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No. EL/3.2.172/1

Date: 25.08.2017

Chief Electrical Engineer,	मुख्य विद्युत अभियंता,
<ol style="list-style-type: none"> Central Railway, Mumbai, CST-400 001. East Central Railway, Hazipur-844 101. East Coast Railway, Chandrashekharapur, Bhubaneshwar-751 016. Eastern Railway, Fairlie Place, Calcutta-700 001. North Central Railway, Block-A, Subedarganj, Allahabad-211 033. Northern Railway, Baroda House, New Delhi-110 001. North Western Railway, Jaipur- 302 006 North Eastern Railway, Gorakhpur-273001 North East Frontier Railway, Maligaon, Guwahati-781011 South Central Railway, Secunderabad-500 071. South East Central Railway, Bilaspur-495 004. South Eastern Railway, Garden Reach, Kolkata-700 043. Southern Railway, Park Town, Chennai-600 003. South Western Railway, Hubli- 580020 West Central Railway, Jabalpur-482 001. Western Railway, Churchgate, Mumbai-400 020 Chittaranjan Locomotive Works, Chittaranjan-713 331 Diesel Locomotive Works, Varanasi-221 004. Integral Coach Factory, Chennai- 600 038 Rail Coach Factory, Kapurthala, Punjab Metro Railway, Metro Bhawan, 33/1, J.L. Nehru Road, Kolkata-700 071 	<ol style="list-style-type: none"> मध्य रेलवे, मुम्बई सीएसटी -400 001 पूर्व मध्य रेलवे, हाजीपुर-844 101 पूर्व तटीय रेलवे, चन्द्रशेखरपुर, भुवनेश्वर-751 023 पूर्व रेलवे, फेयर्ली प्लेस, कोलकाता-700 001 उत्तर मध्य रेलवे, ब्लाक ए-2, सुबेदारगंज इलाहाबाद - 211 033 उत्तर रेलवे, बडौदा हाऊस, नई दिल्ली-110 001 उत्तर पश्चिम रेलवे जयपुर- 302006 उत्तर पूर्व रेलवे गोरखपुर- 273001 उत्तर पूर्व फ्रेन्टियर रेलवे मालीगॉव गुवाहाटी-781011 दक्षिण मध्य रेलवे, रेल निलायम, सिकंदराबाद-500 371 दक्षिण पूर्व मध्य रेलवे, बिलासपुर - 495 004 दक्षिण पूर्व रेलवे, गार्डेनरीच, कोलकाता-700 043 दक्षिण रेलवे, पार्क टाउन, चेन्नई-600 003 दक्षिण पश्चिम रेलवे हुबली-580020 पश्चिम मध्य रेलवे, जबलपुर-482 001 पश्चिम रेलवे, चर्चगेट, मुम्बई- 400 020 चित्तरंजन रेल इंजन कारखाना, चित्तरंजन - 713 331 डीजल रेल इंजन कारखाना, वाराणसी-221004 इंटीग्रल कोच कारखाना, चेन्नई-600038 रेल कोच कारखाना, कपूरथला (पंजाब) मेट्रो रेलवे, मेट्रो भवन, 33/1, जे.एल. नेहरू मार्ग, कोलकाता-700 071

Special Maintenance Instructions No. RDSO/2017/EL/SMI/0311 (REV '0')

dated 25.8.2017

1. TITLE:

Magnetic Particle Testing (MPT) of Traction motor (TM) nose stay in conventional locomotives/EMUs/MEMUs/Metro Railway, TM suspension holder support and motor support in WAG₉/WAP₇ locomotives and traction motor support arm in WAP₅ locomotives.

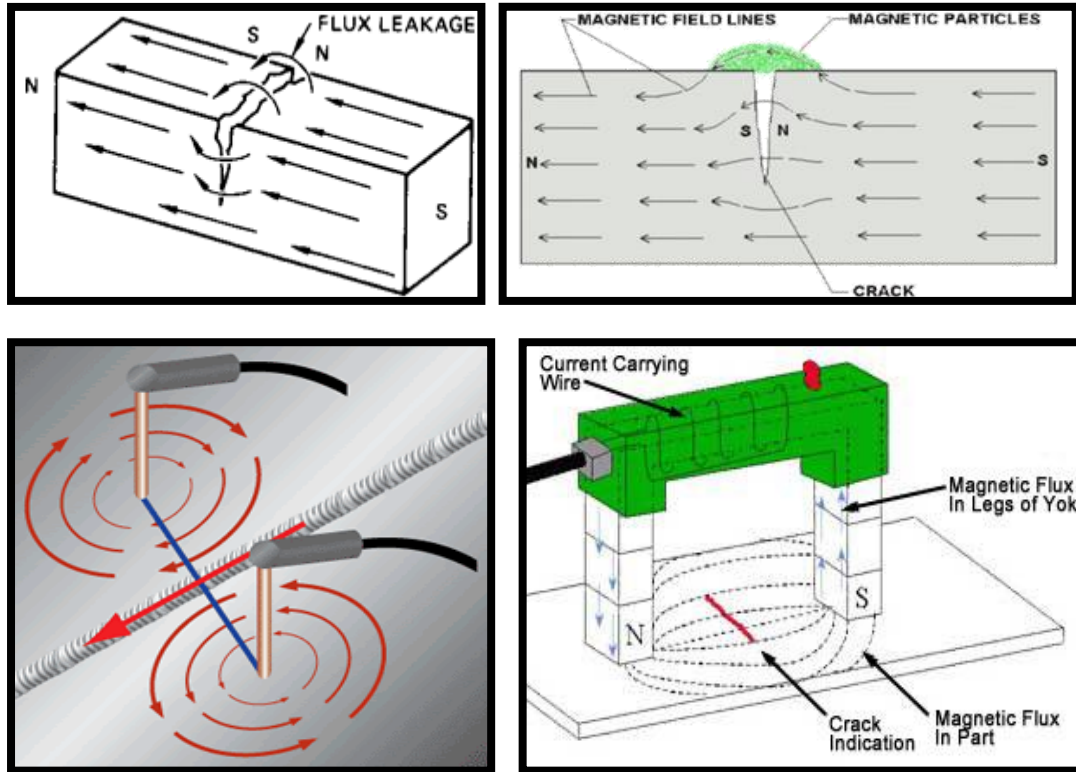
2. BRIEF HISTORY:

- 2.1 On 22.06.2017, a case of falling of traction motor in Loco No. 22209/WAP₄/BRC while working in train No. 12904 was reported due to breakage of Traction motor nose stay.
- 2.2 Instructions for carrying out DPT of TM nose stay had already been issued vide RDSO SMI No. RDSO/2017/EL/SMI /0308 (Rev '0') dated 28.06.2017.

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- 2.3 It is observed that DPT can detect surface cracks whereas; MPT can detect sub-surface cracks also.
- 2.4 As these are vital safety item, it is decided to carry out their MPT also. Existing practices of DPT will also continue.
- 2.5 **Principle & Procedure of MPT:**
- 2.5.1 The magnetic particle method is based on the principle that magnetic lines of forces, when present in a ferro-magnetic material will be distorted by a local change in the permeability due to the presence of any discontinuity having permeability different to that of the test piece.
- 2.5.2 These distorted magnetic lines of forces result in leakage flux which leaps through air from one side of the discontinuity to the other side creating magnetic north and south poles at these points of exit and re-entry respectively.
- 2.5.3 If finely divided ferro-magnetic particles are applied to the surface of the test piece they are attracted by these poles to form a pattern of the discontinuity.
- 2.5.4 Maximum sensitivity is achieved when the flaw lies at right angles to the magnetic flux, but the sensitivity is not reduced below the effective level if the flaw is oriented at an angle of up to 45° from the optimum direction. Beyond 45°, the sensitivity is diminished apparently. For this reason, the complete examination of any surface requires the flux to be passed in two directions at right angle to each other in separate operation.
- 2.5.5 The surface to be examined shall be clean, dry and free from rust, oil, scale, excessive slag and other extraneous matter which may interfere with the sensitivity of examination. In general, satisfactory results may be obtained when the surface is in the as welded condition. However, rough surfaces hamper the mobility of magnetic particles due to mechanical trapping which in turn produces false indications. In such cases, surface preparation by wire brushing or any other suitable method is necessary. To reveal fine defects, the surfaces to be inspected should be smooth machined to at least a 6.3microns finish. However, a thin layer of paint of 0.05 mm maximum thickness does not interfere with the formation of indications.
- 2.5.6 If a magnet is just cracked but not broken completely, a north and south pole will form at facing edges of the crack. The magnetic field flux lines exits the north pole and re-enters at the south pole
- 2.5.7 The magnetic field spreads out or diverts, when it encounters the small air gap created by the crack, due to difference in permeability (μ) of air and the magnetic material. When the field spreads out, it appears as if leaking out of the material and, thus is called a flux leakage field. A fine powder of a magnetic material spread over, will form cluster or heap at the crack-location. Using this principle the cracks on traction motor nose stay/ suspension holder support/motor support can be detected as per the procedure given below.

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- 2.5.8 The procedure involves cleaning surface properly with a paint brush and cloth and then applying the cleaner to have clear surface and afterwards applying the white contrast paint on the surface to provide contrast background for better visibility. Then the permanent magnetic poles (Yoke) are to be placed on both sides of the location wherever cracks are suspected
- 2.5.9 After placing the permanent magnets, the crack can be visible by applying a solution consisting of fine magnetic powder mixed with kerosene. The permanent magnets are to be placed in such a way that the flux produced by them is perpendicular to the suspected location of crack
- 2.5.10 The bath strength of Magnetic Particle shall be as given in IS:3703:2004.
- 2.5.11 The permanent yoke shall have lifting power of 20 Kg with pole spacing of 75-150 mm.
- 2.5.12 Tangential field Hall Effect Gauss meter can be used for checking adequacy of magnetic field and residual magnetism after testing. Tangential field strength shall have a minimum value of 30G.
- 2.5.13 Magnetic Flow detection ink & powder shall be as per IS: 6410:2013.

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2.6 **Applicable Standards for MPT:**

SN.	Standard Number	Title
1.	IS 3415: 1998	Glossary of Terms Used in Magnetic Particle Flaw Detection
2.	IS 3703:2004	Recommended Practice for Magnetic Particle Flaw Detection
3.	IS 5334:2014	Magnetic Particle Flaw Detection of Welds- code of practices
4.	IS 7743:2006	Recommended Practice for Magnetic Particle Testing and inspection of Steel Forgings
5.	IS 6410:2013	Magnetic Flaw detection ink & powders- Specification
6.	IS 13805:2004	General Standard for Qualification and Certification of Non-destructive Testing Personnel- Specification.

These standards shall be followed while carrying out MPT.

3. **Objectives :**

Detection of surface/sub-surface cracks of welded joints of TM nose stay in conventional locomotives/EMUs/MEMUs/Metro Railway, TM suspension holder support and motor support in WAG₉/WAP₇ locomotives and traction motor support arm in WAP₅ locomotives.

4. **Modified Instructions:**

4.1 Magnetic Particle Testing of following shall be carried out during major overhauling & repairs of Traction motor/bogie:

- (i) TM nose stay in conventional locomotives/EMUs/MEMUs/Metro Railway.
- (ii) TM suspension holder support in WAG₉/WAP₇ locomotives.
- (iii) Motor supports on bogie transom (TM 1, 2, 5 & 6 locations) and pivot transom (TM3 & 4 locations) in WAG₉/WAP₇ locomotives.
- (iv) TM support arms and its respective support area in bogie in WAP₅ locomotives.

4.2 MPT will be carried out in addition to DPT as per existing instructions.

4.3 In the application of the method, three essential steps are involved

- (i) The part must be properly magnetized.
- (ii) Suitable magnetic particles must be applied over the surface of the part in such a way that they can move to collect at leakage fields occurring at discontinuities.
- (iii) Any accumulation of magnetic particles must be observed and interpreted.

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4.4 **Assessment of Flaws :**

- 4.4.1 If the indication is caused by the surface discontinuities, the particles are usually tightly held to the surface by a relatively strong magnetic field. The line of particles shall be sharp and well defined. But, if the indication is caused by sub-surface discontinuity, the particles are held in a broad fuzzy accumulation rather than in sharp and well defined patterns
- 4.4.2 Relevant indications are those which results from mechanical discontinuities.
- 4.4.3 Non-relevant indications are caused by distortion of magnetic field resulting from magnetic writing, cold working, hard and soft spots, boundaries of heat affected zones, abrupt change of section, etc. Care shall be taken to identify and eliminate them, as they may mask the actual defects.
- 4.4.4 Any indication suggested to be non-relevant is to be considered relevant till it is proved otherwise.
- 4.4.5 Broad areas of particle accumulation which could mask indications of discontinuities are unacceptable and these areas shall be cleaned and re-examined.
- 4.5 Since the weld had been cleaned prior to magnetic particle inspection, it is liable to rusting unless protected. Temporary corrosion protective may be applied over the component after magnetic particle inspection.
- 4.6 Magnetic Particle flaw detection of welds shall be carried out by qualified personnel as per IS 13805.

5.0 **Application to class of locomotives**

All Electric Locomotives, EMUs/MEMUs & Metro Railways.

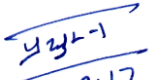
6.0 **Agency of Implementation**

All Electric Loco sheds, EMU Car Sheds, POH Workshops & Production Units.

7.0 **Periodicity of Implementation**

Every Major Overhaul & repair of traction motors/bogies.
TOH/IOH/POH of the Electric Locomotives.
POH of the EMUs/MEMUs & Metro.

Encl: nil


25.8.17

(P. K. Saraswat)
for Director General/Electrical

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