



DISTANCEMASTER™

Enhanced systems for wheel-rail
adhesion management and recovery

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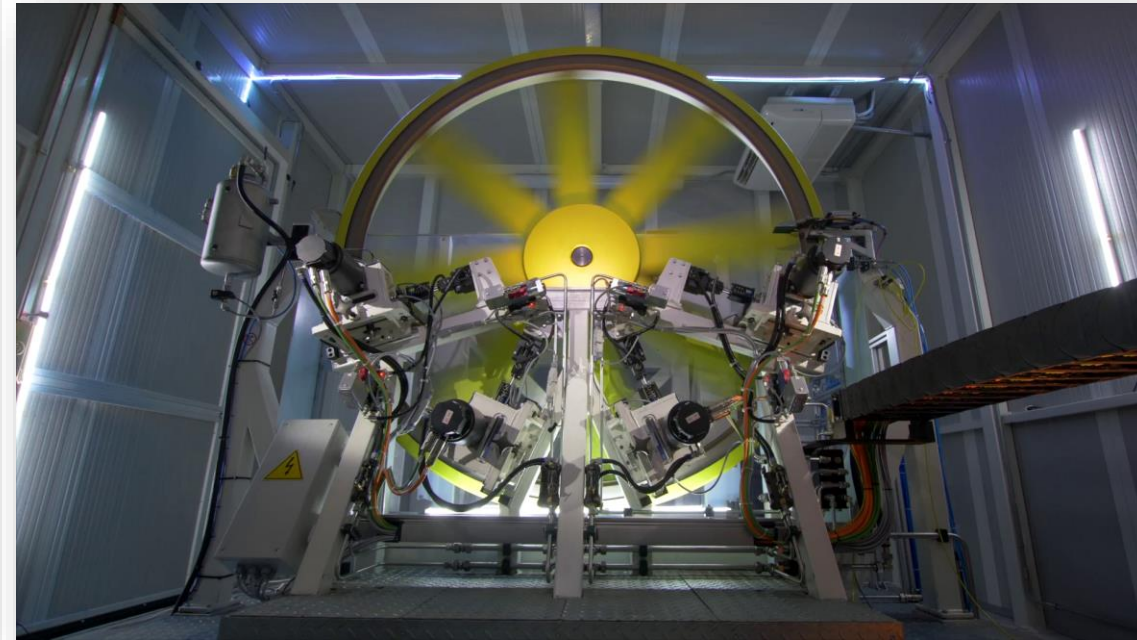


SCHIENENFAHRZEUGTAGUNG

In the frame of S2R, the rail industry stake holders have identified the wheel-rail adhesion as one of the most relevant bottle neck in rail transport efficiency.

- WABTEC has heavily invested in **fundamental research** and in dedicated field tests to explore the adhesion phenomena in terms of wheel-rail contact and in terms of adhesion recovery propagation.
- A **test rig** , unique in the world, has been developed to recreate the adhesion conditions met on field.

the Wabtec multi-axe roller rig



**Maximizing brake performance stability,
reducing dispersion, reducing maintenance costs**

3 enablers:

- **DM-Adaptive WSP:** Optimizing slide control, when it happens
- **DM-Control+:** Maximize at train level the use of available adhesion
- **DM-Smart Sanding:** Generate locally adhesion when needed



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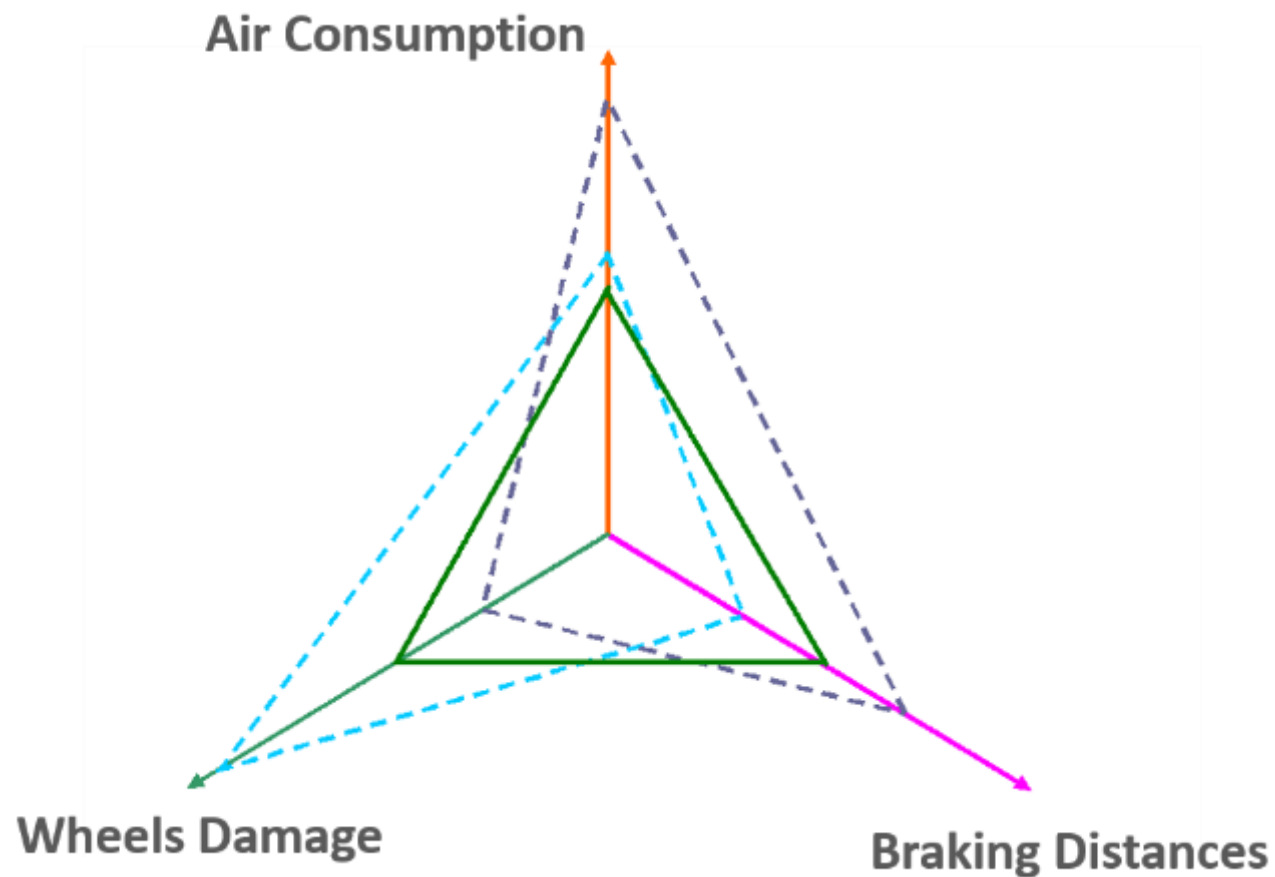


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wheel slide protection



WSP system is in charge of the modulation of the braking force in case of degraded wheel-rail adhesion that could lead to axles slide and, if not mitigated, to wheels lock.



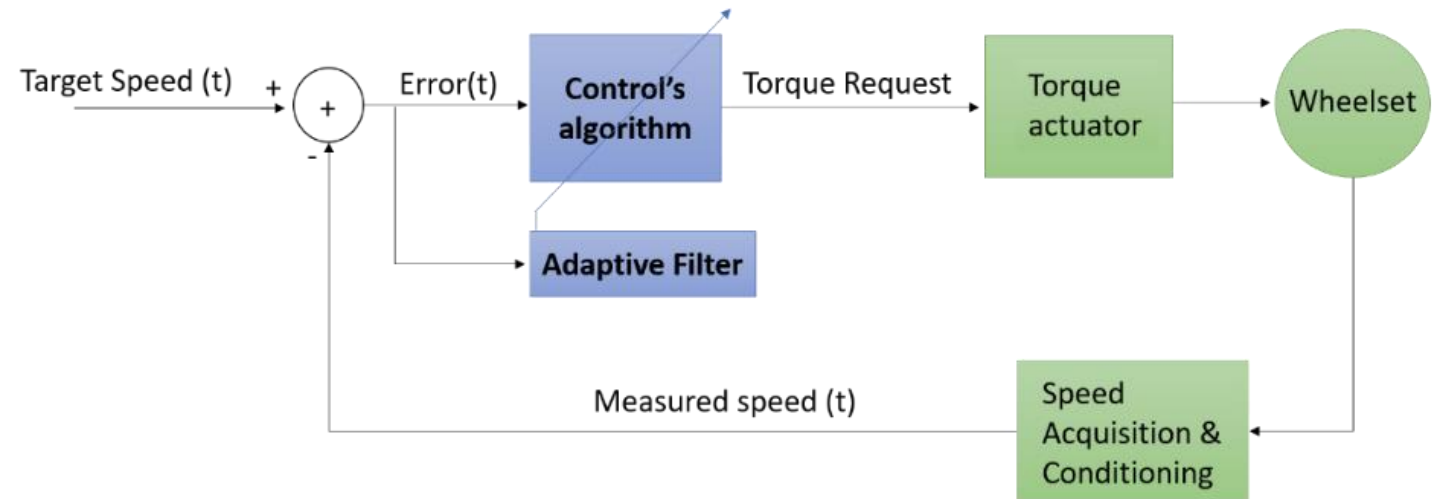
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Adaptive wheel slide protection



The adaptive WSP addresses different market needs

- Increase the level of performance in degraded adhesion (stopping distance)
- Reduce WSP commissioning time
- Maintenance cost linked to wheel flats



- A new WSP algorithm based on "Adaptive Filter" technology
- During sliding, the Adaptive Filter performs a continuous tuning of the internal control coefficients, per each individual axle, based on the actual adhesion value, in every possible environmental conditions.
- DM-Adaptive WSP doesn't require manual tuning

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Adaptive wheel slide protection



Adaptive WSP performance improvement in
low adhesion (0,08 to 0,05)

Average braking distance elongation vs dry:

EN15595/UIC
max extension (12 axles)

+20%

Standard
WSP AEF91

+12%

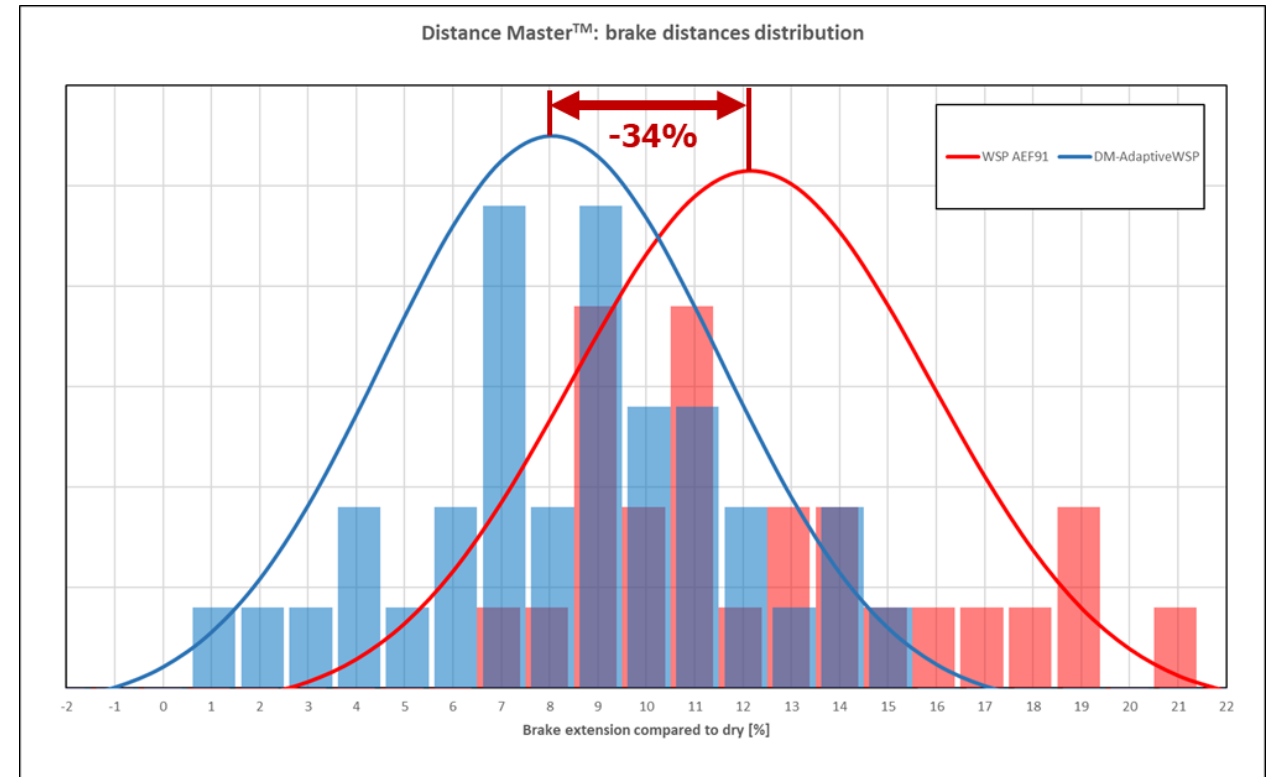
Adaptive WSP

+8%

34% braking distance improvement

Test performed on Euskotren EMU – Bilbao, Spain

200+ brake applications



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Adaptive wheel slide protection

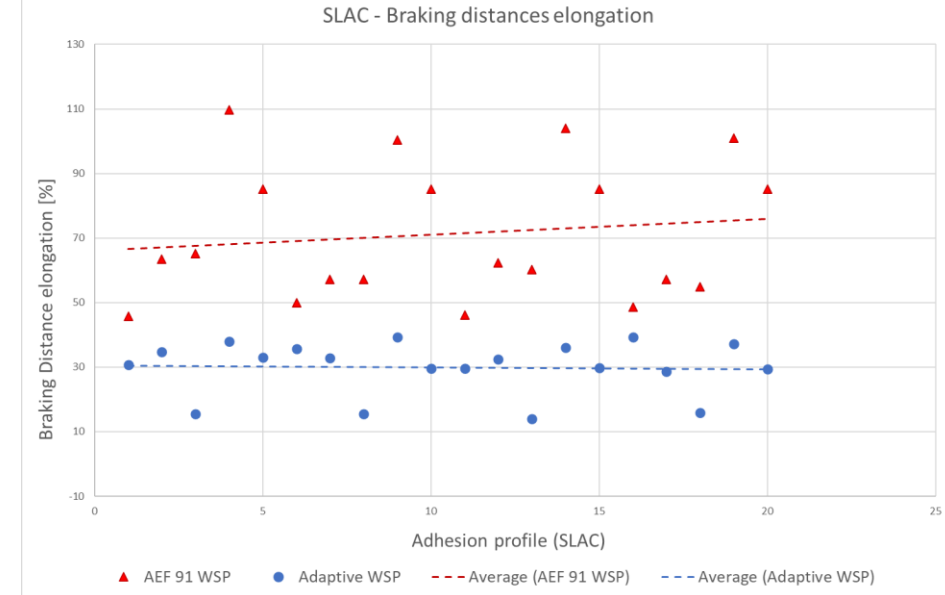


Adaptive WSP performance improvement in extremely low adhesion (0,01 and below)

- **Better protection against wheel flats, reduced maintenance costs - 80% on Regiolis fleet (200 trains monitored) vs state of the art previous generation WSP**
- **No difficulty for commercial service in autumn 2022 (removal of speed limits and good punctuality)**
- **Reduced braking distance extension (from +70% to +30%)**
- **Reduced dispersion: More predictable braking distance**

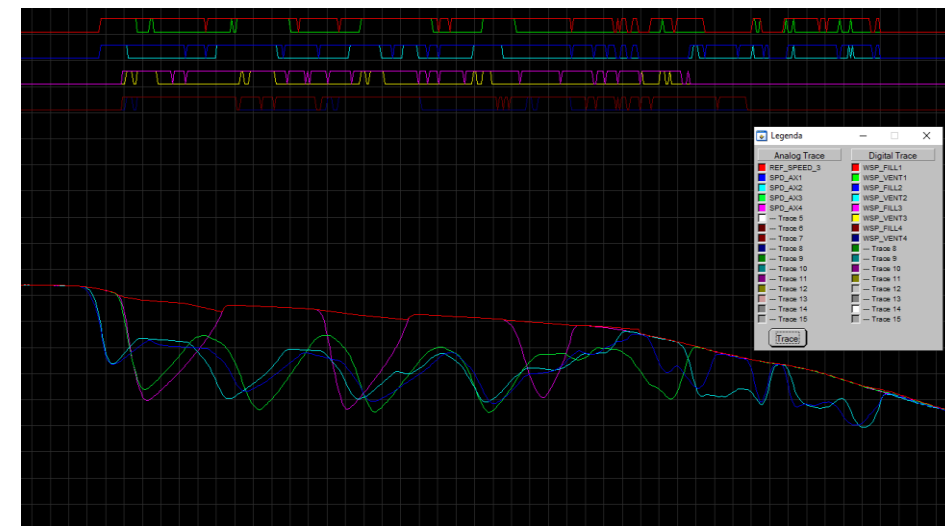
Test performed on WSPER test bench in sustained very low adhesion

- **AEF 91:** Average braking distance extension +70%, high dispersion
- **A-WSP:** Average braking distance extension +30%, much lower dispersion



Test performed during certification on oiled track, Regiolis (SNCF) - France

- Reference speed remains stable
- Not a single wheel flat during the test campaign



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Adaptive wheel slide protection



Accredited lab. test references

- DB Systemtechnik (Germany)
- DB ESG – WSPER (UK)



Trains, operational service

- Regiolis (Alstom – France)
- EuskoTren (CAF – Spain)
- Amtrack (USA)
- TS18 India (Medha – India)
- RRTS (Alstom – India)



Trains, on-going commissioning

- TET-AMLD (CAF – France)
- J151 (Rotem – Singapore)
- New York Metro

3 enablers:

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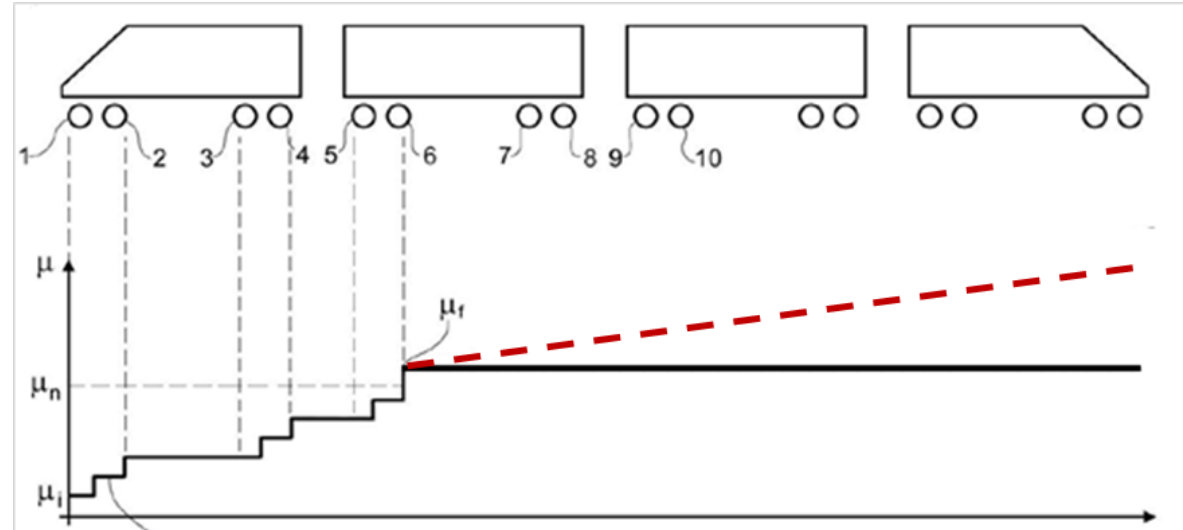
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Adaptive WSP & DM-Control+



DM-control+ is a brake control algorithm for optimised use of the available adhesion along the train.

- Control based on train's deceleration target
- No need of additional electronic control unit (**distributed** logic)



- Each Brake Control Unit monitors locally the instantaneous train deceleration, increasing the braking effort in the area of available adhesion
- The function is limited according to:
 - maximum force tolerable by the brake actuator
 - adhesion limit (according to TSI or specific limit for application)
 - thermal capacity of friction pairs
- SIL4 implementation allows use in **emergency brake**
- No communication between units, distributed intelligence architecture doesn't require additional hardware, e.g., Master Brake Coordinator unit

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Adaptive WSP & DM-Control+



Adaptive WSP & Deceleration compensation
performance improvement in low adhesion (0,08 to 0,05)

Adaptive wheel slide protection & Deceleration
compensation

Average braking distance elongation vs dry:

EN15595/UIC
max extension (12 axles)

+20%

Standard
WSP AEF91

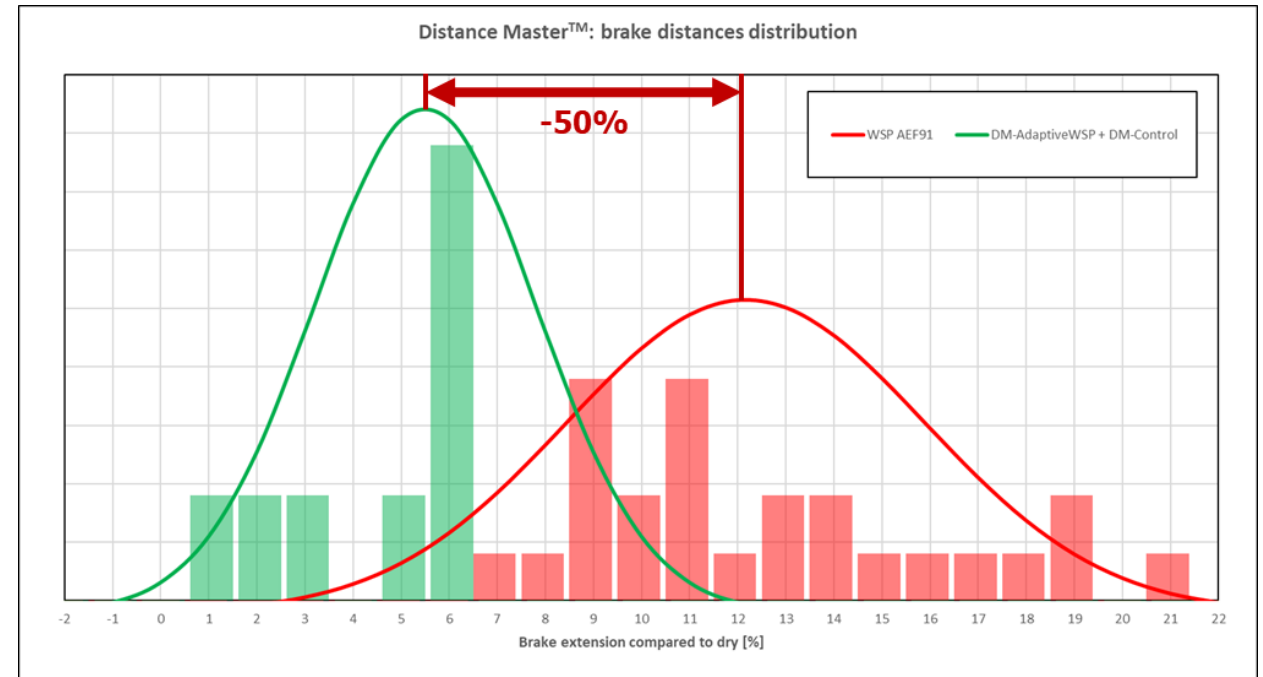
+12%

Adaptive WSP
& DM-control+

+6%

50% braking distance improvement

Test performed on Euskotren EMU – Bilbao, Spain
200+ brake applications



- Due to the cleaning effect of each wheel on the track, braking effort redistribution along the train enables significant improvement
- In same conditions, braking distance improvement becomes -50% (+34% with A-WSP only), dispersion is also greatly reduced

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Deceleration compensation, multiple benefits



Deceleration compensation
also supports other
degraded conditions

Deceleration
Compensation
Disabled

Deceleration
Compensation
Enabled

**Performance
improvement**

Downhill -14 %



1 bogie isolated / in failure



Able to compensate isolated bogie/s ensuring nominal performances --> no need of speed reduction

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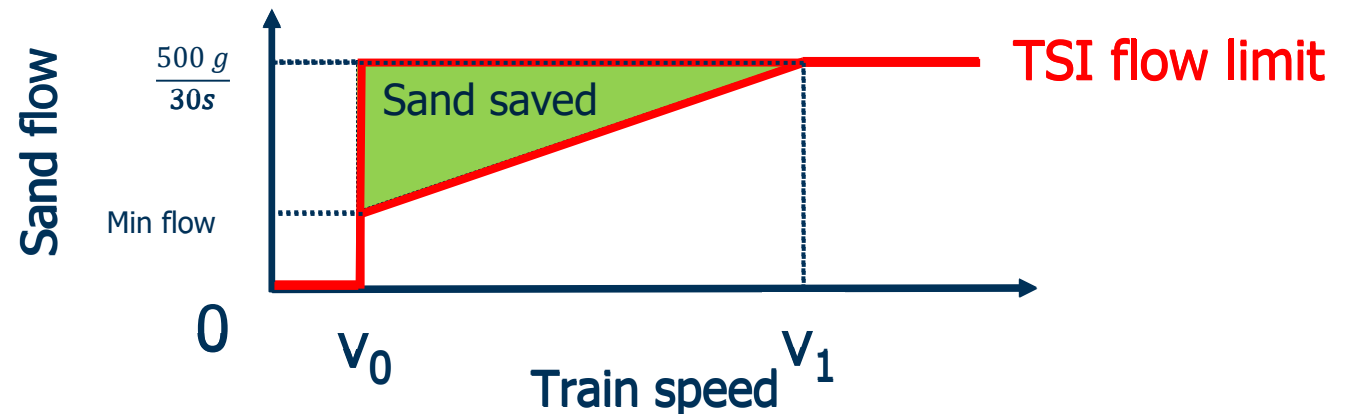
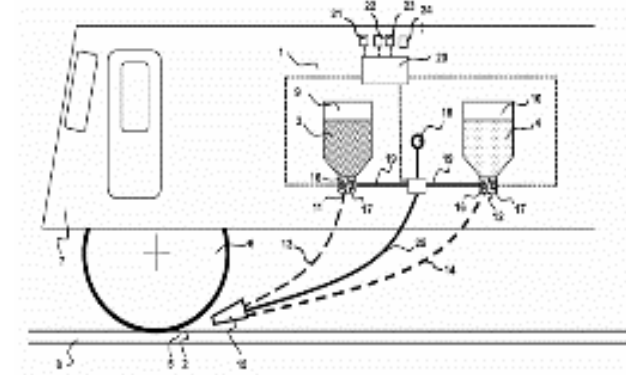
The smart sanding

- reduces sand consumption
- minimizes the extension of braking distance in low adhesion
- minimizes the dispersion of braking performances in low adhesion

The following results are evaluated in low adhesion condition (0,05-0,08) according to EN15595
Sanders are installed on axle 3 and 9 of a 3-cars EMU

Sand saving = 40%
500 g (@ 90Km/h)

@ 90Km/h)



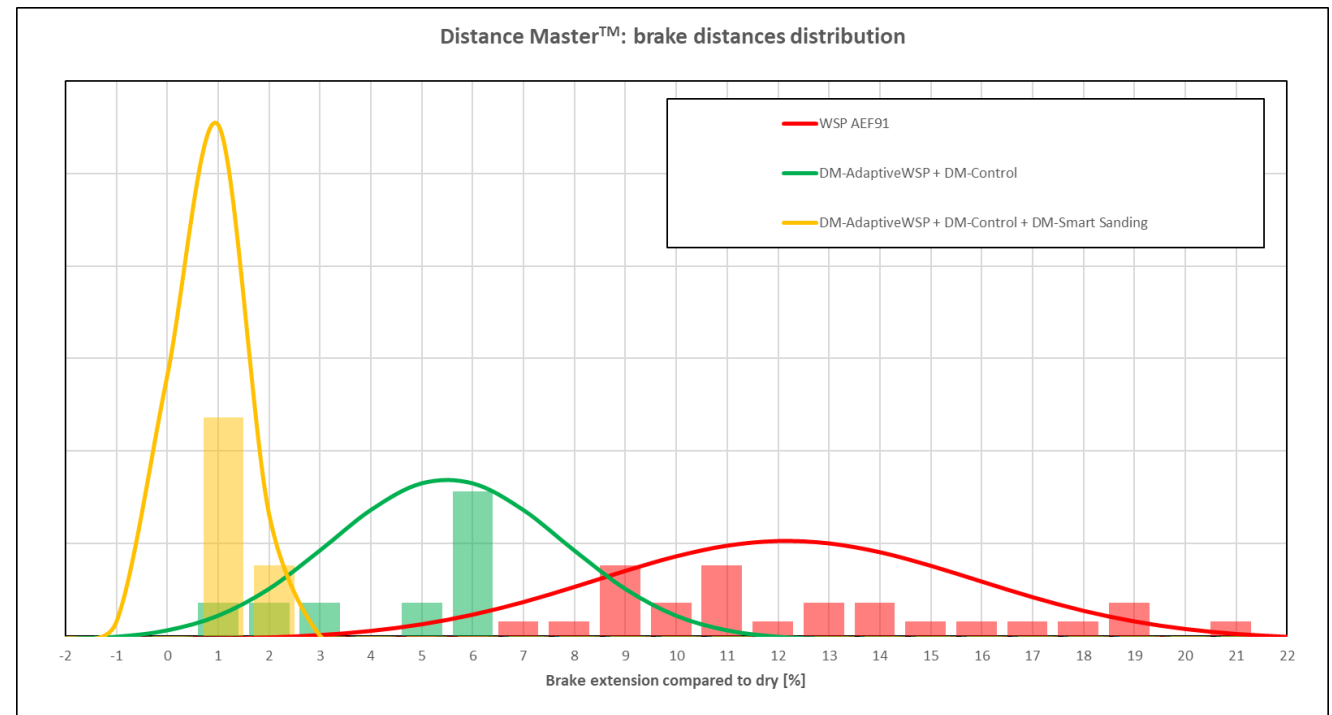
SmartSanding:

Generate locally adhesion when needed.

Performance improvement in low adhesion
(0,08 to 0,05)

**Braking distance extension
almost disappears (+1%)**

Test performed on Euskotren EMU – Bilbao, Spain



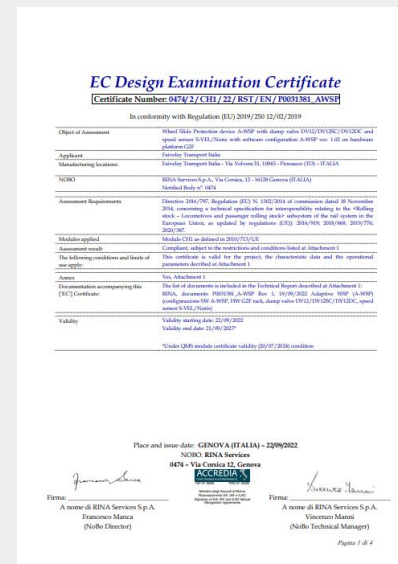
- Result can vary upon number & position of sanding unit in the train
- A design tool has been created to optimise sanding system upon performance & available adhesion

DM-A-WSP: TSI declaration of conformity

- Dynamic test in DBST lab & WSPER
- Dynamic test on train Eurailtest / Regiolis
- Assessed by RINA
- EC Interoperability Certificate (Sept 2022)

Ready for your projects !

- Ready for metros, TSI projects and UK applications
- Performance and functional compliance to:
 - GM/GN2695 at WSPER
 - EN15595:2011 and EN15595:2018



Up to **-50% elongation**

In EN15595 conditions:
Elongation=6% -> ↑ GEGR

Smart Sanding

Sanding controlled by WSP:
Elongation <2%

Minimal sand consumption
Compliant with TSI Loc&Pas
and EN 15595

SIL 4 functions

Dynamic WSP monitoring,
Less frequent safety timer
intervention, reduced # of
flats

Minimized wheel flats

0 wheel flat occurrence during testing on oiled
track
-80% flats on first large fleet with A-WSP
-85% dissipation energy
through sliding

No tuning

First time right: No need to
setting / tuning, fully
operational from first wheel
turn
Reduced project risk & costs



Thank you for the attention

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