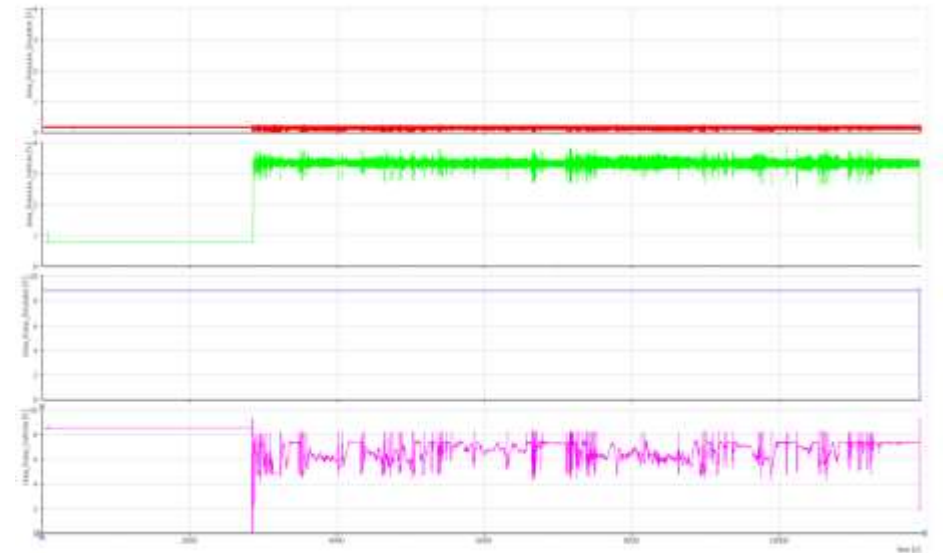
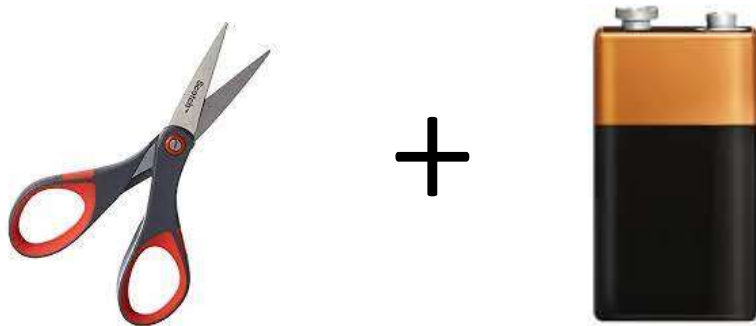


Route	Date	Time	Emulator installed? (Y/N)	Driven mileage (km)	Driven hours (h)	Comments
Route 5	13/04/2021	16:49	Yes	239.6	3.65	No MILs present and no counters increased.
Route 6	14/04/2021	18:26	Yes	237.75	3.46	No MILs present and no counters increased.

RESULTS PARALEL MODE



- ▶ THE EMULATOR USES CAN MESSAGES TO DETECT VEHICLE IGNITION
- ▶ CONTROL AND ACTUATOR SIGNALS ARE REPLACED BY **CONSTANT VOLTAGES**
- ▶ THE ECM IS FEED WITH FAKE MAX INJECTION PRESSURE
- ▶ THE PUMP IS REQUIRED NOT TO INJECT



RESULTS DEVICE EVALUATION



- ▶ THE SYSTEM **COMPLETELY AVOIDS** THE **UREA** INJECTION
- ▶ THE SYSTEM **AVOIDS** ANY **DTC, MIL** OR **INDUCEMENT MODE** ACTIVATION
- ▶ **NO_x** EMISSIONS **INCREASED** AROUND **400%** IN THE TEST
- ▶ AD BLUE **SAVINGS** ADDED TO AROUND **5€/200 KM**
- ▶ SAVINGS AROUND 20€ PER DAY
- ▶ DEVICE **PAYBACK** IS AROUND **6 DAYS** FOR AN INTERNATIONAL TRUCK



▶ **THINK OF THE INCENTIVES**

RESULTS DEVICE EVALUATION



▶ INCENTIVES

- ▶ DURING VEHICLE LIFETIME SAVING **SEVERAL TENTHS OF THOUSAND EUROS**
- ▶ SINGLE TRUCK OWNER IMPORTANT **INCREASE ON PROFITS**
- ▶ FOR A FLEET IT MAY REPRESENT A **COMPETITIVE ISSUE**
- ▶ **DETECTION** BY PTI OR POLICE BODIES **ALMOST IMPOSSIBLE** BY DESIGN AND LACK OF REFERENCES



CONCLUSIONS



- ▶ **TAMPERING** IS MORE THAN A TECHNICAL ISSUE, IT IS **BEHAVIORAL**
- ▶ **EXPERIENCE** SHOWS THAT **TECHNOLOGY PROGRESS** WILL **CHALLENGE** ANY **TAMPERING PROTECTION** BY DESIGN IN FEW MONTHS
- ▶ TO **PREVENT TAMPERING**, WE NEED BOTH **DESIGNS MORE TAMPERING PROOF** AND TO **FACILITATE DETECTION**
- ▶ THE **DIAS PROJECT** IS AN **EXCELLENT** INITIATIVE FOR MORE ROBUST DESIGNS. IT NEEDS TO BE **COMPLETED** TO FACILITATE **TAMPERING DETECTION** [HTTPS://DIAS-PROJECT.COM/](https://DIAS-PROJECT.COM/)
- ▶ **ADAS, AD** AND **EV** MAY ALSO FACE SIMILAR INCENTIVE PROBLEMS
- ▶ THE **WHOLE LIFE** OF THE VEHICLE, **THE INCENTIVES** GENERATED AND THE **ENFORCEMENT** NEED TO BE CONSIDERED WHEN PLANNING FUTURE AUTOMOTIVE REGULATIONS





Thank you for your attention!

www.citainsp.org

Rue du Commerce 123 - 1000 Brussels, Belgium

+32 (0)2 469 06 70

secretariat@citainsp.org