

टेलैक्स : 0535-2424 RDSO-IN
फैक्स : 91-0522-458500
तार : 'रेलमानक' लखनऊ
Telegram : 'RAILMANAK', Lucknow
टेलीफोन/Tele : 451200 (PBX)
450115 (DID)



भारत सरकार - रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ - 226 011
Government of India-Ministry of Railways
Research Designs & Standards Organisation
LUCKNOW - 226 011

TECHNICAL CIRCULAR NO-6

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Chief Electrical Engineer,

- Central Railway, Mumbai CST 400 001
- Eastern Railway, Fairlie Place, Calcutta 700 001
- Northern Railway, Baroda Hous, New Delhi 110 001
- Southern Railway, Park Town, Chennai 600003
- South Central Railway, Rail Neelayam, Secunderabad 500 071
- South Eastern Railway, Garden Reach, Caluctta 700 043
- Western Railway, Churchgate. Mumbai 400 020

Sub: Over-loading of traction motors on WAG -7 locomotive Remedial action to be taken.

With the introduction of WAG7 locomotives, on most sections a combination of 2 WAG5 locos have been replaced by single WAG7 locomotive, to haul 58 box N loads. While WAG 7 loco is more powerful than WAG5, it is not equal to two WAG5 locos. With this in view, traction motor currents were measured in various sections of Central, Eastern and South Eastern Railways with trailing loads of 4700t. The investigation reports No. IR-61 to IR-64 have already been circulated to railways. Summary of observations is given in Annexure-I enclosed.

The haulage capacity of different class of locomotives are contained in the load tables, a standard document available with Railways. Based on the Load Tables, a ready reference data has been prepared, regarding capability of the locomotives to haul the consists of loads, generally in use, on various gradients the same is enclosed as Annexure -II (Three Sheets). It is mentioned here that this table be used for the purposes of ready reference only. For any detailed study, the standard document, i.e. Load Table needs to be referred.

The type tests of Hitachi motors, for that matter any traction motor, contains the data regarding temperature rise of the machine at various currents from cold conditions (ambient). No temperature rise tests were available due to over loading, after the machine has been continuously running at the rated current. With the help of M/s BHEL this study has been carried out for Hitachi motor and the observations are contained in annexures -III and III-A enclosed.

The WAG7 locomotive (both versions with gear rates of 18:64 and 16:65) are unable to start a load of 4700t at on 1:200 gradient. The maximum load this locomotive can start on 1:200 gradient is 4500t. But the locomotive can run through in the sections of 1:200 or 1:150 gradients with out stopping in between. This is the situation mostly prevailing on Railways. To meet such

situations, therefore specific instructions for operations have to be followed. These are given below:

A. 1/200 Gradient (4700 t load)

- (i) If the load stalls on 1/200 gradient, assistance be called for immediately without trying to start the load by repeatedly trying to and fro movements.
- (ii) Approach the gradient at max. possible speed, to gain momentum.
- (iii) For WAG7 locomotive with gear ratio 16:65, the gradient can be negotiated on full power (32nd notch) without over loading the traction motor for any length of stretch of the gradient. The balancing speed would be about 40 kmph.
- (iv) For WAG7 locomotive with gear ratio 18:64 the traction motor currents will exceed the permitted values at full power (32nd notch). the driver therefore, needs to keep a watch on the traction motor current and limit the same to a level of 960Amp (1hr. rating), by suitably notching down. He may have to notch down up to 28 notch (depending on the OHE voltage). For this situation, the traction motor current will be 960 A and balancing speed of about 35 kmph will be attained. With such operation, any length of 1/200 gradient can be negotiated without over loading the traction motor.

(B) 1:150 Gradient (4700 t):

- (i) Demand assisting engine, whenever the load stops on 1:150 gradient.
- (ii) If the 1:150 gradient is longer than 3.25 km at a stretch banker engine is needed for such stretches. Alternatively it is preferable to use two WAG5 locomotives,
- (iii) The gradient should be approached with maximum possible speed, to gain momentum.
- (iv) While on run the traction motor current should be limited to 1120 Amp by suitably notching down as in (A) (iv) above. A speed of 15 kmph will be obtained to negotiate the gradient. With this a stretch upto 3.25 km can be negotiated without exceeding temperature rise limits of traction motor.

RDSO may be kept informed about the experience gained by the Railways on the subject.

Ramesh Chandra

Encl: Annexure I, II
And III in six sheets

(RAMESH CHANDRA)
for Director General (Elec.)

Copy To:-

1. Secretary (Electric Traction), Railway Board, Rail Bhawan New Delhi 110001-for information.
2. Chief Electrical Engineer, Chittaranjan Locomotive Works, Chittaranjan 713 331-for information.
3. Sr. Divl. Electrical Engr. (Operations).
 - Central Railway, DRM Office, Mumbai CST 400 001.
 - Central Rly., DRM Office, Bhusawal (Maharashtra)
 - Central Railway, DRM Office, Bhopal (M.P.)
 - Central Railway, DRM Office, Jabalpur (M.P.)
 - Central Railway, DRM Office, Jhansi (U.P.)

 - Eastern Railway, DRM Office, Howrah
 - Eastern Railway, DRM Office, Dhanbad
 - Eastern Railway, DRM Office, Asansol
 - Eastern Railway, DRM Office, Mughalsarai.

 - Northern Railway, DRM Office, Delhi.
 - Northern Railway, DRM Office, Allahabad.

 - Southern Railway, DRM Office, Bangalore
 - Southern Railway, DRM Office, Chennai.

 - South Central Railway, DRM Office, Vijayawada.
 - South Central Railway, DRM Office, Secunderabad.

 - South Eastern Railway, DRM Office, Kharagpur
 - South Eastern Railway, DRM Office, Chakradharpur
 - South Eastern Railway, DRM Office, Bilaspur
 - South Eastern Railway, DRM Office, Nagpur

 - Western Railway, DRM Office, Vadodara.
 - Western Railway, DRM Office, Kota.



Encl: As above.

(Ramesh Chandra)
for Director General (Elec.)

SUMMARY OF OBSERVATIONS REGARDING OVERLOADING OF TRACTION MOTORS OF WAG 7 LOCOMOTIVES ON CENTRAL, EASTERN AND SOUTH EASTERN RAILWAYS.

1. Single WAG-7 locomotive is being utilized against two WAG 5 locomotives earlier used for hauling 4700 t load on 1:200 and 1:150 gradients.
2. Traction motors are being over loaded in 1:200 and 1:150 gradients the extent of overload depends on the length of the gradient. In certain sections the gradients have been found as much as 10 km at a stretch.
3. Single WAG 7 locomotive is not able to start a load of 4700t on 1:200 or 1:150 gradients. It has been observed that the drivers are trying to start the load by moving the train backward by 2-3 kms then picking up the speed and again attacking the gradient at a suitable speed so as to over come the gradient effect.
4. On 1:200 gradient the currents reach the levels of 1200 Amps. for 21 minutes against permitted value of 8 minutes, thus overloading the traction motors.
5. On 1:150 gradients currents of the order of 1180 Amps. are attained for a duration up to 20 minutes against permissible value of 10 minutes . Thus severely overloading the traction motors.

READY RECKONER
(Sheet = 1/3)

LOAD 4700 t

Starting T.E. reqd	Grade	Loco Combination	Whether able to start	Running speed
19.54 T	Level	Single WAG5	Yes	80
		Single WAG7	Yes	93
		Single WAG9	Yes	100
29.20 t	1/500	Single WAG5	Yes	59
		Single WAG7	Yes	71
		Single WAG9	Yes	83
32.90 t	1/360	Single WAG5	Yes	51
		Single WAG7	Yes	61
		Single WAG9	Yes	74
42.70 t	1/220	Single WAG5	Yes	65
		Single WAG7	Yes	35
		Single WAG9	Yes	57
44.00 t	1/200	Twin WAG5	Yes	62
		Single WAG7	Yes*	35
		Twin WAG7	Yes	75
		Single WAG9	Yes	53
53.20 t	1/150	Twin WAG5	Yes	51
		Twin WAG7	Yes	63
		Single WAG9	No**	40
		Twin WAG9	Yes	77
61.40 t	1/125	Twin WAG5	Yes	4
		Tripple WAG5	Yes	62
		Twin WAG7	Yes	56
		Twin WAG9	Yes	68
70.00 t	1/100	Single/Twin WAG5	No	-
		Tripple WAG5	Yes	52
		Twin WAG7	Yes	19
		Twin WAG9	Yes	57

- * (1) Single WAG -7 will be able to start a load of 4500t on 1:200 grade (Gear ratio 18:64).
(2) 1:200 grades can be started and negotiated on run for any lengths of grades at full power by locos with gear ratio 16:65.
(3) Locos with gear ratio 18:64 cannot start but can run without stopping at reduced power (28th notch).
- ** (i) Single WAG -9 can start 4250t on 1: 150 grade with present software.
(2) After modification to software single WAG-9 will be able to start 4700 t on 1:150 grade (Trials on tow locos completed).

READY RECKNONER
(Sheet = 2/3)

LOAD 3300 t

Starting T.E. reqd	Grade	Loco Combination	Whether able to start	Running speed
14.00 T	Level	Single WAG5	Yes	89
		Single WAG7	Yes	100
		Single WAG9	Yes	100
20.80 t	1/500	Single WAG5	Yes	71
		Single WAG7	Yes	86
		Single WAG9	Yes	100
23.40 t	1/360	Single WAG5	Yes	66
		Single WAG7	Yes	79
		Single WAG9	Yes	93
29.50 t	1/220	Single WAG5	Yes	50
		Single WAG7	Yes	62
		Single WAG9	Yes	76
31.00 t	1/200	Single WAG5	Yes	27
		Single WAG7	Yes	58
		Single WAG9	Yes	71
36.70 t	1/150	Single WAG5	No	-
		Twin WAG5	Yes	67
		Single WAG7	yes	39
		Single WAG9	Yes	58
41.30 t	1/125	Single WAG5	No	-
		Twin WAG5	Yes	59
		Single WAG7	Yes	4
		Twin WAG7	Yes	73
		Single WAG9	Yes	51
48.20 t	1/100	Single WAG5	No	-
		Twin WAG5	Yes	50
		Single WAG7	No	-
		Twin WAG7	Yes	63
		Single WAG9	No	-
		Twin WAG9	Yes	77

READY RECKNONER
(Sheet = 3/3)

LOAD 2200 t

Starting T.E. reqd	Grade	Loco Combination	Whether able to start	Running speed
9.53 T	Level	Single WAG5	Yes	100
		Single WAG7	Yes	100
		Single WAG9	Yes	100
14.20 t	1/500	Single WAG5	Yes	83
		Single WAG7	Yes	97
		Single WAG9	Yes	100
16.00 t	1/360	Single WAG5	Yes	78
		Single WAG7	Yes	92
		Single WAG9	Yes	100
20.10 t	1/220	Single WAG5	Yes	68
		Single WAG7	Yes	83
		Single WAG9	Yes	100
21.10 t	1/200	Single WAG5	Yes	65
		Single WAG7	Yes	79
		Single WAG9	Yes	94
25.00 t	1/150	Single WAG5	Yes	54
		Single WAG7	Yes	67
		Single WAG9	Yes	81
28.10	1/125	Single WAG5	Yes	17
		Twin WAG5	Yes	74
		Single WAG7	Yes	58
		Single WAG9	Yes	72
32.70 t	1/100	Single WAG5	Yes	3
		Twin WAG5	Yes	68
		Single WAG7	Yes	50
		Single WAG9	Yes	61

**STUDY ON THE LIMITS OF TRACTION MOTOR CURRENTS IMMEDIATELY
AFTER CONTINUOUS RATING OF 900 AMPS HITACHI TRACTION MOTOR.**

1. The Hitachi traction motor has a continuous rating of 900 Amps and 1 hour rating of 960 Amps. The overloading capacities as indicated in the type test reports are as under:

1350 Amp - 5 minutes

1200 Amp. - 15 minutes

1100 Amp. - 20 minutes

The above overloading capacities are based on starting from cold conditions.

2. Temperature rise studies have been conducted with the help of BHEL/Bhopal in oct.'97. The results so obtained are listed as Annexure-III A.
3. From Annexure-III A overload capability of traction motor, immediately after a continuous duty of 900A comes out to be as under:

1000A - 40 Minutes

1100A - 15 Minutes

1200A - 8 Minutes

1300A - 5 Minutes

1350A - 2 Minutes

The above values are the threshold limits, without any further margins. The traction motors will get overloaded, with higher temperature rise, if the above current exceeds the duration mentioned above.

Annexure III A

BHARAT HEAVY ELECTRICALS LTD.

TRACTION MACHINES ENGINEERING DIVISION

RESULTS OF TEST CARRIED ON TRACTION MOTOR TYPE HS-15250A

DATE OF TEST 29.10.97

MOTOR NO. 4673688

TYPE OF TEST	RATING	TEMPERATURE RISE DEG.C				BRGS.	
		ARM	IP	SF	COMMR	PE	CE
1.CONT.HEAT RUN	750 V, 900 AMPS 95% FF	94	91	104	72	35	06
2. SHORT TIME OVERLOAD	1. 750 V, 1350A, 95% FF FOR 2 MINUTES	116	107	119	78	31	04
	2. 750V, 1300A, 95% FF FOR 5 MINUTES	117	121	132	80	32	05
	3. 750V, 1200A, 95% FF FOR 10 MINUTES	126*	131	144	88*	32	08
	4. 750V, 1100A, 95% FF FOR 17 MINUTES	120	126	141	86*	39	06
	5. 750 V, 1000A, 95% FF FOR 40 MINUTES	114	116	132	83	41	07
3.PERMITTED VALUES		124	151	151	85		

Note:

The temperature rise on the commutator and armature is exceeding in case of Item3. In case of Item 4 the temperature rise of the commutator is exceeding than the permitted value. Therefore the time for which a 1200 Amp loading can be permitted has been accepted by RDSO as 8 min. against 10 min. Similarly the time for which loading of 1100 Amp is permitted has been accepted as 15 min. based on the above results.