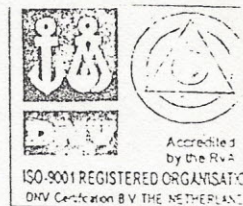


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Lucknow - 226011



No. EL/3.2.19

Dated 21.06.2001

Chief Electrical Engineer,

- Central Railway, Mumbai CST- 400 001.
- Eastern Railway, Fairlie Place, Kolkata - 700 001
- East Coast Railway, Chandrashekharapur, Bhubaneswar- 751 001.
- East Central Railway, Hazipur, Dichi (Bihar)
- Northern Railway, Baroda House, New Delhi-110 001
- North - Eastern Railway, Gorakhpur - 272 601.
- Northeast Frontier Railway, Maligaon, Guwahati - 781 011
- North Central Railway, Hasting Road, Allahabad-211 001.
- North West Railway, Jaipur (Rajasthan)
- Southern Railway, Park Town, Chennai-600 003
- South Central Railway, Rail Nilayam, Secunderabad -500 371.
- South Eastern Railway, Garden Reach, Kolkata -700 043
- South Western Railway, Bangalore - 560 046
- Western Railway, Churchgate, Mumbai -400 020
- West Central Railway, Jabalpur.
- New Zone Railway, Bilaspur.
- Chittaranjan Locomotive Works, Chittaranjan- 713 331

SPECIAL MAINTENANCE INSTRUCTION NO. ELRS/SMI/0197-2001, REV. '1'

(Note : This SMI supersedes RDSO's SMI No. SMI/197 & SMI No. 190.)

1. Title :

Driving technique and use of proportionate brake application to prevent cases of wheel skidding on dual brake as well as pure air brake electric locomotives.

2. Brief History :

- 2.1 Earlier application of braking force on train than on the locomotive results in skidding of the wagons and tensioning of locomotive coupling as locomotive keep on dragging the braked wagons. On the other hand, earlier braking force on locomotive than on the train results in the ramming of the train against the locomotive resulting in the locomotive's wheel skidding.

In order to avoid both the above situations, it becomes necessary to synchronize the brake application on both the train and the locomotive. Accordingly, a provision has been made in the C3W distributor valve for proportionate brake application on locomotive whenever brake application on train is made through A9. Also, for judicious application of brakes on locomotive in order to avoid any of the situation described above, a paddle switch called PVEF has been provided.

in driver's cab for the driver to press and release synchronized brakes on the locomotive as per the requirement. Para No. 30645 of ACTM Vol. III also specifies for the driver to ensure pressing of PVEF paddle switch while applying train brakes whenever he experiences poor brake power of the train, in order to avoid wheel skidding of locomotive's wheels due to ramming of the train against the locomotive.

2.2 The setting of 'RGEB' in dual brake locomotives had been advised in the past as follows;

- N/C contact of RGEB should open from 4.2 kg/cm^2 of BP pressure during brake application.
- N/C contact of RGEB should close from 2.8 kg/cm^2 of B.P. pressure during brake release.

In dual brake locomotives, RGEB is activated by MR pressure coming through H5/HB5 pneumatic valves on getting the pneumatic signal from A9/VA1B, as the case may be. The direct settings of RGEB, H5 as well as HB5 in terms of MR pressure, B.P. pressure and vacuum level have been specified in Annexure- I of RDSO's 'Miscellaneous Report No. MP.Misc.- 45' of July 1996. Therefore, there is no meaning of indirect setting of RGEB as given above. It is also noted that setting of H5 valve for cut out of RGEB, is very much on the lower side as compared to indirect cut out setting of RGEB which is specified as 4.2 kg/cm^2 . As a result, as and when automatic brakes are being applied from A9 in dual brake locomotive, N/C contact of RGEB in the circuit of QRS gets opened at 4.2 kg/cm^2 of B.P. pressure making 'VEF' ineffective as N/O contact of QRS in the 'VEF' circuit also opens simultaneously. Under such conditions, if load is of poor brake power, continuous ramming of train against the locomotive will take place as driver will not be able to isolate the locomotive brakes through paddle switch 'PVEF'.

2.3 Railways have been asking clarifications on piston stroke of brake cylinder for various types of locomotives as well as traction motor current on which loco should or should not move after full brake application through A9.

3. Application :

Locomotives provided with IRAVB2 and IRAB2 brake system.

4. Object :

This SMI deals with the preventive measures as well as checklist to investigate the cases of locomotives' wheel skidding and to minimise them

5. Instructions :

- i) Brake cylinder pressure in locomotive should not be more than 2.5 kg/cm^2 at full application position of A9. However, brake cylinder pressure corresponding to full application position of SA9 should remain at 3.5 kg/cm^2
- ii) Brake application as well as release timings should be as follows ;

(Ref: Motive Power Directorate's letter No. SD.DEV.IRAYB-2 dated 19/22.9.88)

(A) For Passenger Carrying Services :

- (a) Brake application time : 6 to 9 seconds for 95% of maximum pressure build up.
- (b) Brake release time : 10 to 15 seconds for brake cylinder pressure reduction upto 0.4 kg/cm^2 .

(B) For Goods Services :

- (a) Brake application time : 20 to 25 seconds for 95% of maximum pressure build up.
- (b) Brake release time : 25 to 30 seconds for brake cylinder pressure reduction upto 0.4 kg/cm^2 .

NOTE :

The 'goods' as well as 'passenger' position of handle provided on C3W valve should be clearly marked and drivers/trip shed staff/maintenance staff should be counselled properly.

- iii) The hardness of the brake blocks should be randomly checked every time a new supply is received. The hardness should invariably be between 160-220 BHN.
- iv) The brake power of the locomotive should be checked in the following manner;
- Apply full brakes using SA9. The brake cylinder pressure gauge should indicate a reading of 3.5 kg/cm^2 under such condition.

Take notches through MP and record the observations as per table given below ;

| S. N. | Type of Loco | Gear Ratio | Traction motor current at which loco should not move | Traction motor current at which loco should move |
|-------|--------------|------------|--|--|
| 1. | WAM4 | 15:62 | 600 | 800 |
| 2. | WAM4 | 21:58 | 800 | 1000 |
| 3. | WAG5 | 15:62 | 600 | 800 |
| 4. | WAG5 | 18:64 | 600 | 800 |
| 5. | WAP1 | 21:58 | 800 | 1000 |
| 6. | WAP4 | 23:58 | 800 | 1000 |
| 7. | WAG7 | 16:65 | 600 | 800 |
| 8. | WAG7 | 18:64 | 600 | 800 |

NOTE :

The above values have been calculated theoretically from the loco characteristics. During practical working, there may be a variation of ± 50 Amps.

- v) Check the piston travel of all brake cylinders and free movement of wheel in brake released condition. The specified value of brake cylinder piston stroke for different types of locomotives in their respective MP/MIs is as follows;

| S. N. | Type of Loco | Type of bogie | Brake Shoe release for which piston stroke has been specified | Specified piston stroke | References |
|-------|----------------------|---------------------|---|-------------------------|---|
| 1. | WAM4/WAG5/WCAM1/WCG2 | Co-Co trimount | 10 mm | 95-105 mm | RDSO's Instruction Bulletin No. MP.IB.VL.01.04.01, (Rev. 0.00). |
| 2. | WAP1/WAP4 | Flexi coil mark I | 6 mm | 50 mm (approx.) | Para 3.1.2.2 of MP.MI 90/80. |
| 3. | WAG7 | High adhesion bogie | 6 mm | 67 mm (approx.) | Para 1.4.5 (d) of VL.MI 01/96 of Nov. '96. |

NOTE :

1. The measurement of piston stroke length should be done only after placing distance pieces of specified thickness between wheel tread and brake block.
 2. The piston stroke length is a function of brake shoe release and total leverage of brake rigging. The increase of 1 mm brake shoe release will increase piston stroke length by 10 mm, 6 mm and 11 mm in WAM4/WAG5, WAP1/WAP4 and WAG7 class of locomotives approximately.
- vi) The setting of RGEB, H5 and HB5 in dual brake locos must be ensured as follows ;

| S.N. | Type of Valve | Setting | Reference |
|------|---------------|---|--|
| 1. | RGEB | Cut out - $(7.5 \pm 0.1) \text{ Kg/cm}^2$ Cut in - $(6.5 \pm 0.1) \text{ Kg/cm}^2$ | Annexure-I of RDSO's Misc. Report No. MP.Misc.- 45 of July '96. |
| 2. | H5* | Cut in - $(1.9 \pm 0.1) \text{ Kg/cm}^2$ Cut out - $(2.4-2.8) \text{ Kg/cm}^2$ | -do- |
| 3. | HB5 | 360-410 mm of Hg. | -do- |

* In dual brake locomotives being provided with modification for automatic operation of flasher light, H5 valve will get replaced with RGEB2 directly mounted on BP pipe.

- vii) The regression of power through H5 as well as HB5 valve should be tested as follows ;

H5 Relay Air Valve :

Charge the brake pipe by keeping A9 automatic brake valve handle in release position. Put HVSI 1 & 2 and HVMT 1 & 2 on position '0' and take 2-3 notches. Reduce the brake pipe pressure by A9 brake valve. When the BP pressure drops to $1.9 \pm 0.2 \text{ kg/cm}^2$, regression of GR - 0.0

should take place. Progression of GR should again be possible only when BP is restored to $2.4 - 2.8 \text{ kg/cm}^2$.

HB5 Relay Air Valve:

Charge the brake pipe by keeping A9 automatic brake valve handle in release position. With HVSI 1 & 2 and HVMT 1 & 2 on position '0', take 2-3 notches. Now lift D1 emergency brake valve lever partially

ensuring that only vacuum in train pipe drops slowly and does not permit BP pressure to drop. Alternatively, vacuum train pipe on either end of the loco may be loosened on its dummy plug. Regression of GR should take place when vacuum level drops between 360-410 mm. Progression of GR should again be possible only when vacuum level is restored back.

- viii) The setting of RGEB in pure air brake locos must be ensured as follows ;

Cut out - 2.5 Kg/cm^2

Cut in - 4.2 Kg/cm^2

- ix) The working of 'VEF' valve through paddle switch 'PVEF' should be checked during every trip inspection as well as schedule/unschedule visit of the locomotives to the Shed.

In the MU formation, no indication of 'VEF' working in the rear loco is available in the driving cab of leading loco. Therefore while doing pneumatic testing in the multiple formation, simultaneous 'VEF' working in both the locos should be physically verified.

- x) Drivers should be counseled for judicious use of 'PVEF' while applying the brakes in the train that is whenever he takes the control of the train, he should check up the brake power of the train by partially applying the brakes before the first block section. If he feels that the brake power of the train is satisfactory, he should not resort to apply 'PVEF' while applying brakes through A9. In case he feels otherwise, then only he should use 'PVEF'.

- xi) Trials conducted by RDSO in the past have proved that synchronized proportionate brake application on locomotive is not responsible for locomotive's wheel skidding in case of brake application on load through A9 upto proportionate brake cylinder pressure of 3.8 kg/cm^2 in locomotive. The skidding of locomotive's wheels do take place if train is stopped using only loco brake i.e. SA9 even from a speed of 10-20 kmph.

- xii) Wheel skidding in locomotive wheels take place whenever braking forces exerted on the wheels exceeds the limit of adhesion. Adhesion coefficient along with other factors also depend on track and weather conditions. In case of poor track conditions due to bad weather or otherwise, adhesion coefficient reduces to much lesser extent. In such cases, if the brakes are not applied judiciously (lesser brake force with cautious use of PVEF) then wheel skidding of the locomotive wheels may take place. Similarly, total brake block force applied on the wheel tread depends on the progressive coefficient of friction between brake block and wheel tread. Both instantaneous coefficient of friction as well as progressive coefficient of friction are dependent on speed i.e higher the speed the

lower will be the values of both the above types of friction coefficients. These values further keep on increasing with reduction in speed. The theoretical values calculated for total brake block force on the wheels' treads with A9 as well as SA9 in fully applied condition have been given in Annexure enclosed herewith for a moderate value of coefficient of friction assumed as 0.25 (prevalent at a speed of around 20-25 kmph). It may be noted from Annexure-I that with full automatic brakes applied (brake cylinder pressure $\cong 2.5 \text{ kg/cm}^2$) there are very little chances of exceeding the braking adhesion limit. However, if braking is done with SA9 in fully applied condition (brake cylinder pressure $\cong 3.5 \text{ kg/cm}^2$) then there are chances that braking adhesion limit may get exceeded. However, at higher speeds, coefficient of friction will be much less and there will not be any chances of wheel skidding even if full independent brakes are applied using SA9.

Therefore, it is clear that braking technique while working a train or light engine has to be commensurate with speed, weather conditions, track conditions as well as type of brake blocks.

- xiii) Additional C₂ relay valve (A31) should be checked for existence of 6 mm choke on its exhaust port. If this choke is not existing then it should be invariably provided.
- xiv) The modification of the control circuit as suggested by RDSO vide modification sheet no. WAG5/21 for isolating the proportionate brakes on locomotive in case of dynamic braking must be ensured.
- xv) Drivers/Operating Staff should be encouraged to report the cases of wheel skidding at the first instant and competent staff should be entrusted the job of investigation wherever possible.
- xvi) In case of locomotive's wheel skidding, load should also be checked for jamming.
- xvii) RDSO's modification sheet no. ELRS/MS/0304/2000, Rev. '0' dated 6/9.2.2001 on replacement of existing $\frac{1}{2}$ " pipe line connecting MR3 reservoir through air flow measuring valve to port no. 1 of additional C₂ relay valve and port no. 3 of additional C₂ relay valve to B.P. pipe line with $\frac{3}{4}$ " pipe line should be implemented on priority in all the locomotives as it will reduce the release time of the load brakes considerably.
- xviii) A-9 Auto brake valve should be set to regulate the brake pipe pressure of $5.0 \pm .1 \text{ kg/cm}^2$ in the release position of the brake valve.

xix) HIS-4 control valve should be correctly set to regulate the control air pressure from 1.4 to 1.7 kg/cm² to get a vacuum in train pipe with 5/16" dia leak hole of 530 + 10 mm Hg.

- 0

xx) The pressure/vacuum gauges should be periodically calibrated to give correct indication of pressure/vacuum.

xxi) All the pipe joints leading from the brake cylinder to the pressure gauges should be air tight. Even minor leakage in these joints can cause appreciable drop in reading of the pressure gauge.

6. Drawing/Sketch : None

7. Agency for Implementation :

All Electric Loco Sheds and Workshops of Indian Railways.

8. Distribution :

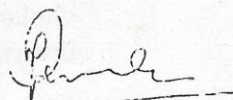
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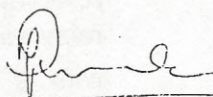
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ANNEXURE

| S. N. | Type of Loco | Weight of Loco (in t) | Total brake block force on loco wheels (in t) | | Total brake block force x μ (0.25) x Brake rigging efficiency (0.85) (in t) | | Adhesion limit of braking force (locomotive weight x μ adhesion)* (in t) |
|-------|--------------|--|---|--|---|--|--|
| | | | B.C. Pressure $\cong 3.5$ Kg/cm ² | B.C. Pressure $\cong 2.5$ Kg/cm ² | B.C. Pressure $\cong 3.5$ Kg/cm ² | B.C. Pressure $\cong 2.5$ Kg/cm ² | |
| 1. | WAM4 | 112.8 | 85.8 | 61.3 | 18.23 | 13.02 | 18.04 |
| 2. | WAG5 | 118.8 (with TAO motor) 126 (with Hitachi motor) | 85.8 | 61.3 | 18.23 | 13.02 | 19.0 (for TAO motor) 20.16 (for Hitachi motor) |
| 3. | WAP1 | 108 | 89.13 | 63.7 | 18.93 | 13.52 | 17.28 |
| 4. | WAP4 | 112.8 | 89.13 | 63.7 | 18.93 | 13.52 | 18.04 |
| 5. | WAG7 | 123 | 96.8 | 69.14 | 20.56 | 14.69 | 19.68 |

* μ adhesion for braking has been taken as 16% which is the maximum assumed design value for conventional locomotives.