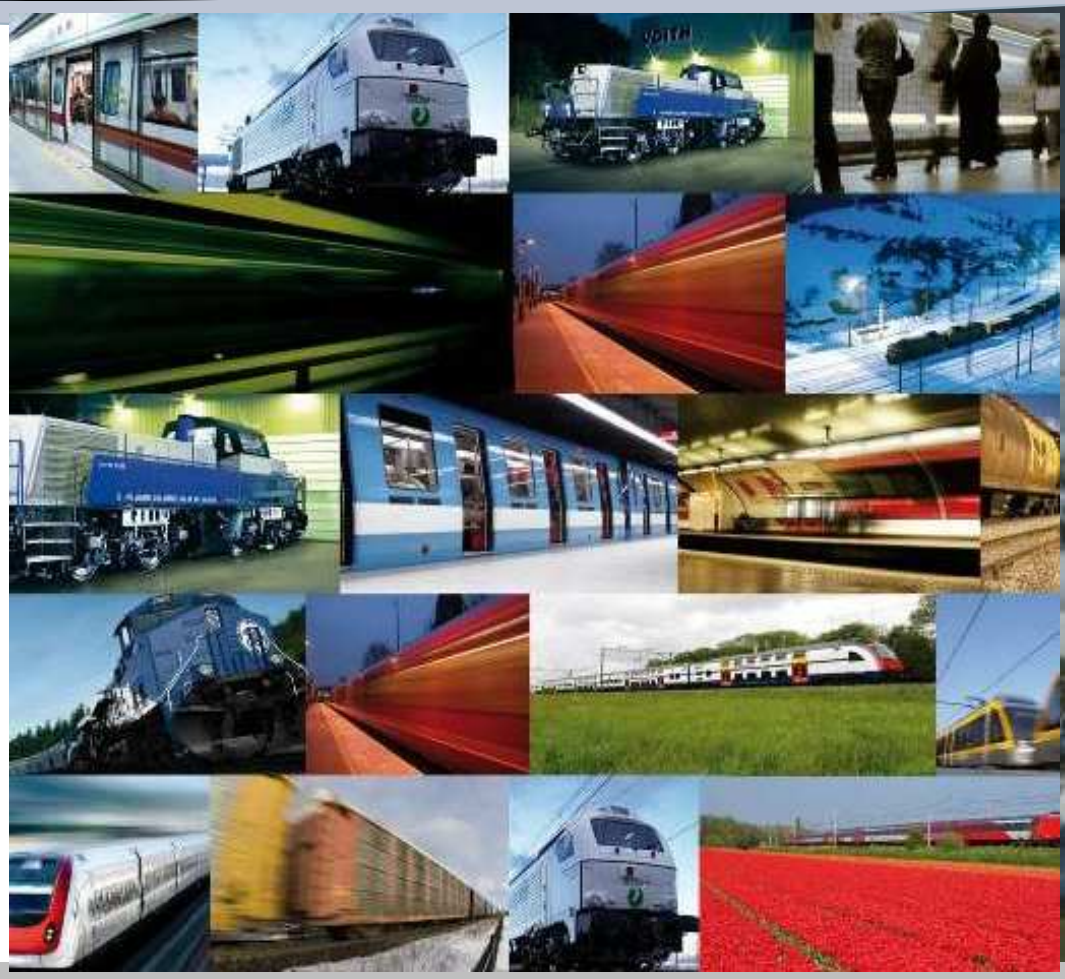
KNORR-BREMSE

Wheel Slide Protection Device



Rajiv Agarwal

14th CMG Meeting, PURI

September 16, 2014

Agenda

Company Overview	▪ Group Product Overview ▪ KB India New Facility
Functioning of WSP	▪ Main Components ▪ Salient features of WSP ▪ Control Logic ▪ Working principle of WSP
Maintenance of WSP	▪ WSP fault codes ▪ WSP checking procedure ▪ Precaution for failure of WSP Parts
Fault diagnosis	▪ Troubleshooting
Spares stocking at sheds	▪ Recommended list of spares

Answer for a world of mobility

Knorr - Bremse



Every day, more than 1 billion people put their trust in systems from Knorr-Bremse

Every day, more than 1 billion people put their trust in systems from Knorr-Bremse



Knorr-Bremse is the world's leading manufacturer of braking systems for rail and commercial vehicles

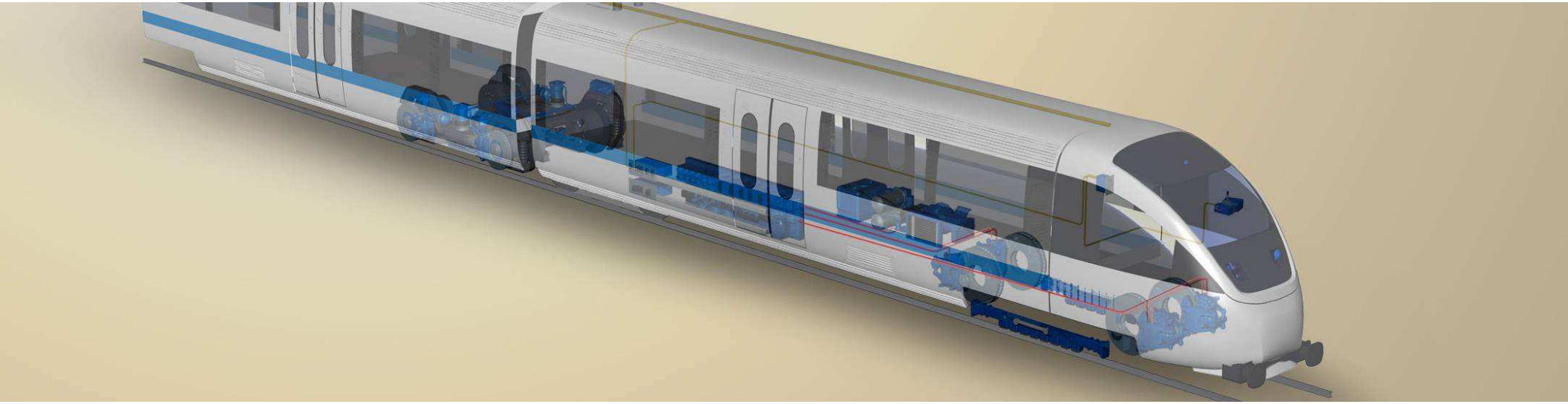
Rail Vehicle Systems

- **Locomotives**
- **High-speed trains**
- **Passenger rail cars**
- **Freight cars**
- **Streetcars**
- **Multiple units**

Commercial Vehicles

- **Trucks**
- **Buses**
- **Engines**
- **Special vehicles**

Braking systems



Brake control

- Control units
- Carrier systems
- Brake control valves
- ESRA components
- Sensors

Bogie

- **Brake discs and pads**
- **Brake caliper units**
- **Tread brake units**
- **Track brakes**
- **Sanding systems**

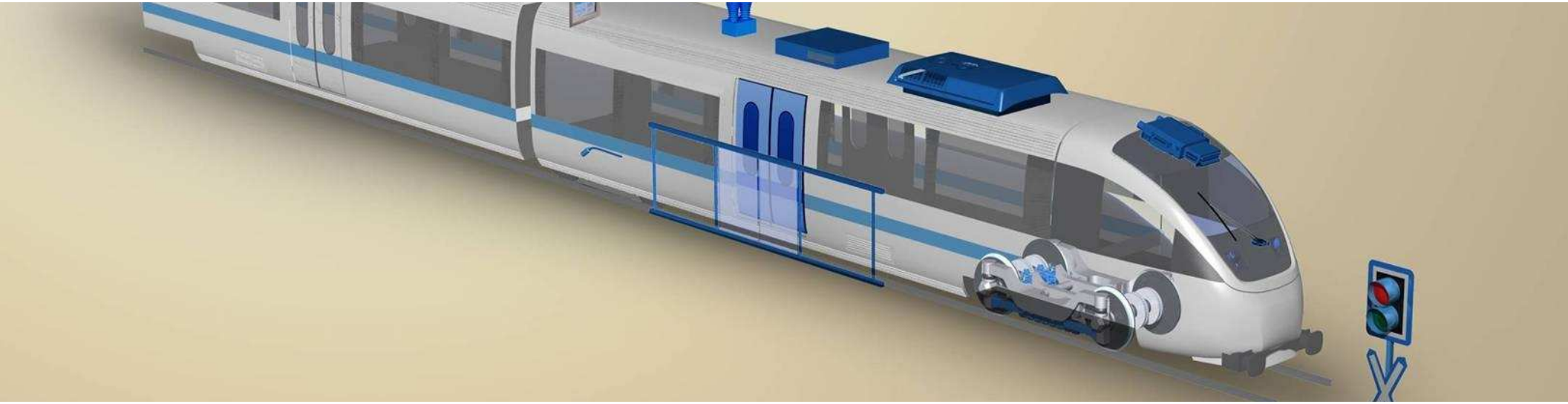
Air supply

- **Compressors**
- **Air driers and filters**
- **Condensation collectors**

Hydraulics

- **Hydraulic units**
- **Actuators**

On-board systems



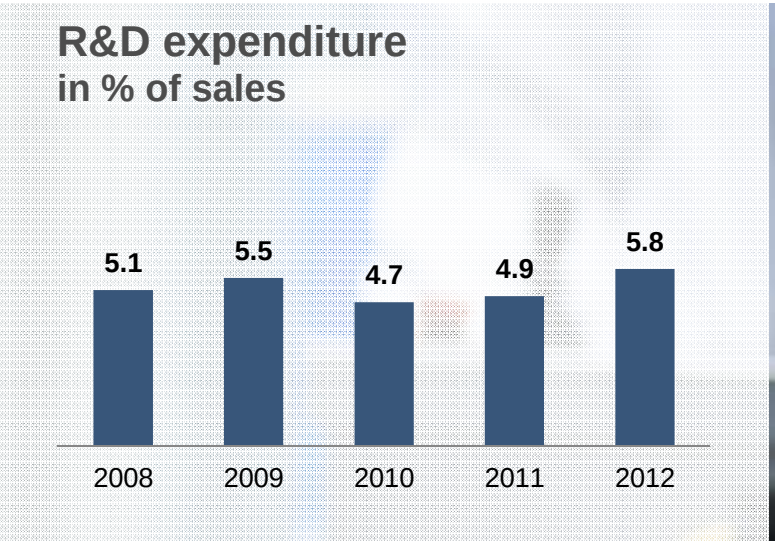
On-train

- Door systems
- Air-conditioning systems
- Power supply
- Windscreen wipers
- Information systems
- Driver information systems

Off-train

- Platform screen door systems
- Train safety systems
- Signalling systems
- Passenger information systems
- Drive simulators

Innovation is the key to future market success



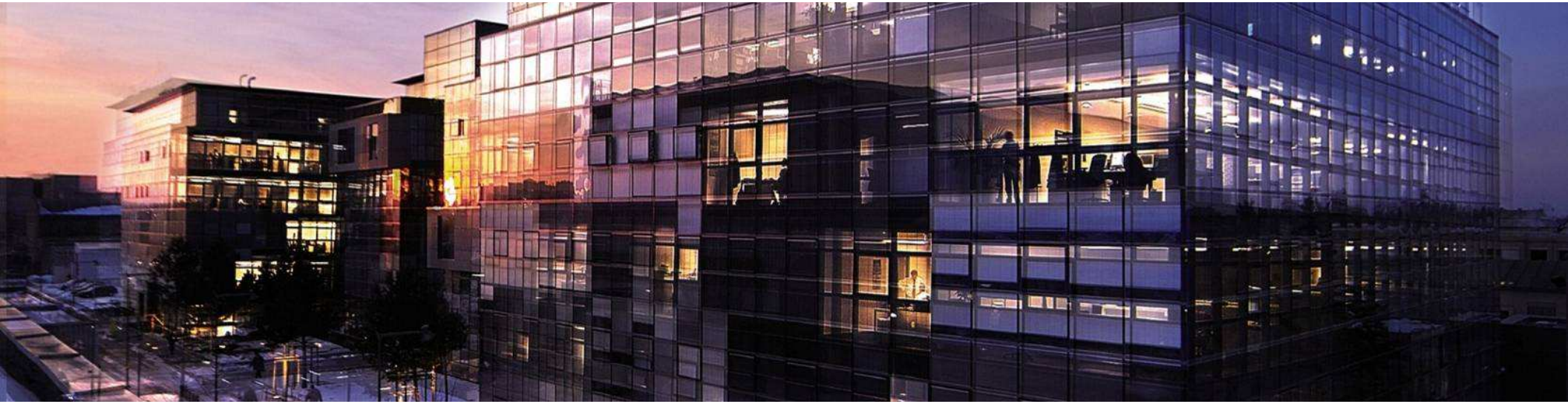


Research and development

- 5.8 % of turnover – 250 m € (2125 cr INR) is spent on development of new products
- 3,193 employees working worldwide in research and development (incl. projects).
- Owns 1765 patents.
- Collaboration with many scientific institutions

16 new subsidiaries and plants have opened since 2005

Munich TCK, Germany



2005
- Munich TCK, Germany
- Bristol, England
- Melksham, England
- Arcore, Italy
- Pune, India

2006
- Sakado, Japan

2007
- Bowling Green, USA
- Suzhou II, China

2008
- Getafe, Spain

2010
- Budapest, Hungary
- Kematen, Austria
- Liberec, Czech Republic

2011
- Acuna, Mexico

2012
- Microelettrica, Italy

2013
- Westminster, USA
- Itupeva, Brazil
- Faridabad & Pune, India

2014
- Granville, Australia
- Kecskemét, Hungary

KB India – New Facility



- Founded - 1993
- 100% subsidiary of Knorr-Bremse, Germany
- ISO-9001-2000 Certified Company since1998
- IRIS Certified Company since July 2009.
- **More than 400** Permanent Employees
- Moved to new Green Field Plant in mid 2013.

- Equipped with ultra modern Industrial facilities including machining, assembly, surface treatment & various type testing facilities
- KB India is housed with Design Centre catering to KB Group
- Fully Air-Conditioned and Dust proof Shop-floor facilities
- Pan India Sales & Service Support Network with regional offices in North, East, West and South

Assembly/ Machine Shop











- Equipped with ultra modern Machining Facilities
- Fully Air-Conditioned and Dust proof Shop-floor facilities.
- High Tech assembly lines
- Floor paint to prevent oil from going in the soil.

Zinc & Manganese Phosphating, Waxing, Anodising & Painting Lines are installed In-house









Warehouse & Receipt Inspection









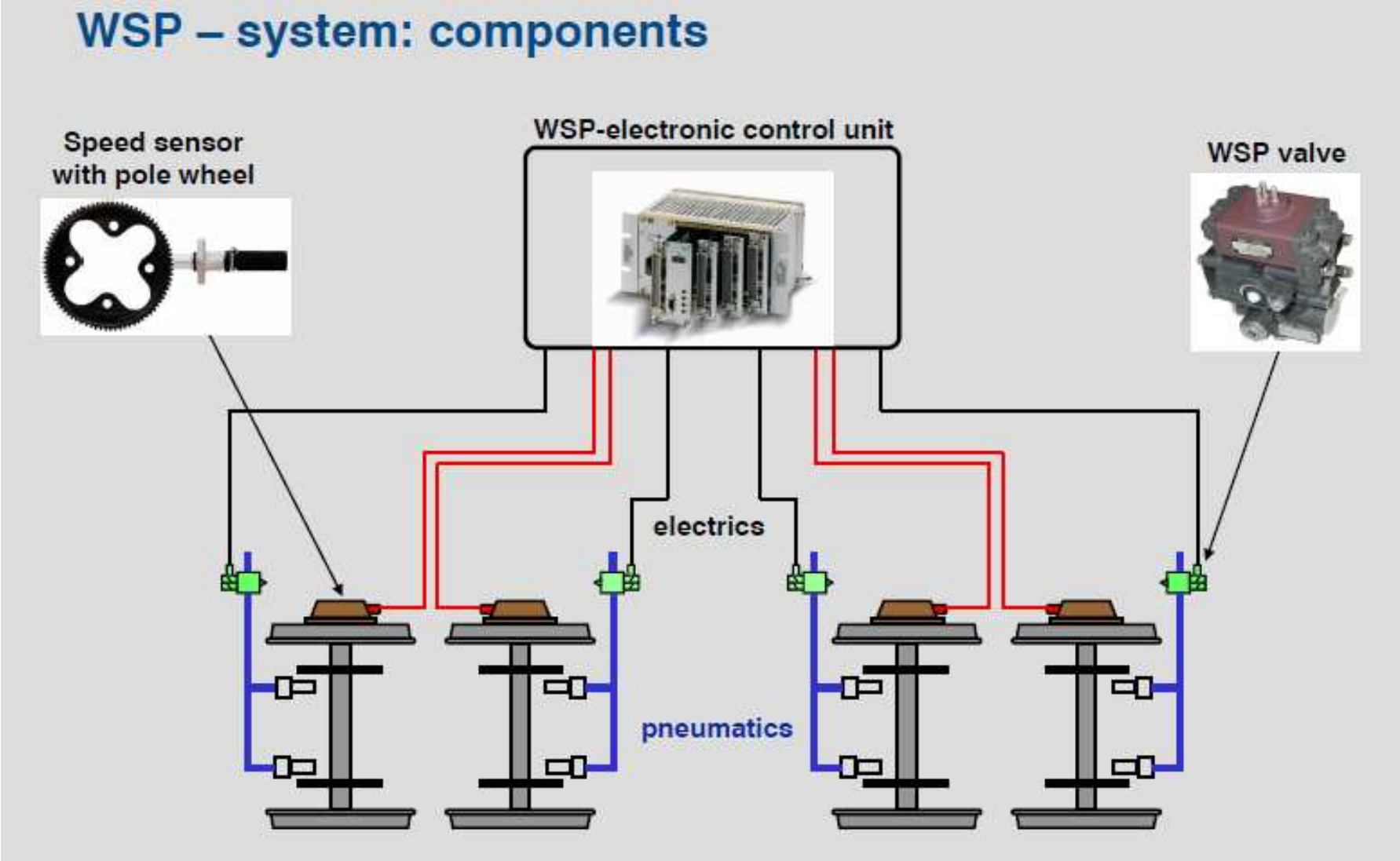
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Functioning of WSP	■ **Main Components** ■ **Salient features of WSP** ■ **Control Logic** ■ **Working principle of WSP**
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The main components for WSP (per coach) are

Description of items	Qnty per Coach
Control Unit MGS2 consisting of	1
MB04 card	1
PB03 card	1
EB01 card	1
Set of connector	1
Phonic / Toothed wheel	4
Speed Sensor	4
Junction box for Speed sensor	4
Junction box for Dump Valve	2
Connectors	4
Anti skid valves / Dump Valves	4
Pressure switch	1

Main components for WSP system



Salient features

- WSP device fitted to the vehicle has the role of reducing excessive wheel sliding resulting from brake applications in situations where wheel / rail adhesion is temporarily impaired and prevents wheels from locking / skidding.
    - Safe protection of all wheelsets from locking even in the face of extremely low adhesion due to wet leaves on the rails.
    - Makes good use of the wheel / rail adhesion by regulating brake force.
    - Allows short stopping distances by improving the mean coefficient of adhesion.
    - Low air consumption
    - Low power consumption
- Meets the requirements of UIC Code 541-05 and is listed in the UIC appendix L as approved system.
- The wheel slide protection (WSP) system has evolved from KNORR BREMSE's proven experience in the field of microprocessor-based "wheel slide control". The control units are based on **E**lectronic **S**ystem for **R**ailway **A**pplications (ESRA) technology.

WSP system for LHB coaches

UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

UIC - CERTIFICATE

Number / Nummer / Numéro: B-003/2009-02

In accordance with UIC-conformity-assessment in December 2006 becomes for the vehicle component:
Gemäß UIC-Konformitätsbewertung vom Dezember 2005 wird bestätigt, dass die Fahrzeugkomponente:
Selon la procédure UIC de l'évaluation de la conformité de décembre 2005, il est confirmé que le composant de véhicule:

Wheel slip protection device / Gleitschutzgerät / anti-enrayeur:

Knorr MGS 2

for application in coaches, locomotives and EMU/DMU up to a maximum speed of 405 km/h
für Verwendung in Reisezugwagen, Lokomotiven und Triebzügen bis zur Höchstgeschwindigkeit von 405 km/h
pour utilisation dans voitures, locomotives et automoteurs jusqu'au vitesse maximale de 405 km/h

the company / der Firma / de la société
KNORR-BREMSE Systeme für Schienenfahrzeuge GmbH
Moosacher Str. 80
D - 80809 München, Deutschland

corresponds to the requests of the set of rules named in the appendix 1 point 1.
den Anforderungen des in der Anlage 1, Punkt 1, genannten Regelwerkes entspricht.
satisfait aux exigences définies dans l'Annexe 1 point 1.

The technical documents current for this Certification are stated in Appendix 1 point 2.
Die für diese Zertifizierung geltenden technischen Dokumente sind in der Anlage 1, Punkt 2 angegeben.
Les documents techniques applicables à cette certification sont repris à l'Annexe 1 point 2.

UIC
General Directorate / Generaldirektion / Direction Générale
Department Research & Technology
Abteilung Technik & Forschung
Sector Expert Team: 7
16, rue Jean Rey
F-75015 Paris

Paris, 4 February 2009

Frank Minde
Chairman SET 7

Gabriele Maffei
Director Research & Technology

UIC-Certificate Nr: B-003/2009-02

1.) UIC confirms that this vehicle component defined above corresponds to the requirements of the set of rules named: / Die UIC bestätigt, dass die umseitig zitierte Fahrzeugkomponente den Anforderungen der unten genannten Regelwerke entspricht: / L'UIC confirme que le composant de véhicule défini ci-dessus est conforme aux exigences définies dans la réglementation :

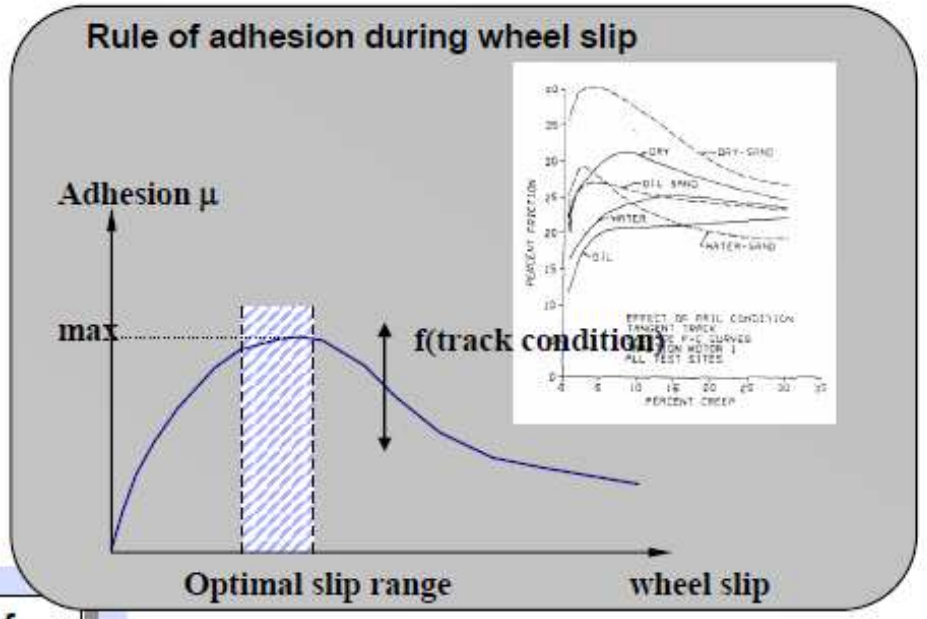
- **UIC Leaflet 541-05, 2nd edition August 2005**
  UIC-Merkblatt 541-05, 2. Ausgabe, August 2005
  Fiche UIC 541-05, 2ème édition, août 2005

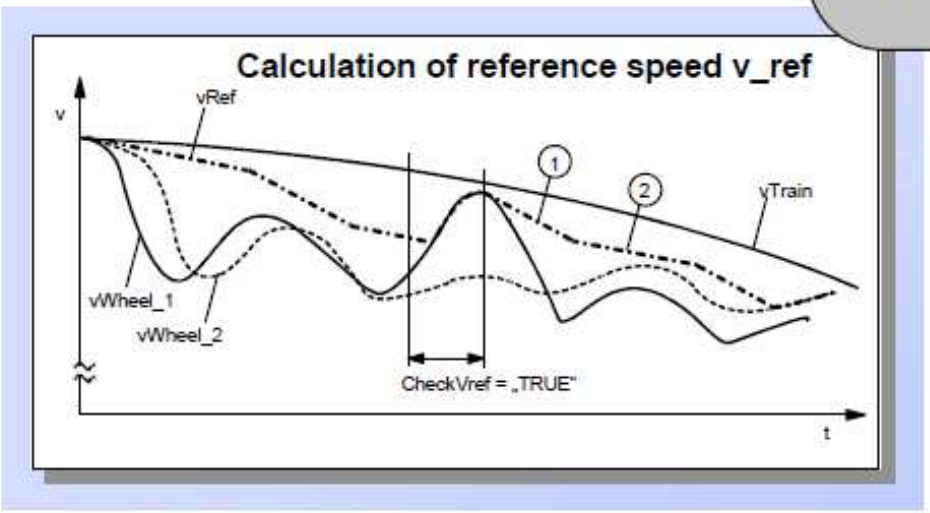
2.) The technical documents applicable to this Certification are :
Die für diese Zertifizierung geltenden technischen Dokumente sind :
Les documents techniques applicables à cette certification sont les suivants :

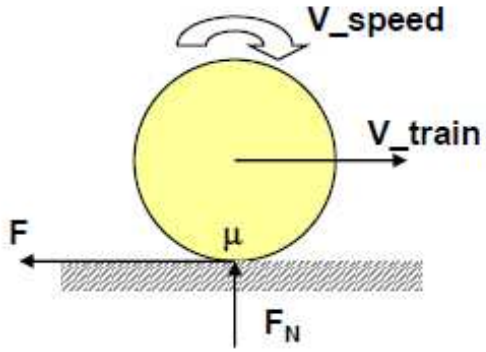
- Request of Knorr-Bremse from : / Antrag der Fa. Knorr-Bremse vom : / Demande de la société Knorr-Bremse du :
  07.04.2008
- Functional description of the system/ Allgemeine Systembeschreibung-Nr.: / description générale du dispositif :
  S-IE21.21-de, 02/2001, Rev.02, Technische Beschreibung / Technical description/ Notice technique
- Test specifications / Prüfspezifikation / Specifications d'essai
  UIC 541-05
- Test reports / Prüfberichte: / Rapports d'essais:
  - **Prüfbericht 66.09/99 von DB, „Gleitschutz-Untersuchung am IC-Steuerwagen Bpmbdzf 297.3"**
  - **Prüfbericht 66.30/00 von DB, „Gleitschutz-Prüfung ICE-TD, BR605, 2. Teilbericht"**
  - **Prüfbericht 831-PR-0500-06 von DB, „AVE S 103 Bremstechnische Prüfung"**
  - **Prüfbericht 23/07, IdentNr. 3EGH00031-5336, von BOMBARDIER, „Elektrische Lokomotive E 186 (TRAXX-Lokomotive), Prüfung des pneumatischen Gleitschutzes sowie des elektrischen Kraftschlussreglers"**
  - **Prüfbericht 08P5871-VTZ213-062145-PR01 von DB zur bremstechnischen Prüfung der Diesellok VOSSLOH EURO 4000**
  - **Prüfbericht UT SF RP 1820 von TRENITALIA, Prüfstandsversuche mit SKF Gebern**
  - **Prüfbericht UT SF RP 1551 von TRENITALIA, Prüfstandsversuche mit FS Gebern**
- Assessment of / Gutachten von: / Expertise de:
  R. Körber, Grillgasse 48, A-1100 Wien
  J. Eisenblätter, Weserglacis 2, D-32423 Minden
  W. Notten, Stationshal 17, NL - 3500 GA Utrecht
  document B 126 RP G4, November 2008
- Conclusions of Sector Expert Team 7 "Braking" / Schlußfolgerungen des Sector Expert Teams 7 „Bremswesen: / Conclusions du Sector Expert Team 7 "Freinage":
  SET 7 – Paris, 22-01-2009, TOP 3.3

Basics

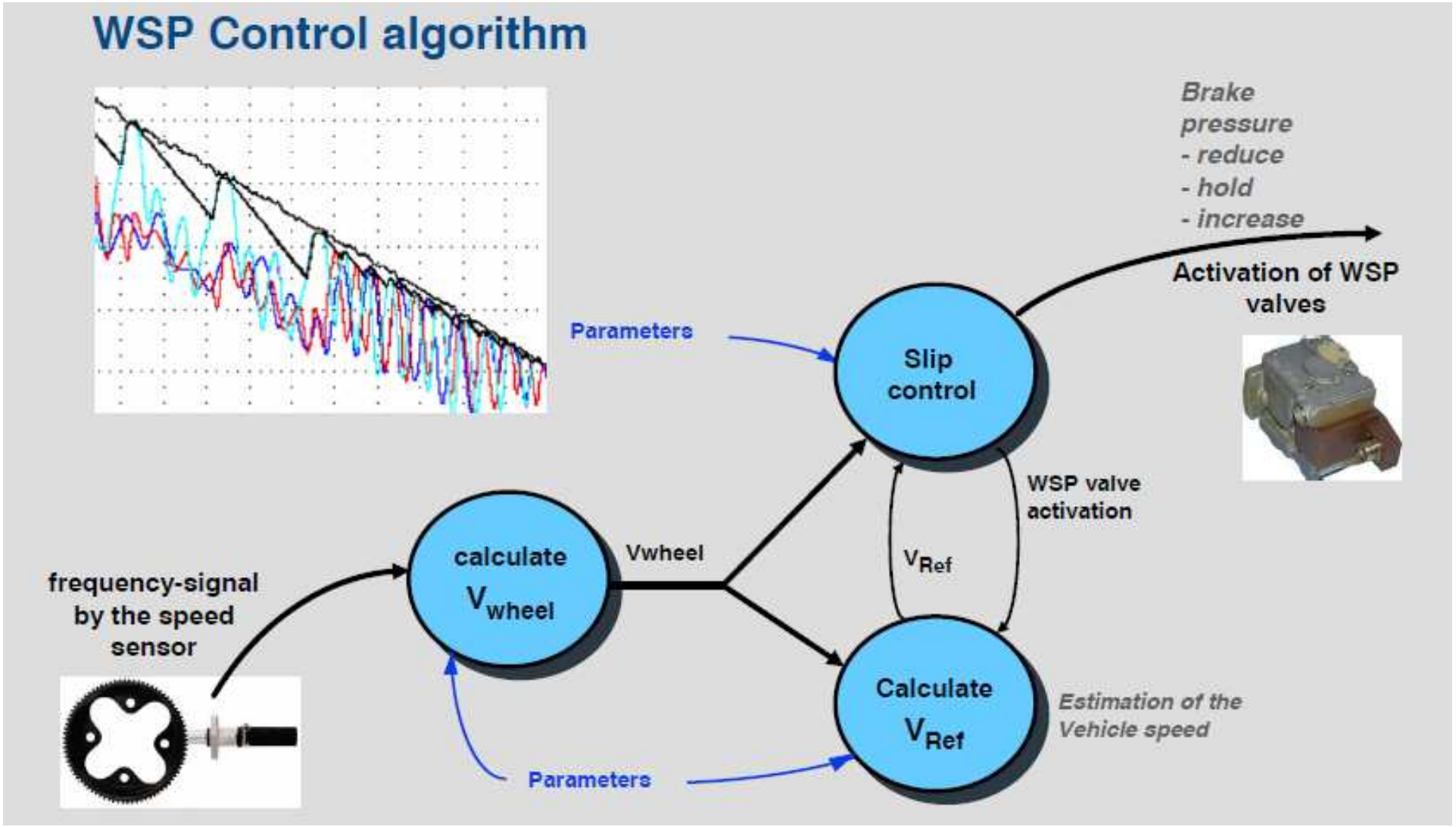
- There is a maximum of adhesion at a certain slip between wheel and track
- The adhesion depends on the track condition
- The WSP system calculates the reference speed based on the available wheel speed informations



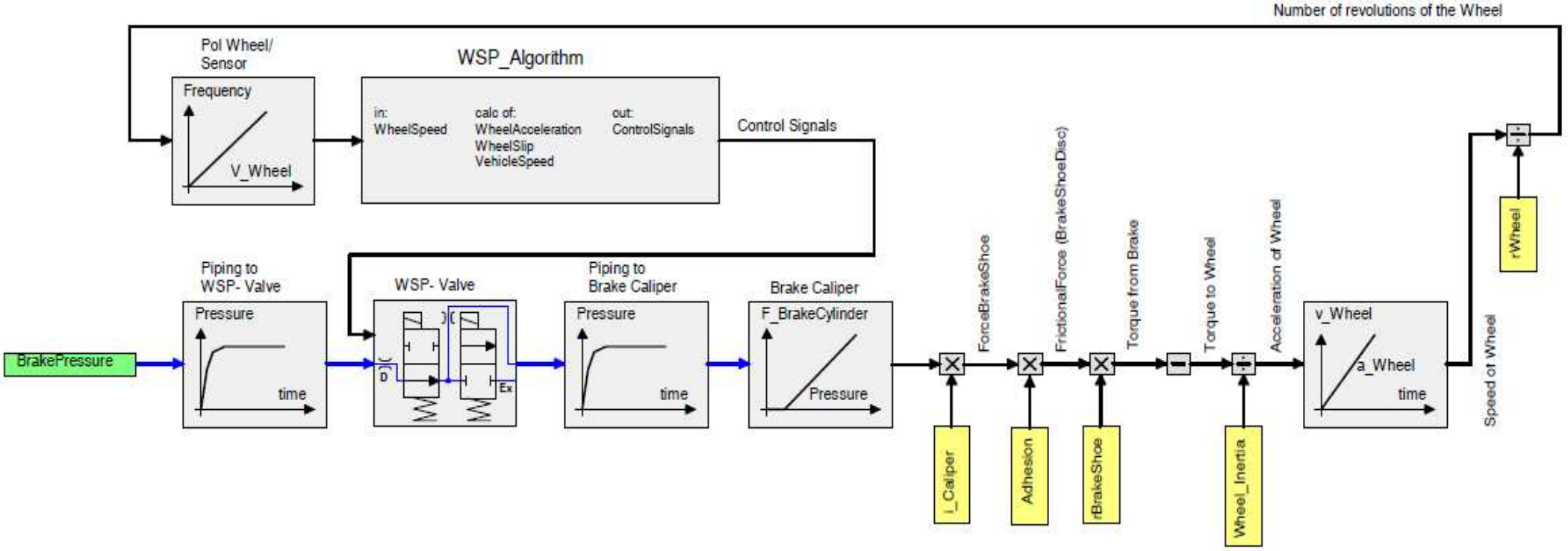




Control Logic



Control Logic



Working principle of WSP – Control Loop

The wheel slide protection (WSP) system forms a closed loop through the brakes and wheel set.

The speed sensor detects the speed of the wheel without physical contact and sends a proportional frequency signal to the control unit.

The control unit evaluates the frequencies from all of the vehicle’s speed sensors and generates signals enabling the anti-skid valve to control the brake cylinder pressure.

The gradient for decreasing or increasing the brake cylinder pressure can be lowered by “pulsing".

The control loop adjusts the brake cylinder pressure to the instantaneous wheel-to-rail adhesion, keeping the wheels within their optimum range of slip and ensuring maximum possible brake force transmission.

Static and Dynamic Trials

In May 2012, the static and dynamic trials for working of WSP system on LHB coaches was conducted with RDSO & NR in the stretch between Delhi cantonment to Rewari.

KNORR-BREMSE

LHB - Coaches LHB - Coaches Indian Railways May 2012

Results of Wheel-Slide-Protection Tests	Doc. No.: TA28601/762
	Revision: 01 - en

10 Conclusion

Tests were conducted to prove that the Knorr-Bremse WSP system works reliably and effects an optimal utilization of the given friction conditions.

All tests defined in the test specification were conducted.

The test results satisfy the requirements.

Tests in Emergency brake mode and at velocity of 110 km/h were conducted on dry tracks for reference. As required by the directive there was no WSP-valve activity during any of the tests on dry tracks.

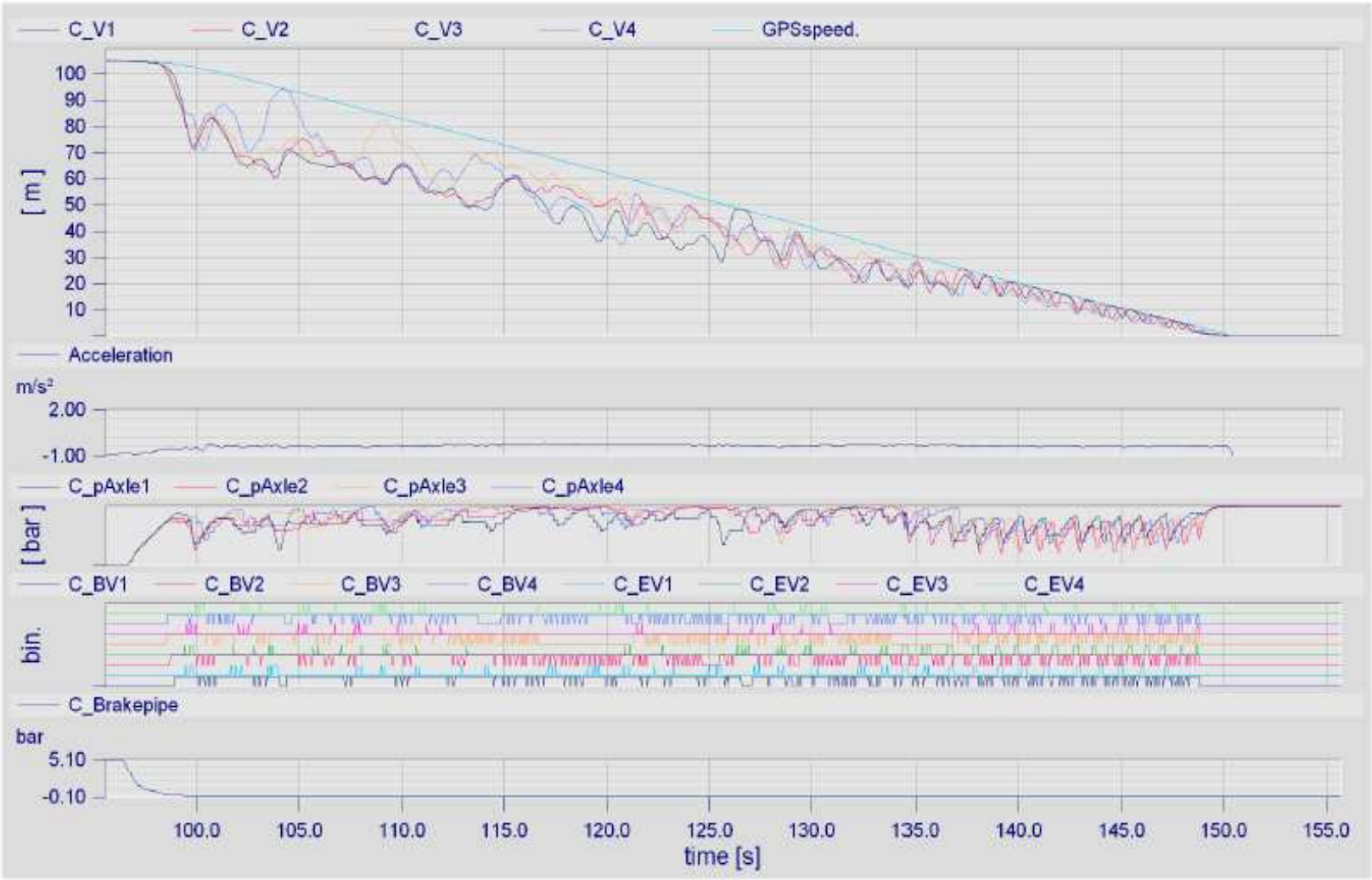
Subsequently tests with reduced adhesion (on sprayed tracks) were performed.

The test results were assessed according to the test specification, taking into account the conditions initial adhesion and minimum slide.

No blocked wheels happen during the WSP test run.

Static and Dynamic Trials

Graphs during dynamic trials on EOG Coach with Dump valve activity



Static and Dynamic Trials

Graphs during dynamic trials on Power Car with Dump valve activity



WSP system on board the LHB coach



Control Unit

The World of ESRA



Intelligent Brake Handle





EP-Compact Control Unit



MBS Module



ESRA Underfloor



Compact WSP MGS2-C



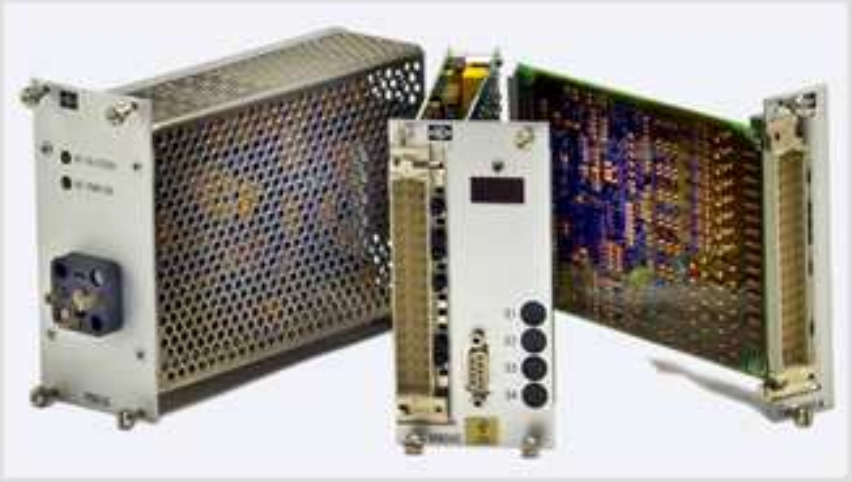
dMICEF module

ESRA = Electronic System for Railway Applications

ESRA Boards: Overview

Power Boards

- PB01: 24V, 36V, 48V
- PB03: 72V, 110V

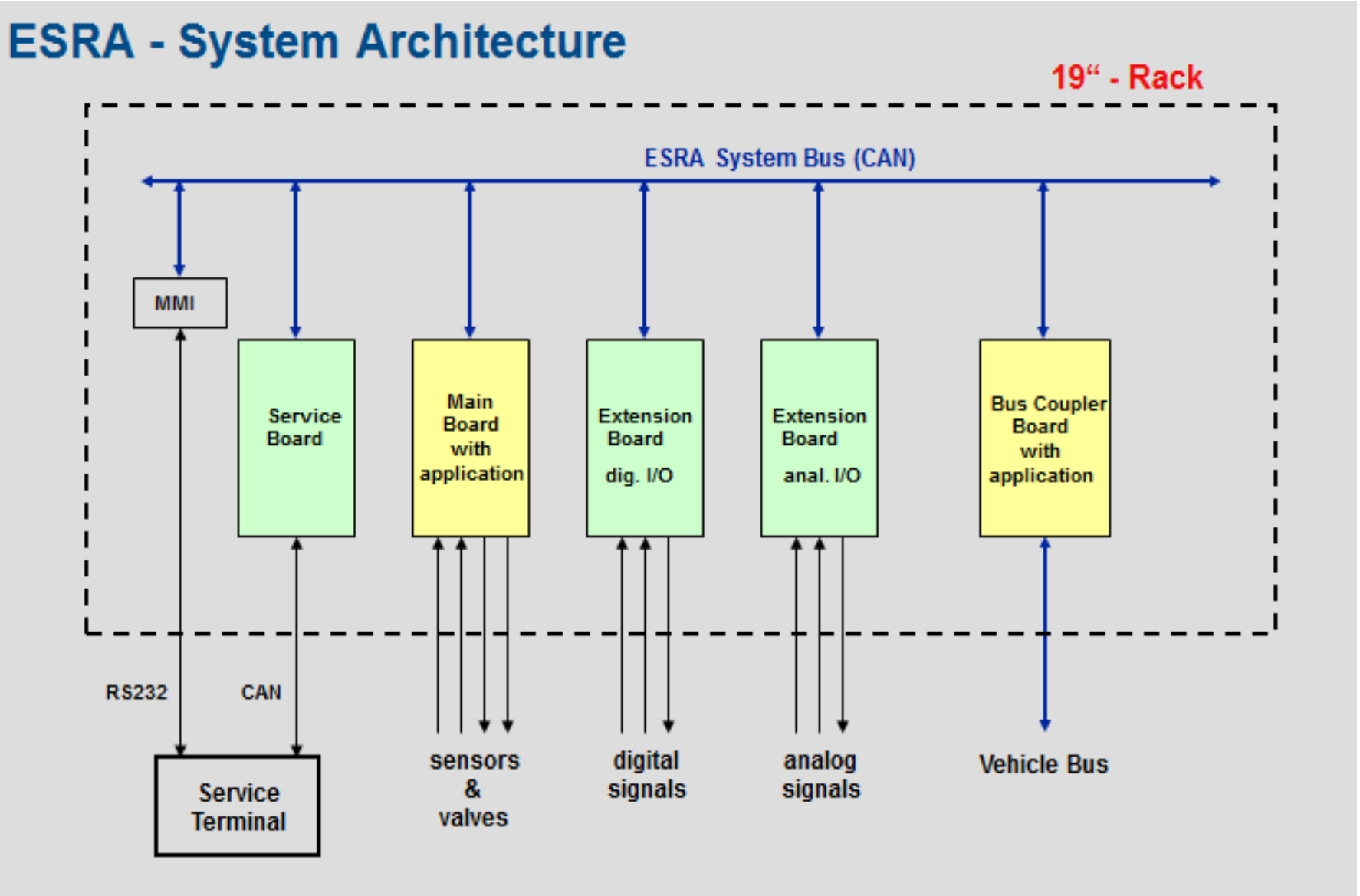


Extension Boards

- EB01: Binary I/O
- EB02: Binary Input
- EB03: Analog I/O
- EB04: Brake Handle

Main Boards with application

- MB03/ MB04: For brake control, WSP and other functions
  Main Controller C167 + fail safe Controller
  Sensor-Inputs, Power-Outputs
- MB04C: like MB03 / MB04 plus MMI, RTC, datalogger
- MB07: Controller C167, for additional performance


ESRA - System Architecture
19“ - Rack
ESRA System Bus (CAN)
MMI
Service Board
Main Board with application
Extension Board dig. I/O
Extension Board anal. I/O
Bus Coupler Board with application
RS232
CAN
Service Terminal
sensors & valves
digital signals
analog signals
Vehicle Bus

PB03 Board

The power board supplies all the voltages for powering the boards, actuators and sensors.

If the vehicle is left to stand idle, the control unit can be switched off to a “standby" mode of low primary current consumption (standstill sleeper mode). The unit is reactivated by a pressure switch at a preselected level in the feed pipe.

MB04 Board

Wheel slide protection i.e. acceleration and slip control, is implemented entirely on board MB04. It contains all the electronic peripherals for individual wheel slide control at up to four wheels or wheel sets. The anti-skid valves are powered by 24V from board MB04. MB04 has a man-machine interface (MMI) integrated into its front panel.

Man-machine interface

MGS2 has a man-machine interface (MMI) integrated into its front panel. The MMI peripherals comprise:

− a 9-pin Sub-D female connector for the RS232 interface (to connect a service terminal),

− a 4-character alphanumeric display, and

− 4 control keys.

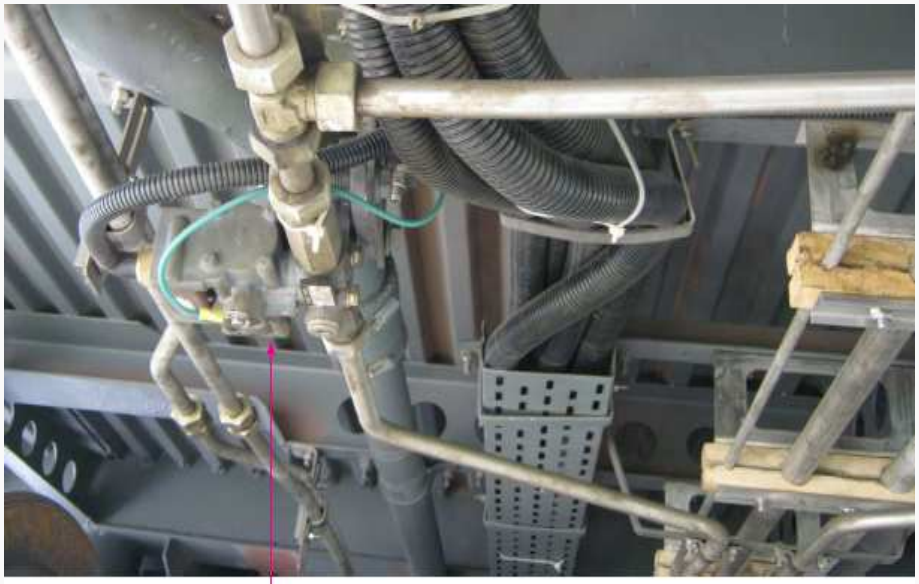
EB01 Board

EB01 is an extension board in the MGS2 control unit. It provides digital inputs and outputs. It is also utilized for supplementary functions such as door control.

Anti-skid valves

The anti-skid valve works as an actuator in the wheel slide control loop, and is activated by the control unit.

The anti-skid valve is designed to reduce the brake cylinder pressure step by step whenever required.



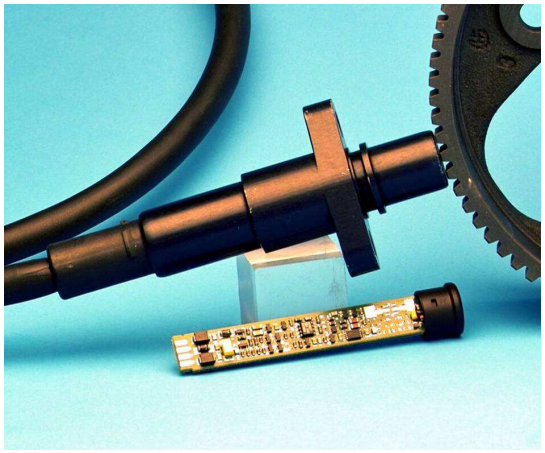
Anti Skid Valve (Dump Valve)



Speed sensors

The speed sensor scans a ferromagnetic rotating gear (tooth module / Phonic wheel) that is centered over the axle. It works without physical contact and does not wear. The frequency of the digital current signal is directly proportional to the circumferential speed of the rotating gear. When the vehicle is at standstill, the output current from the sensor assumes the value (low & High).

The control unit monitors the speed sensors for correct operation at both standstill and on the move. Open circuits and faults to ground are identified. The electronic part of the speed sensors withstands short-circuiting, prevents reversal of its polarity and resists EMC interference. Rotating gears with 80 teeth are used as standard.







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WSP Fault Codes

Display – **99** means System OK.

Display – **95** means System OK, but some previous fault codes has got logged (Volatile – can be erased by pressing S3 button on MB 04 Card).

Display – **7201** means fault in one wheel set.

Display – **7301** means fault in several wheel set.

Display – **8888** Display Test (Shows in sequence of diagnosis / testing) .

Display – **89** Testing Mode (Dump Valve self testing in progress).

Display – **0301** means fault noted / sourced / related to MB 04 Card (Shows in sequence of diagnosis).

Display – **0201** means fault noted / sourced / related to EB 01 Card (Shows in sequence of diagnosis).

WSP Fault Codes

Note down fault code (displayed after **0301/0201** after pressing S1 button).

Fault code display in four digit. Ignore last two digit (01) eg If connector of dump valve 3 broken or cut during run then display will show **7201**. After pressing S1 button display will show in following sequence : **8888-7201-0301-3401-7201**. Thus fault code is **34**.

In fault code first digit indicate axle number (1, 2, 3 & 4). Second digit indicate the fault number. Fault number is described below:

1 – Speed Sensor Open / Short Circuit. (Check wiring of speed sensor, wiring is either open or short circuited)

2 – Speed Sensor Signal Error. (Check gap between speed sensor & phonic wheel teeth.) .

3 – Dump Valve Short Circuit. (Check wiring pertaining to dump valve)

4 – Dump Valve Open Circuit. (Check wiring pertaining to dump valve)

To understand fault code please refer the table in next slide.

WSP Fault Codes

	Axle 1	Axle 2	Axle 3	Axle 4
Speed Sensor Open / Short Circuit	11	21	31	41
Speed Sensor Error	12	22	32	42
Anti Skid Valve Short Circuit	13	23	33	43
Anti Skid Valve Open Circuit	14	24	34	44

WSP Fault Codes

Display	Fault	Source	Connected with:
02	Digital I/Os	Board EB01A	
03	Central processing unit	Board MB04A	
10	Time-out	Board MB04A	Wheelset 1
11	Short-circuit/open circuit	Speed sensor 1/feeder	
12	Signal error	Speed sensor 1	
13	Short-circuit	Valve 1/feeder	
14	Open circuit	Valve 1/feeder	
15	Safety monitor defective (test run)	Board MB04A	
20	Time-out	Board MB04A	Wheelset 2
21	Short-circuit/open circuit	Speed sensor 2/feeder	
22	Signal error	Speed sensor 2	
23	Short-circuit	Valve 2/feeder	
24	Open circuit	Valve 2/feeder	
25	Safety monitor defective (test run)	Board MB04A	
30	Time-out	Board MB04A	Wheelset 3
31	Short-circuit/open circuit	Speed sensor 3/feeder	
32	Signal error	Speed sensor 3	
33	Short-circuit	Valve 3/feeder	
34	Open circuit	Valve 3/feeder	
35	Safety monitor defective (test run)	Board MB04A	
40	Time-out	Board MB04A	Wheelset 4
41	Short-circuit/open circuit	Speed sensor 4/feeder	
42	Signal error	Speed sensor 4	
43	Short-circuit	Valve 4/feeder	
44	Open circuit	Valve 4/feeder	
45	Safety monitor defective (test run)	Board MB04A	
70	Speed signal fault, door control		
71	Speed signal fault, electromag. track brake	Board EB01A	
72	Fault at one wheelset		
73	Fault at several wheelsets		
74	Safety monitor fault	Board MB04A	
c8	Activation fault, cumulative fault signalling	Board EB01A	
S2	Connector defect, board EB01A	Board EB01A	
S3	Connector defect, board MB04A	Board MB04A	
8888	Display test		
89	Test running		
95	Volatile faults		
99	System good		

WSP checking procedure at Sheds / Depots / Workshops

Check WSP display (in MB04 Card at WSP panel placed in power panel of coach) before start of maintenance.

WSP display '**99**' means system is healthy. Other testing need to be followed (Dump Valve Self Test by pressing 'S2' switch), if required.

WSP display '**95**' means present status is healthy but system has logged previous fault and system is serviceable. To check the previous fault please follow following steps :

Press 'S1' switch display for less than 3 Sec. Display will show in following sequence : **8888-95-7201(/7301)-0301-A1F101-A2F201-…..-95**. Note down the failure code coach wise and date wise. Take corrective measure in respective areas.

Proceed with other testing (Dump Valve Self Test by pressing 'S2' switch).

DON'T press 'S3' switch (to clear volatile fault memory) and let the coach run with **95** code. But ensure that the required repairs is done for the fault which is showing / logged.

Follow the same procedure in next maintenance or testing. Record & check if any new fault is logged.

WSP checking procedure at Sheds / Depots / Workshops

WSP display '**7201' or '7301**' means there are some current fault logged in system. To check faults follow these steps:

Press 'S1' switch for less than 3 sec. The display will show in following sequence : **8888-7201 (/7301)-0301- A1F101-A2F201-…..-7201 (/7301).** Note down the failure code coach wise and date wise in log book. Rectify according to fault code (A1F1 , A2F2 etc.).

Check the display whether **95** or **7201 (/7301)**. If **95** then proceed with further testing. If fault still exists then rectify accordingly.

DON'T press 'S3' switch (to clear volatile fault memory) and let the coach run with 95 code. But ensure that the required repairs is done for the fault which is showing.

Follow the same procedure in next maintenance or testing. Record and check if any new fault is showing / logged.

Note : If 'S1' switch pressed for more than 3 sec then fault code will be displayed one by one by pressing S1 each time.

Precautions for reduction of Card Failures

Card failures mostly take place because of the following

1) High surges in the electric power supply especially because of welding & other equipment's which draw very high current. Ensure electric supply to control unit is off while using such equipment's.

2) Disconnecting cards when power is ON & display is “LIVE”. Ensure fuse 63 & 65 are removed so that no power supply goes to control unit before removing, loosening or replacing any of the cards in the board.

3) In case download is being taken by using an additional SB03A (part no STN28328) service board / can connector, ensure power is off or fuse is removed before fitting or removing the Can card (In case Railways uses the ST03 Software).

4) Short circuit in the control panel or connecting wrong wires during repair of any other equipment in the control panel which has relevance to control unit provided by Knorr Bremse. Railway electricians to take precautions.

5) Loose connections result into sparking & short circuit of card. Railway electricians to ensure proper connections.

Speed Sensor



Precautions for reduction of Speed Sensor failures

In general the speed sensor Gap should be checked every quarter or whenever the fault 12, 22, 32, 42 is showing in the WSP display. It can be corrected by addition or removal of shims.

The gap has to be maintained between 0.9 mm to 1.4 mm.

In case of damage of the speed sensor, it needs to be replaced. It is not recommended to repair the damaged sensor. Kindly use only Knorr make speed sensor. Other make of speed sensors may not provide proper input for correct functioning of our WSP.

In case of open or short circuit of the speed sensor fault 11,21,31,41 will show in the display. Kindly check the wirings & repair the same. If not repairable then replace.

Phonic wheel







Precautions for reduction of Phonic Wheel failures

1) Ensure correct tightening torque. (As per Alstom manual, Tighten to 21 NM).

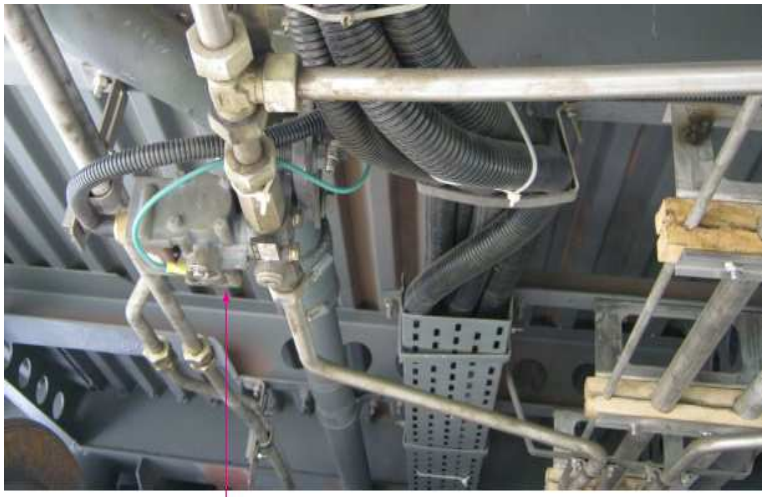
2) Ensure proper Quality of Screws & Washers. (As per RDSO instructions to all Zonal Railways , M8 size screw to IS 1367 Pt.III Class 10.9 along with spring washer to the IS 3063 type-B should be used for securing phonic wheel. LOCTITE 243 or equivalent glue should be used to ensure rigid connection between internal and external thread).

3) Ensure wheel speed sensor Gap is maintained (Kindly maintain the gap of 0.9 mm to 1.4 mm. Less gap can result in touching of wheel sensor with phonic wheel & more gap can result into incorrect signal from sensor to Control unit).

4) Ensure use of proper tools for tightening / removal. (Kindly use box spanner with proper length of extension for tightening the phonic wheel. Use of improper tools / spanners can damage the head of the screw).

Dump Valve (Anti skid valve) & Connector





Anti Skid Valve (Dump Valve)









Precautions for reduction of Anti skid valve & connector failures

1) Wires of Anti skid valve open / short circuited mostly due to hits / loose connections. Railways to ensure that wires are not loose /open / short circuited & accordingly repair / replace.

2) Damage to dump valves due to ballast hits resulting into damage to pins, dump valves, connectors. Visual checking needs to be done. Replacement of damaged parts is necessary.

3) Improper fitment / tightening of connector on dump valve resulting in damage to pins & threading. Railways to correctly fit the connector during fitment / installation.

4) Wires from speed sensor junction box to control panel & from control panel junction box to Anti skid valve get damaged due to ballast. These need to be checked & monitored regularly.



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Spares stocking at sheds	▪ Recommended list of spares

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty. per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Wheel speed sensor	II35456/20013 or STN31450/205 A18U	4	Damage of sensor due to ballast / hits	Check for any visual damages in every trip maintenance . Replace sensor.	There are two ways of Static testing 1. By a pole wheel simulator. 2. by pressing S2 (Self Test) on WSP control panel.	No specific maintenance is required.
			Damage of sensor due to rubbing with phonic wheel	Ensure correct sensor gap on every quarterly schedule or when required. Also ensure phonic wheel is tightened properly, depending on extent of damage. Replace sensor when found damaged.		
Dump valve / Anti Skid Valve	II34652/15024	4	Damage of valve due to hits / ballast	Check for any visual damages in every trip maintenance. Replace dump valve.	There are two ways of Static testing 1. By a pole wheel simulator. 2. by pressing S2 (Self Test) on WSP control panel.	Overhauling of Dump valve is recommended every 36 months (POH).
			Damaged or loose connections to anti skid valve	Tighten connection, repair or replace wires as necessary.		
			Damaged / broken pins due to mishandling / ballast hits	Check for any visual damages in every trip maintenance . Tighten the connector on dump valve with care. If non repairable, then replace dump valve.		

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Connector /plug	N62148/10000	4	Damage of connector due to mishandling / ballast hits	Check for any visual damages in every trip maintenance . Tighten the connector on dump valve with care. If damaged, then replace connector.	Visual Check	No specific maintenance is required.
Junction box (speed sensor)	I.A.1109	4	Damaged due to ballast / hits	Check for any visual damages in every trip maintenance . Tighten the connections , if found loose. If junction box is damaged or jammed, then replace it.	Vishal Check	no special manitenance is required. .
			Loose connections at junction box			
			Jamming of junction boxes due to weather conditions.			
Junction box (Dump Valve)	I.A.1110	2	Damaged due to ballast / hits	Check for any visual damages in every trip maintenence . Tighten the connections , if found loose. If junction box is damaged or jammed, then replace it.	Vishal Check	No special maintenance is required.
			Loose connections at junction box			
			Jamming of junction boxes due to weather conditions.			

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty. per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Toothed wheel / Phonic wheel	I.2.748	4	Damaged due to bolt loosening or eccentric movement because of improper fitment.	Railways to ensure that bolts & washers are fitted & torqued to 21 NM as per guidelines circulated by RDSO in Dec 2011. Also eccentricity needs to be ensured while fitment of phonic wheel .	Visual Check	No specific maintenance is required.
Pressure switch	I92268/00502 or I92268/1813	1	system does not cut off or cut in	Check the pressure switch. Adjust the cut off & cut in. If not repairable, kindly change the pressure switch.	By continuity tester.	No specific maintenance is required.
Control Unit MGS2	STN30518/0276	1	no specific fault observed till date		No display, no WSP working, no self test.	No specific maintenance is required.

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Circuit board (PB03A)	STN25089	1	short circuit / card failure due to loose connectors or improper wiring connections by electricians	Railways to ensure that no loose connectors are used. Electricians to connect wires as per RCF guidelines only. Tighten or replace connector / card, if not repairabale / tightenable.	No power supply to WSP system	No specific maintenance is required
			short circuit / card failure due to high spikes / surges	Railways to ensure that high spike producing / high surge current connections / jobs are not done close to control panel. Power of WSP should be off before commencing with such jobs .		
			short circuit / card failure due to removal of card during power ON condition of the WSP system	Remove fuse 63 & 65 before removing any card from WSP system (control Unit).		
Circuit board (EB01B)	STN25799/01	1	short circuit / card failure due to loose connectors or improper wiring connections by electricians	Railways to ensure that no loose connectors are used. Electricians to connect wires as per RCF guidelines only. Tighten or replace connector / card, if not repairable / tighten able.	Fault code will be displayed on the display of control panel directly	No specific maintenance is required
			short circuit / card failure due to high spikes / surges	Railways to ensure that high spike producing / high surge current connections / jobs are not done close to control panel. Power of WSP should be off before commencing with such jobs .		
			short circuit / card failure due to removal of card during power ON condition of the WSP system	Remove fuse 63 & 65 before removing any card from WSP system (control Unit).		

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty. per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Wheel speed sensor	II35456/20013 or STN31450/205 A18U	4	Damage of sensor due to ballast / hits	Check for any visual damages in every trip maintenance . Replace sensor.	There are two ways of Static testing 1. By a pole wheel simulator. 2. by pressing S2 (Self Test) on WSP control panel.	No specific maintenance is required.
			Damage of sensor due to rubbing with phonic wheel	Ensure correct sensor gap on every quarterly schedule or when required. Also ensure phonic wheel is tightened properly, depending on extent of damage. Replace sensor when found damaged.		
Dump valve / Anti Skid Valve	II34652/15024	4	Damage of valve due to hits / ballast	Check for any visual damages in every trip maintenance. Replace dump valve.	There are two ways of Static testing 1. By a pole wheel simulator. 2. by pressing S2 (Self Test) on WSP control panel.	Overhauling of Dump valve is recommended every 36 months (POH).
			Damaged or loose connections to anti skid valve	Tighten connection, repair or replace wires as necessary.		
			Damaged / broken pins due to mishandling / ballast hits	Check for any visual damages in every trip maintenance . Tighten the connector on dump valve with care. If non repairable, then replace dump valve.		

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty. per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Circuit board (MB04B)	STN28339/ 00000	1	short circuit / card failure due to loose connectors or improper wiring connections by electricians	Railways to ensure that no loose connectors are used. Electricians to connect wires as per RCF / ICF guidelines only. Tighten or replace connector / card, if not repairable / tighten able.	Fault code will be displayed on the display of control panel directly	No specific Maintenance is required
			short circuit / card failure due to high spikes / surges	Railways to ensure that high spike producing / high surge current connections / jobs are not done close to control panel. Power of WSP should be off before commencing with such jobs .		
			short circuit / card failure due to removal of card during power ON condition of the WSP system	Remove fuse 63 & 65 before removing any card from WSP system (control Unit).		

Troubleshooting, Corrective actions & Maintenance aspects for WSP system

Part name	Part no.	Qty. per coach	Fault observed	Details & Remedial action	How to check	Maintenance & Remarks
Circuit board (MB04B)	STN28339/ 00000	1	No display / Dots on WSP display	KBI engineer to download software through the Laptop OR Railways should ask for downloaded MB04B card only	On the display of control panel, there will be no display code & only 4 dots / dashes will appear when a new card without software is inserted in the control panel	Since same cards are used all over world for different projects, so for LHB India project the software has to be downloaded by our service engineer only. As the software are limited, we send new cards with software downloaded. In many case it might be that old cards are available with Railways in which software was not downloaded.

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Recommended Spare parts list for WSP

Part name	Part nno.	Qnty per Coach
Control Unit MGS2	STN30518/0276	1
MB04 card	STN28339/00000	1
PB03 card	STN25089	1
EB01 card	STN25799/01	1
Set of connector	STN30979	1
Phonic / Toothed wheel	I.2.748	4
Speed Sensor	II35456/20013 or STN31450/205A18U	4
Junction box for Speed sensor	I.A.1109	4
Junction box for Dump Valve	I.A.1110	2
Connectors	N62148/10000	4
Anti skid valves / Dump Valves	II34652/15024	4
Pressure switch (for piped panels in BP circuit)	I92268/00502	1
Pressure switch (for Aluminium drilled panels in FP circuit)	I92268/01813	1
NOTE: List of recommended spare parts to be kept in sheds as well as workshops depending on the population. Parts prone to ballast hits, damages & electrical surges (which are not manufacturing defects) should be kept by Railways in stock even during the warranty period.		

Thank you very much for your attention



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