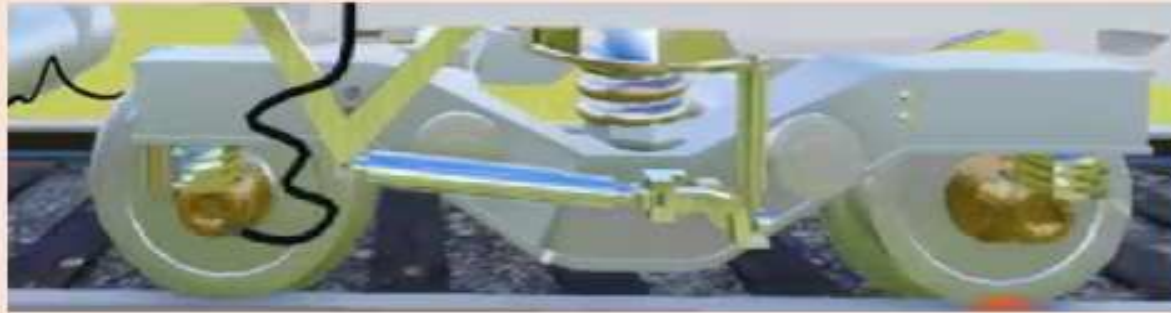




Wheel Slide Protection System



WHEEL SLIDING EFFECT



When Wheel Slides



Changes in Micro- Structure



Main components

- Microprocessor
- Speed sensor
- Dump valve
- Phonic wheel
- Pressure switch



Characteristics of WSP system

- Reduces/checks sliding of wheels on rails.
- It is activated by temporary reduction in Brake force.
- Reduces stopping distance.
- WSP system does not affect Brake power.

Difference between Slide and Skid

“Slide” as the term describes blocking of wheels during braking. It is happens when the circumferential speed of the wheels is significantly lower than the speed of the vehicle over ground.

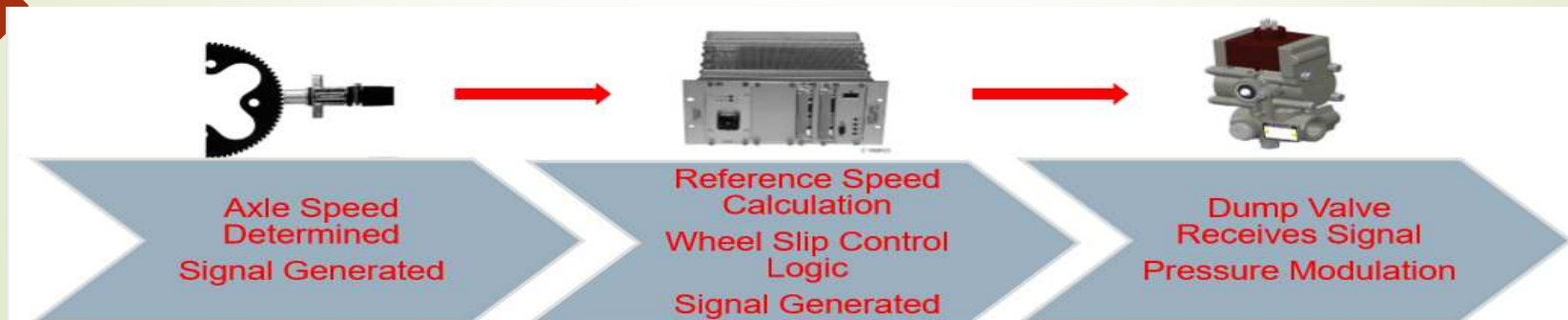
The term **“Skid”** describes the situation when the wheels rotate faster than the speed over ground which can happen during acceleration.

Working principle

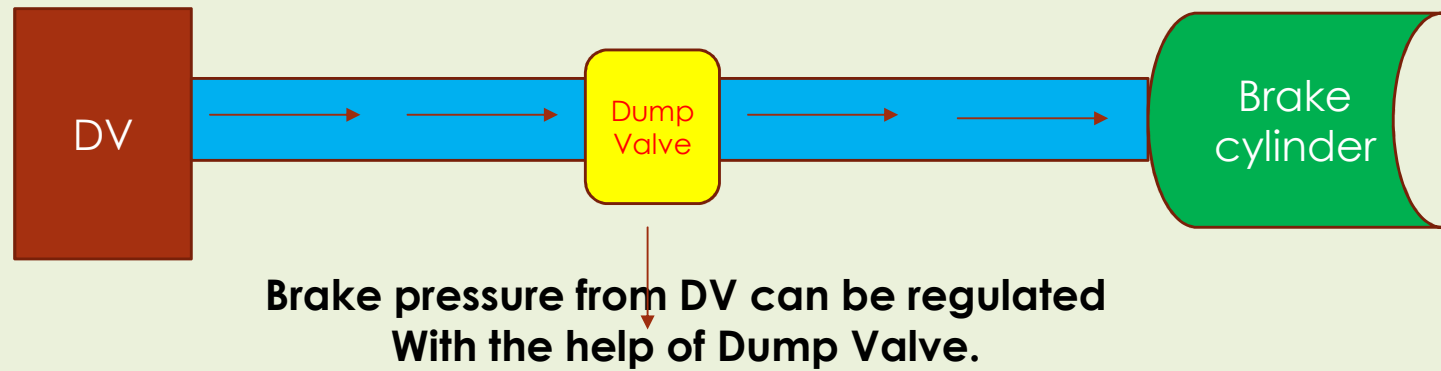
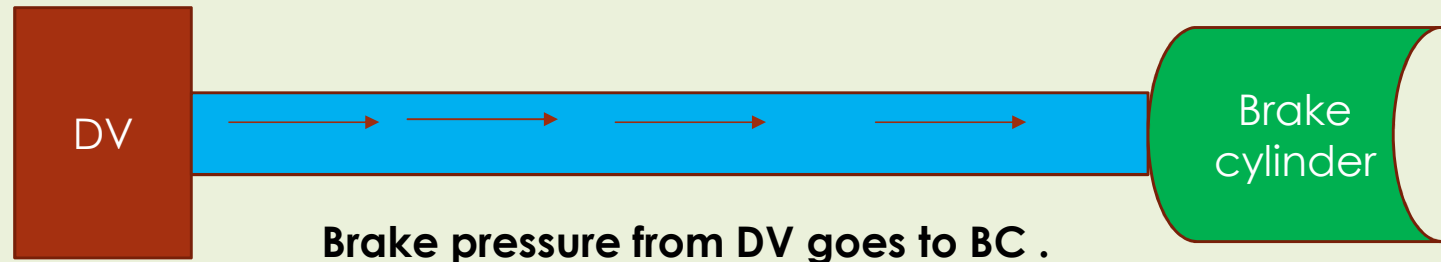
Speed sensor and phonic wheel are mounted on each axle of a coach, which send signal to microprocessor.

Microprocessor evaluates speed of different axles and generate signal to Dump valve.

As per the signal received from microprocessor, Charging port or Exhaust port or both operates to regulate the brake cylinder pressure.



Difference between brake system with WSP and without WSP



Software and logics

System first of all identify the axle with highest speed at any instant. This speed is the reference speed, **Vref**

Based on reference speed, **Vref**, two other virtual speeds are calculated-

Threshold Speed1= **Vth1**

Threshold Speed2= **Vth2**

To calculate **Vth1** and **Vth2** some formula is used in the software, the formulae used may vary between equipment manufacturers

Suppose the formulae to calculate **Vth1** is,

$$\mathbf{Vth1 = Vref - (1.5 + 0.06 Vref)}$$

and to calculate **Vth2** is,

$$\mathbf{Vth2 = Vref - (2.5 + 0.25 Vref)}$$

(Note- the formula used is only tentative and may vary from actual)

Software and logics

Logical statements are provided in the microprocessor software based on which microprocessor generates signal to dump valve to regulate brake cylinder pressure.

Logical statements are of these forms-

If, Speed of any axle= **Vi**

Threshold Speed1= **Vth1** (*upper threshold speed*)

Threshold Speed2= **Vth2** (*Lower threshold speed*)

Then, if **Vi**,

Vi >= Vth1 , Increase brake cylinder pressure

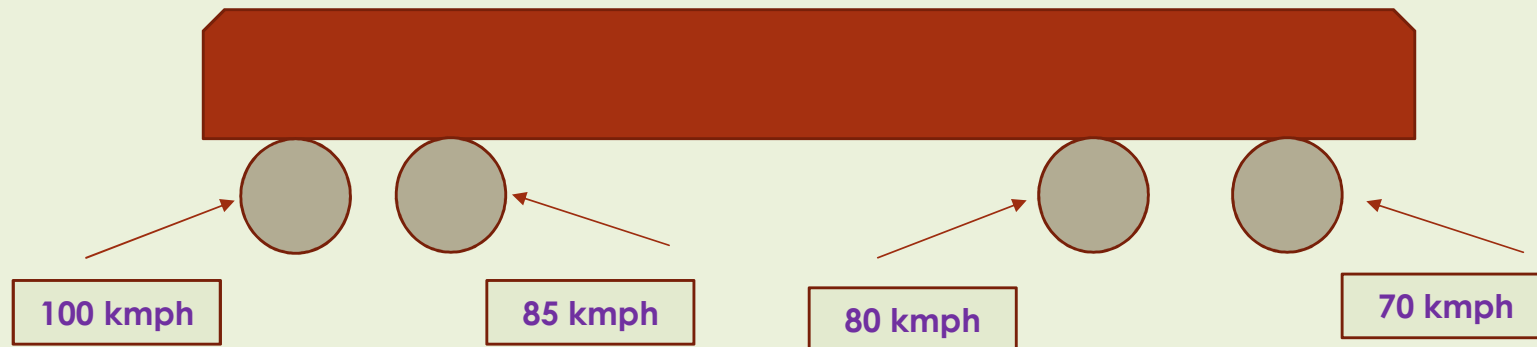
Vth2 <= Vi <= Vth1 , Hold brake cylinder pressure

Vi <= Vth2 , Decrease brake cylinder pressure

(Note- the logics used is only tentative and may vary from actual)

Let us understand with example how system works

Suppose at the time of Braking the axle speeds of different axles are as shown in the figure.



Reference speed **Vref** = ?

System calculates Vref, Vth1, Vth2

Reference speed **Vref = ?**

Vref is the axle with max speed

Therefore,

Vref = 100 kmph

Vth1 = Vref – (1.5 + 0.06 Vref) &

Vth2 = Vref – (2.5 + 0.25 Vref)

Calculate Vth1

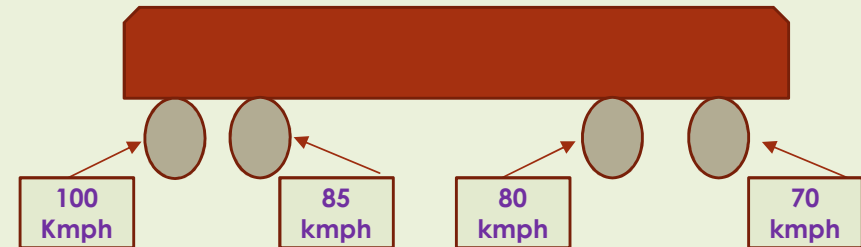
Putting the value of Vref in formula for Vth1

$$V_{th1} = 100 - (1.5 + 0.06 \times 100) = 92.5 \text{ kmph}$$

Calculate Vth2

Putting the value of Vref in formula for Vth2

$$V_{th2} = 100 - (2.5 + 0.25 \times 100) = 72.5 \text{ kmph}$$



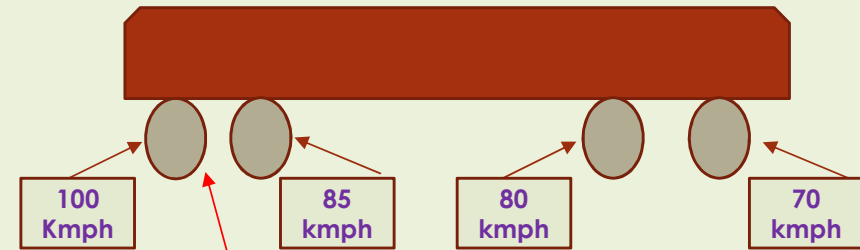
Vref= 100 kmph
Vth1= 92.5 kmph
Vth2= 72.5 kmph

Logical statements
if V_i ,

$V_i \geq V_{th1}$, Increase brake cylinder pressure

$V_i = 100, 85, 80 \text{ \& } 70$

$V_{th1} = 92.5$



System increase brake cylinder pressure on this axle

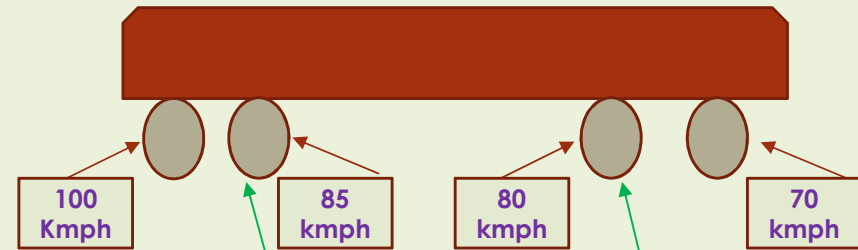
Logical statements
if V_i ,

$V_{th2} \leq V_i \leq V_{th1}$, Hold brake cylinder pressure

$V_i = 100, 85, 80 \text{ \& } 70$

$V_{th1} = 92.5$

$V_{th2} = 72.5$



System holds brake cylinder pressure on these axles

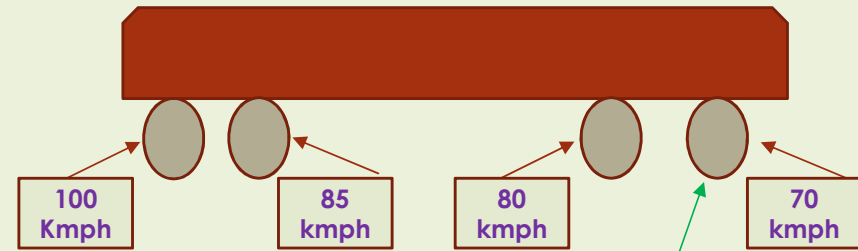
Logical statements
if V_i ,

$V_i \leq V_{th2}$,

$V_i = 100, 85, 80$ & **70**

$V_{th1} = 92.5$

$V_{th2} = 72.5$



Decrease brake cylinder pressure

System decreases brake cylinder pressure on this axle

**How system regulates brake cylinder
pressure??????**

Through Dump Valve



Dump valve

Dump valve is a part of WSP system, which governs brake cylinder pressure based on the signal generated from microprocessor.

Dump valve has two ports-

1. Charging port
2. Exhaust port

Both ports are independent.

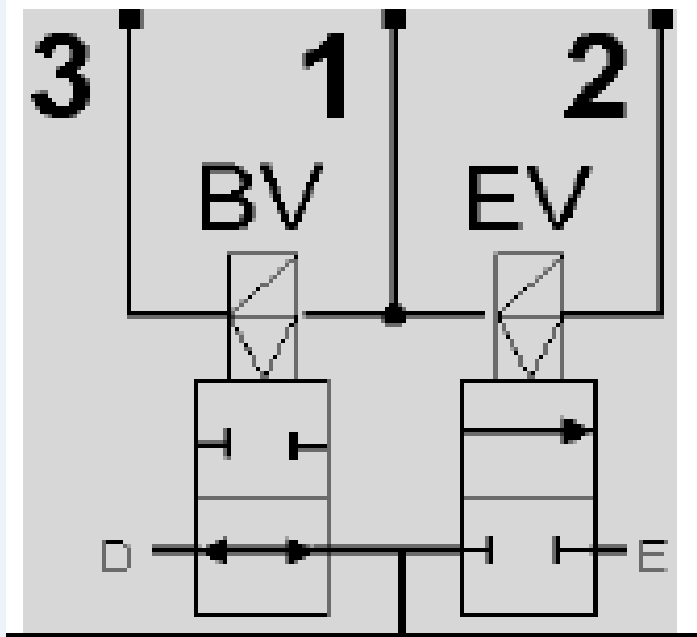
In default position the exhaust port remains closed and charging port in open.

The ports reverse their position, the moment microprocessor generates signal.

Microprocessor generates signal in form of 24V supply to the ports.



Dump valve



24Volt supply from microprocessor

To decrease brake cylinder pressure microprocessor sends 24V signal through cables on both
“Charging and exhaust”
ports



24Volt supply from microprocessor

To hold brake cylinder pressure microprocessor sends 24V signal through cables on both
“Charging” port



No supply from microprocessor

To increase brake cylinder pressure, microprocessor don't sends any signal to the ports, as to increase brake cylinder pressure charging port needs to be open and exhaust to be closed, and this is the default position.



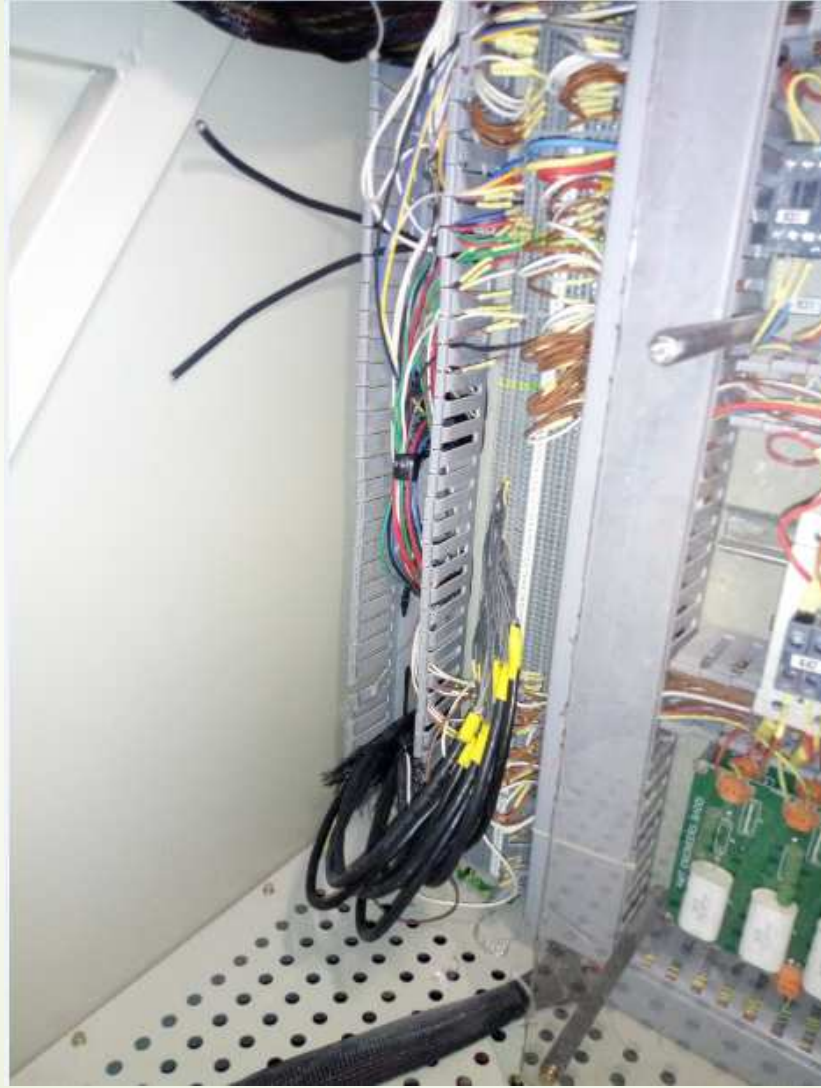
Speed sensor

The speed sensor scans a ferromagnetic rotating gear (Phonic wheel). It works without physical contact. The frequency of the digital current signal is directly proportional to the circumferential speed of the rotating gear

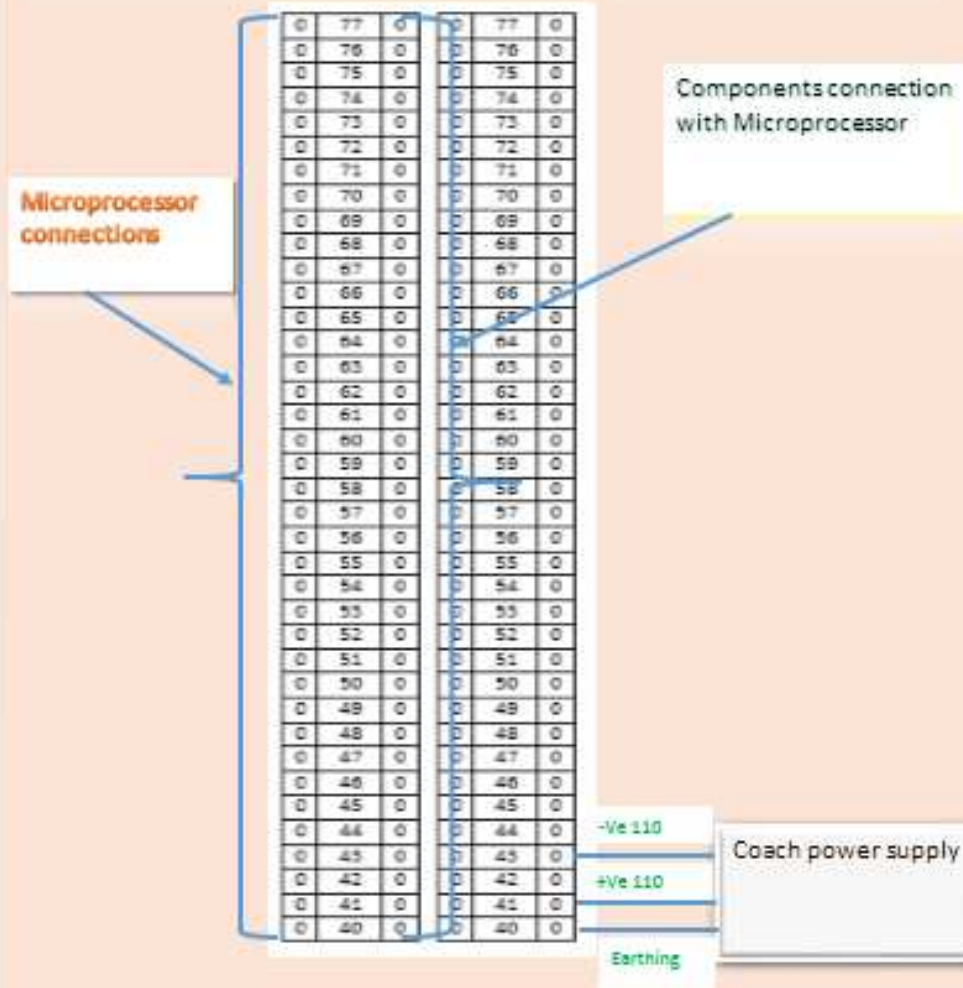




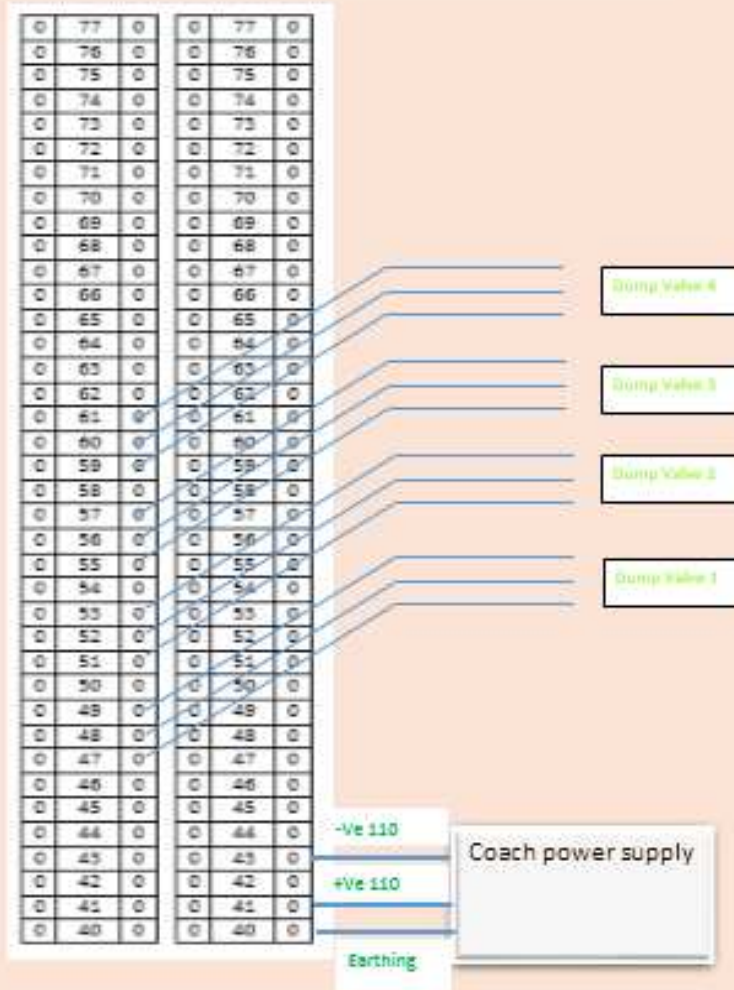
Pics. Showing change in internal inductance of the adjacent sensor



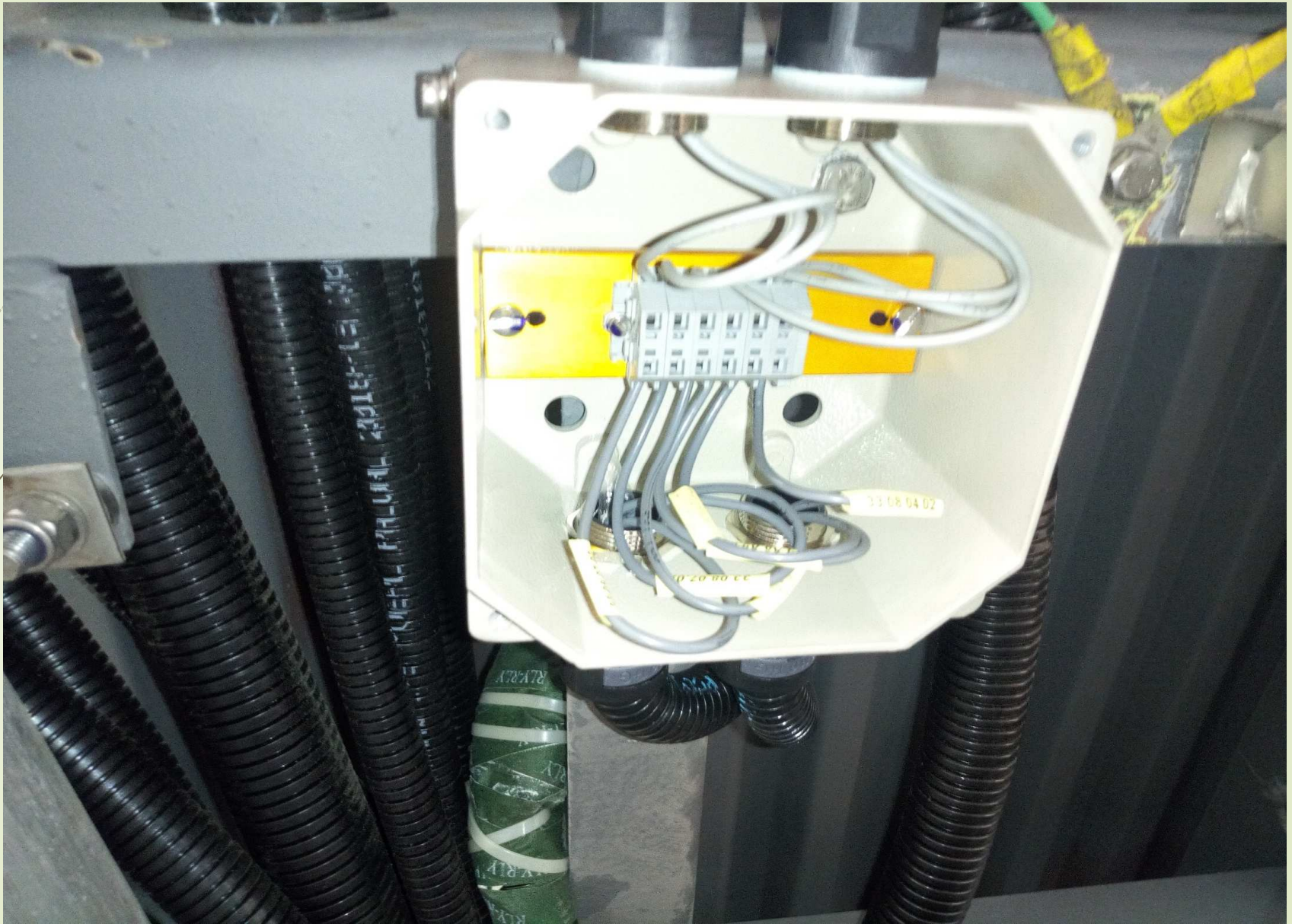
WAGO NUMBERING SYSTEM AND CONNECTION WITH COACH POWER SUPPLY

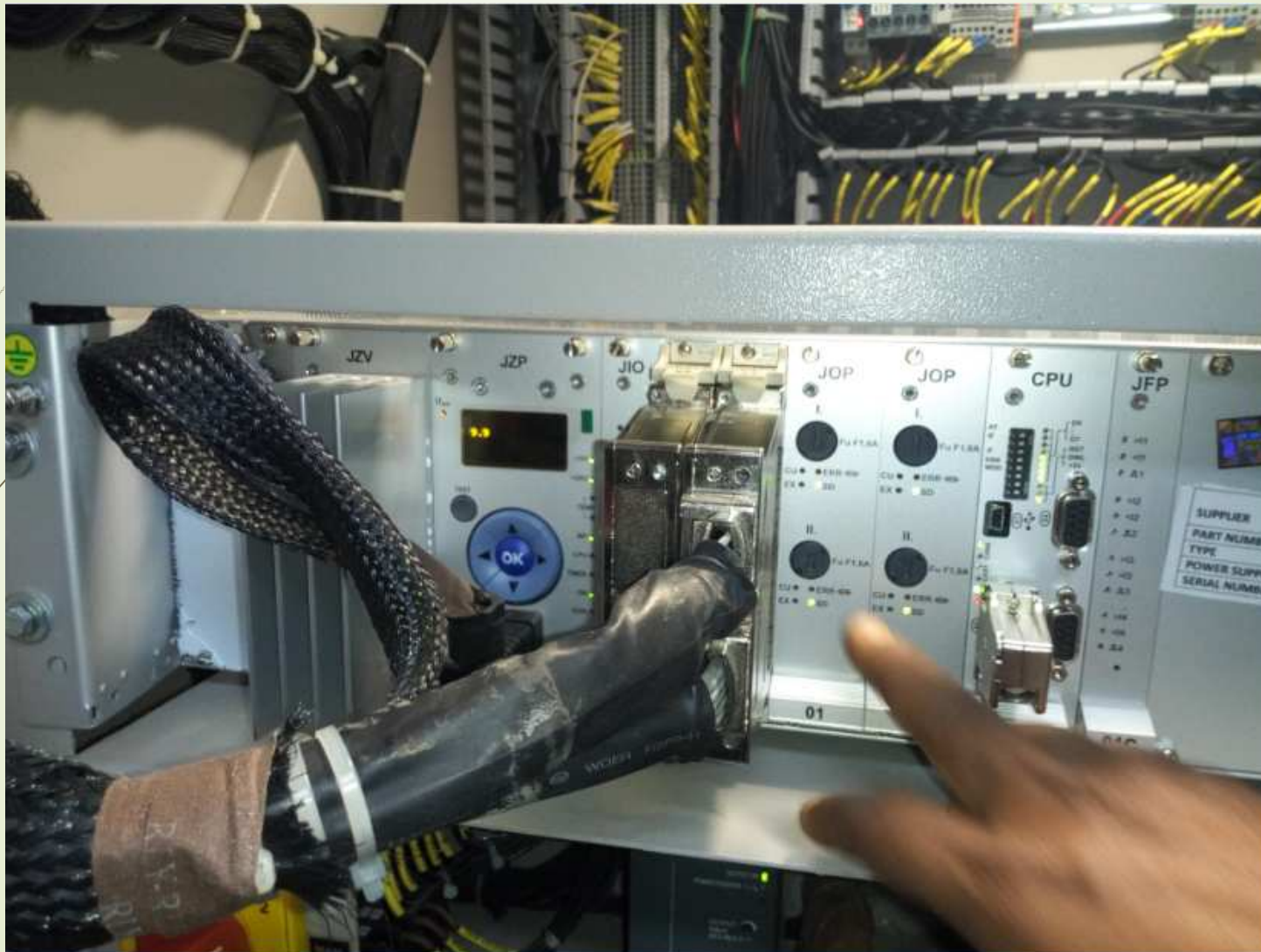


WAGO NUMBERING SYSTEM AND CONNECTION OF MICROPROCESSOR WITH WSP COMPONENTS











Wheel Slide Control Systems (FTIL Type)

Internal Modules Function

The SWKP AS 20 R WSP system could be separated into seven components.

Power Pack N1

Power Pack N2

8 Optocoupler inputs

6 relay output,

2 Semiconductor outputs

Status Display

Solenoid amplifier

GE module.

Push Button function of the CPU front panel

Push – button 1: Diagnostic of Faults

Push-button 2: Test

Push-button 3: Clearing of the Failure memory

Push-button 4: Door test

Push-button 5: X/ Kilometer counters

Working Principle WSP system KNORR BREMESE (MGS2)

The MGS2 wheel slide control system forms a control loop through the brakes and wheel sets. 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 control loop adjusts the brake cylinder pressure to the instantaneous wheel-to-rail adhesion, keeping the wheels within their optimum range to slip and ensuring maximum possible brake force transmission.

Major Components

Power Board

The power board supplies all the voltages for powering the boards, actuators and sensors. A 24V source is used to power the anti-skid valves from the MGS2 control unit.

If the vehicle is left to stand idle for any length of time, the MGS2 control unit can be switched over to a “standby” mode of low primary current consumption (standstill sleeper mode). The unit is reactivated by a pressure switch at a pre-selected level in the brake pipe.

Boards MB04 / MB03

32

Wheel slide control - i.e. acceleration and slip control - is implemented entirely on board MB03 or MB04. MB03 contains all the electronic peripherals for individual wheel slide control at up to four wheels or wheelsets. The anti-skid valves are powered by 24V from board MB03. The only difference between boards MB03 and MB04 is that MB04 has a man-machine interface (MMI) integrated in its front panel.

Wheel slide control - i.e. acceleration and slip control - is implemented entirely on board MB03 or MB04. MB03 contains all the electronic peripherals for individual wheel slide control at up to four wheels or wheelsets. The anti-skid valves are powered by 24V from board MB03. The only difference between boards MB03 and MB04 is that MB04 has a man-machine interface (MMI) integrated in its front panel.

Board EB01

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

Push Button function of the CPU front panel

Push – button 1: Diagnostic of Faults

Push-button 2: Test

Push-button 3: Clearing of the Failure memory

Push-button 4: For OEM

WSP maintenance procedure (WSP system of KNORR Bremese)

There is a display port on Microprocessor as shown in the figure.

9	9		
---	---	--	--

If '99' appears in display port, means WSP system is working properly.
(All speed sensing devices and brake releasing devices are working properly).

Note- only two initial digits are of importance, rest two are dummy numbers

If any problem arises in the WSP system either '72' or '73' appears in display port

Code '72' means- fault on one axle

Code '73' means- fault on more than one axle.

To further know the location and type of problem
We, have Push – button 1 on microprocessor

Press Push – button 1 and hold for few seconds,
'8888' code appears in the display port
Remove finger

For code '72', after pressing push-button 1
Further code like '7201, 0301, 1401, 7201' will appear in the display port

For code '73', after pressing push-button 1
Further code like '7301, 0301, 2301, 3101, 7301' will appear in the display port

In these series-

'7201, 0301, 1401, 7201'

&

0301 are dummy numbers and are of no importance

'7301, 0301, 2301, 3101, 7301'

Codes like 1401, 2301, 3101 are of our importance

Note- only two initial digits are of importance, rest two are dummy numbers

Therefore in codes 1401, 2301, 3101 we need to note down only

14

23

31

Therefore in codes 1401, 2301, 3101 we need to note down only

14

23

31

In these codes first number represents axle Number and the second Number represents type of fault

For code '14' means fault is on first axle

For code '23' means fault is on second axle

For code '31' means fault is on third axle

In these two digit codes, second number represents type of fault

If the second digit is either-

‘1 or 2’- means fault is in sensing devices

If the second digit is either-

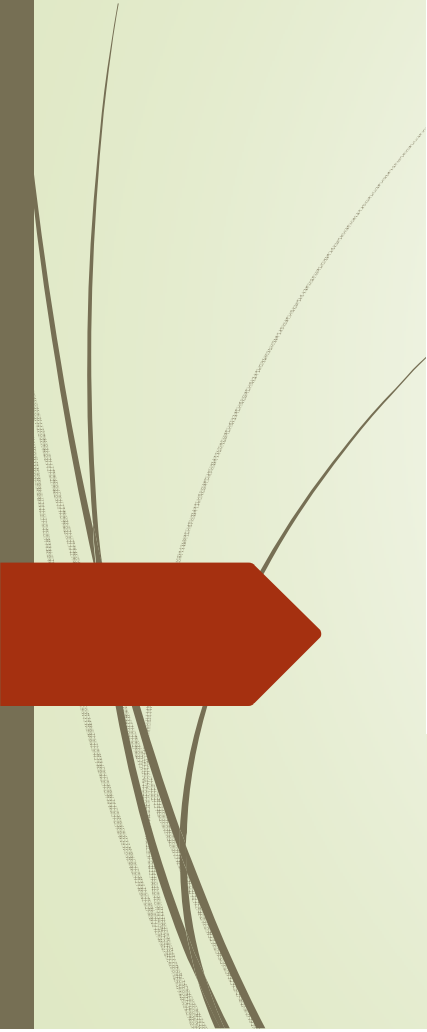
‘3 or 4’- means fault is in releasing devices

Therefore, the combination of these two digits gives us the location of fault and the type of fault in the system

For, example

If the code is ‘13’- means problem is on the first axle and it is in brake releasing devices.

If the code is ‘21’- means problem is on the second axle and it is in speed sensing devices.



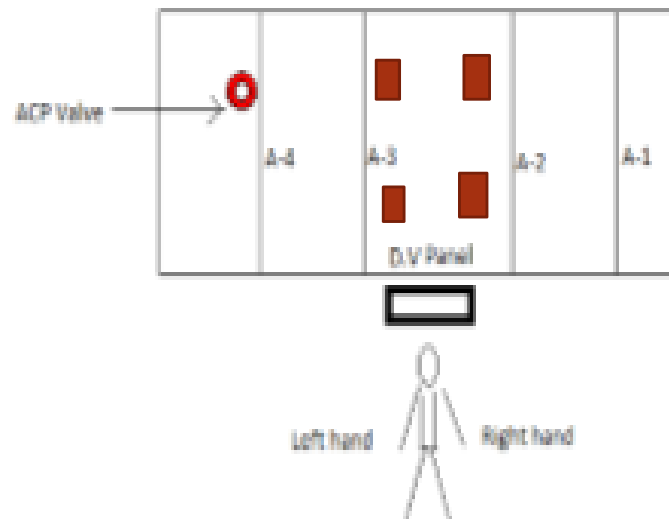
If the code is '43' - means problem is on the fourth axle and it is in brake releasing devices.

If the code is '22' - means problem is on the second axle and it is in speed sensing devices.

If the code is '34' - means problem is on the third axle and it is in brake releasing devices.

If the code is '11' - means problem is on the first axle and it is in speed sensing devices.

Numbering system of Axles



A-1= Axle No. 1, A-2= Axle No. 2, A-3= Axle No. 3, A-4= Axle No. 4

Note- Push button-2, operates only when the train is stationery, it will not operate in running condition.

Push-button 3: Clearing of the Failure memory

After attending the problem in the WSP system, press push button-3. If the problem gets fixed code '99' will appear in the display port. If not it continues giving error codes as mentioned earlier.

Push-button 4: For OEM

Push button 4 is for OEM, we can do nothing with this.

WSP Fault Codes

Code	Inference
99	System is OK.
95	System OK, but volatile faults present – can be erased by pressing S3 button on MB 04 Card.
7201	Fault in one wheel set
7301	Fault in several wheel set
8888	Display Test (Shows in sequence of diagnosis / testing)
89	Testing Mode (Dump Valve self testing in progress).
0301	Means fault noted / sourced / related to MB04 Card (Shows in sequence of diagnosis)
0201	Means fault noted / sourced / related to EB01 Card (Shows in sequence of diagnosis).

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

THE MEANING OF INDIVIDUAL FAILURES OF WSP

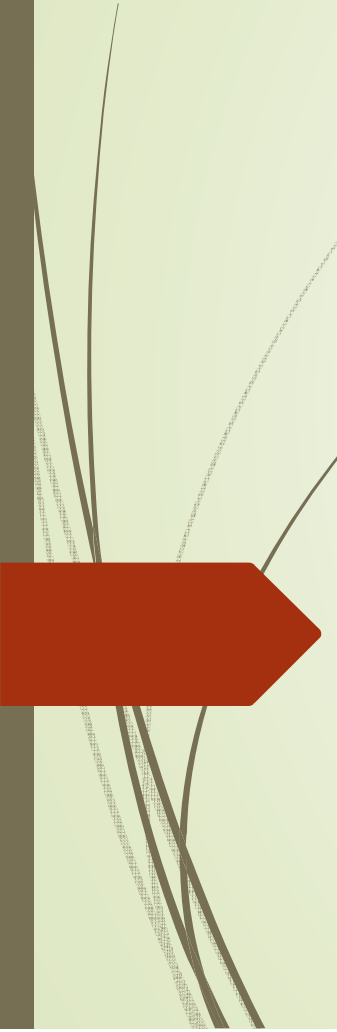
Error Code	Error Description
1.1, 2.1, 3.1, 4.1	Fault in Speed Sensor - axle 1, 2, 3, 4.
1.2, 1.3, 1.5, 1.6	Fault in Dump Valve - axle 1.
2.2, 2.3, 2.5, 2.6	Fault in Dump Valve - axle 2.
3.2, 3.3, 3.5, 3.6	Fault in Dump Valve - axle 3.
4.2, 4.3, 4.5, 4.6	Fault in Dump Valve - axle 4.
9.5	everything is OK, transient error in history
9.9	everything is OK, no previous failures stored in SRAM memory

Care & Precautions to be Taken for Proper Functioning of WSP

- Never use non-standard fasteners for fitment of Phonic wheel on axle.
- Speed sensors are not missing/open circuit.
- Speed sensors& cables are not properly connected.
- Sensor cable not fitted with loose strands.
- Dump valve not leaking during brake application.
- Junction box in not broken /damaged condition.
- Water cleaning of axle box housing should not be done.
- Improper dump valve connection should not be done.

Common problems of Speed sensor and related components

- Gap between phonic wheel and speed sensor may not be in the range (0.9 to 1.4)mm
- Phonic wheel may be loose.
- Use of non-standard fasteners for fitment of Phonic wheel on axle.
- Speed sensors are missing/open circuit.
- Speed sensors & cables are not properly connected.
- Sensor cable fitted with loose strands.
- Junction box in broken /damaged condition.
- Water cleaning of axle box housing.
- Speed sensor defective.



Thanks for your kind attention

**Pushpak Ranjan
CI/STC/CB/LKO**

ERROR: syntaxerror
OFFENDING COMMAND: --nostringval--

STACK:

```
/Title  
( )  
/Subject  
(D:20210914160938+05'30' )  
/ModDate  
( )  
/Keywords  
(PDFCreator Version 0.9.5)  
/Creator  
(D:20210914160938+05'30' )  
/CreationDate  
(LENOVO)  
/Author  
-mark-
```