

IRS:S-87

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FOR OFFICIAL USE

INDIAN RAILWAYS STANDARD SPECIFICATION
FOR
AC INDUCTIVE TYPE OF AWS system
[Sub-urban section]

REFERENCE COPY

Signal Directorate

REFERENCE COPY

No. STS/C/61st/SSC

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Sub: Allotment of IRS No. to specification.

Ref: Railway Board's letter No. 87/W3/SG/M/15 dated 20.5.88.

Specification covered under item No. 944 was discussed in 61st Signal Standards Committee held on 9th and 10th Feb. '88 at IRISST, Secunderabad. The recommendations of the SSC included approval of specifications covered was

1. Draft specification No. RDSO/SPN/S-74/88.
for Auxiliary Warning System.

2.

A copy of Board's letter No. 87/W3/SG/M/15 dated 20.5.88 conveying Board's acceptance is sent herewith. You may kindly allot IRS Number to the above specification so that the same can be issued as final standard to Railways.

DA: As above.

N. Kumar
(Naresh Kumar)
Jt. Director Stds. (Signal)-IV

DD/MP (Specn)

IRS: S 87 - 1992 is allotted
for Auxiliary warning system

R. Krishna

1/7/92

CDA/E/SS. Sec. MP. Hr

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R. Krishna

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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS
(रेलवे बोर्ड Railway Board)

No.87/W3/SG/M/15

रेल भवन, नई दिल्ली-110001, तिथि
Rail Bhavan, New Delhi-110001, dated 20.5.1988

The Director General(S&T),
R.D.S.O.,
Lucknow.

M. K. S. No 26

Sub: 61st Meeting of the Signal Standards
Committee (1988).

Ref: Your letter No.STS/C-61 dated 16.2.1988.

.....

A copy of the report of 61st Signal Standards Committee(1988)
is returned herewith. Board have examined the recommendations made
by the Committee and comments against each item are given below:

Item No.940 To consider revision of specification
IRS:S:7 for Roundels and Lenses.

Adoption of revised specification is approved after conduct
of trials with yellow lenses and subject to visibility distance being
confirmed after its systematic recording. Results of the
trials may please be advised.

Item No.941 To examine the double pull operating arrangement
for 52 to 1 in 12 Thick Web Curved Switch with GRS
5E DC Electric Point Machine.

Out of the two suggestions made to improve clearance at JOH,
providing increased throw at actual toe in excess of currently stipula-
ted throw of 115 mm is preferred to increasing the heel divergence.
Continuance of present operating arrangements for thick web switches
as working is approved.

Item No.942 To consider the design of axle counter block system
for double line electrified sections.

Adoption of the design of equipment as an advance standard is
approved after incorporation of following further modifications.

- (i) Replacing the expression 'LC' used on the panel by 'Line Closed';
- (ii) Broadbasing the specification of multiplexers; and
- (iii) Carrying out suitable changes in the chapter Block Working Manual, clearly bringing out the provision of counter facilities at the receiving stations only, and covering the third case of a portion of train being left in the section due to train parting.

Item No.943 To examine the single pull operating arrangement for 1 in 12 ordinary curved switch.

Single pull arrangement may be tried out. This arrangement is preferable to increasing of heel divergence.

Item No.944 To consider draft specification No.RDSO/SPN/S-74/88 for Auxiliary Warning System

Adoption of specifications of AWS as advance standard is approved. A copy of the specifications after incorporating various modifications recommended by the SSC may please be sent.

Item No.945 To consider revision of specification IRS:S.23 for electrical signalling and interlocking equipment

Part (I) & (II) of this specification may be issued as tentative standard after incorporating the specific modifications.

For part(III) dealing with electronics, a sub-committee consisting of S/ Shri R.Jayaraman, Sr.DSTE(MW)/SC Rly., G.Marnisamy, Professor/IRISET, R.S.Parihar, Dy.CSTE/SE Rly., and a convenor from RDSO may be constituted to review the draft specification and to recommend changes latest by 30.6.1988.

Item No.946 To examine the design of interlocking connections of layout facing point (BG) 52 w/90R with rail point clamp and electric thruster.

The trial should be carried out at four more points and results of trial should be circulated to various members of the Signal Standards Committee for further consideration.

Item No.947 To consider the minimum limits of ballast resistance for PSC sleepers in the context of achievable values of insert to insert insulation resistance of these sleepers with and without liners.

Trials are being conducted with Epoxy coated inserts by Western Railway in DC traction areas.

All Zonal Railways have been advised to indicate their experience on working on track circuits with PRC sleepers having minimum of 500 Ohms insulation between inserts and along with liners.

Final decision on these items will be taken after the results of the trials by Western Railway and after study of reports submitted by Zonal Railways.

Receipt of this letter may please be acknowledged.

DA: As above.

K.N./am
(K.N. Jain) 19-5-88
Executive Director S & T (R)
Railway Board.

Government of India
Ministry of Railways
(Railway Board)

INDIAN RAILWAYS STANDARD SPECIFICATION FOR AC
INDUCTIVE TYPE OF AUXILIARY WARNING SYSTEM
(TENTATIVE)
FOR SUBURBAN SECTION

0. FOREWORD

0.1 This specification requires reference to the following specifications :

- IS:9000 Basic climatic and mechanical durability test for electronic components.
- IRS:S23 Electrical Signalling and Interlocking equipment (Tentative)
- IS:694 PVC insulated cables for voltages upto (Part-I) 1100 V; Pt-I with copper conductors.

1. SCOPE

- 1.1 This specification covers the general, operational and technical requirements of the Auxiliary Warning System (hereafter referred to as AUS) for use on Indian Railways
- 1.2 This specification has been prepared by taking into account the specification for AUS equipment issued earlier under S.No. IRS:S38 and recent developments in the technology.
- 1.3 This specification shall be read in conjunction with other relevant information regarding locomotive, braking distance, speed - time curve or any other requirement specified by the purchaser as a part of tender.

2. GENERAL REQUIREMENTS

2.1 The AUS equipment shall consist of following :

(a) Track side equipment comprising of :

- i) Track magnet ; &
- ii) Interface to the signalling system, if required by the purchaser.

(b) Engine equipment comprising of :

- i) Engine magnet;
- ii) Evaluation Unit ;
- iii) Indication and Control Panel;
- iv) Techo Generator ;
- v) Brake actuating unit ; &
- vi) Isolating unit.

2.2 The track magnet's components namely, coils, cores, condensers and other auxiliaries shall be encased in a box of suitable material to make it difficult to pilfer. The terminals shall be brought out in a covered compartment of the same housing for external connections. This housing shall be capable of being fixed to the Rails/sleepers. No external power supply shall be required for operation of track magnet. The track magnet shall be compatible with the engine equipment.

2.3 The track side equipment is intended to warn the driver that he is approaching a signal and to automatically initiate the brake application to bring the train to a stop or to reduce its speed to a predetermined level, if the driver fails to acknowledge the warning indication and take proper action. To facilitate above, the track side equipment shall be capable of being linked to signal as through suitable interface devices preferably using opto couplers.

2.4 The track side equipment shall be installed in between the two rails of a track, nearer the left side rail (as seen in the travelling direction) on main/branch line sections. However, on the suburban sections provided with automatic signalling, the track side equipment shall be located nearer the right side rail. On portions of main sections having automatic signals located at spacing between 400-600 metres, two track magnets, one nearer the left side rail and another nearer the right side rail, shall be provided.

2.5 On main/branch line sections, the track side equipment shall generally be provided near the distant and home signals. Additional track magnets may also be provided as desired by the Purchaser.

2.6 On suburban sections provided with automatic signalling, a track side equipment shall be installed short of every automatic signal. Additional track magnets may be provided at intermediate locations or level crossings, if specified by the Purchaser.

2.7 The engine magnet shall be compatible with the track magnet and shall consist of the following:

- (a) A set of coils and condensers properly housed in a weather-proof casing with the connections of the coils and condensers taken out and terminated on a multiple socket;
- (b) Multi-core cable with both ends terminated on multi-pin plugs to fit at one end on the multi-pin socket indicated in clause 2.7(a) above and at the other end on the multi-pin socket provided in the Evaluation Unit mentioned in clause 2.8(b). The length of the cable shall be prescribed by the Purchaser and it shall cover the distance between the two multi-pin sockets mentioned above and laid in such a manner as to be of no hindrance to the maintenance of the loco parts.

2.8 The engine equipment shall consist of the following:

- one each on either side, shall be provided on locomotives, which would traverse portions of main line sections having automatic signals.
- (a) The engine magnet(s) mounted under the engine frame on both left and right hand sides of the engine at suitable location. Two engine magnets/
 - (b) Evaluation Unit which shall receive indications from the engine magnet, evaluate them and operate relays, indication lamp/LEDs, hooter and buzzer as required.
 - (c) An indication and control panel consisting of necessary buzzer, hooters, indicators and vigilance/acknowledgement buttons housed in proper boxes. The box, housing the indications and vigilance/acknowledgement buttons, shall be capable of being fixed on the wall of the engine cab in such a position as to be easily seen and operated by the driver.
 - (d) A reliable, axle-mounted tacho generator to determine the speed and distance covered by the train. It shall be capable of being used on various types of axles presently used on engines of different types and shall function satisfactorily in a speed range of 0-200 KMPH. It shall also be capable of ascertaining the direction of the train movement.
 - (e) Arrangements for automatic application of brake(s) of the locomotive, either directly or through vigilance or deadman's device on diesel/electric locomotives, electric multiple unit stock (E.M.U) or diesel multiple unit (D.M.U).
 - (f) An isolating unit to isolate the A/S system from the engine control system in the event of the failure of A/S Engine equipment.

2.9 Adequate number of maintenance test kits including testing instruments for aligning and adjustment of track side and engine equipments independently shall be supplied along with the A/S system. The number of each type of instrument shall be decided by the Purchaser. Special tools and instruments for installation of the system, if necessary, shall also be supplied.

2.10 The system shall be capable of working satisfactorily upto a speed of 250 KMPH.

2.11 The system shall be suitable for single, double and multiple track Broad Gauge (1676 mm) and Metre Gauge (1000 mm) sections.

2.12 The track and locomotive equipments shall be capable of being so installed that they do not infringe the relevant Broad Gauge or Metre Gauge Schedule of Dimensions of Indian Railways.

2.14 The AWS equipment shall be capable of being linked to the vacuum brake system used on Indian Railways. It shall also be capable of being linked to the air brake system used on Electric/Diesel Multiple Units.

3. OPERATING REQUIREMENTS

3.1 Normally a blue lamp and a white lamp (indicating proper functioning of the system) shall be lit steadily indicating that AWS system is in working condition.

Note: A white LED strip may be used in place of white lamp.

3.2 The AWS equipment shall provide the following indications and take action as described below when a locomotive passes over a track equipment with the corresponding signal displaying the undermentioned aspects:

Sl.No.	Signal aspect	Lamp/LED indication	Brake application
1.	Green	Blue lamp/LED strip extinguishes and relights after 5 secs. Buzzer sounds for 5 secs. when blue lamp/LED strip is out.	Nil
2.	Double yellow	Blue lamp/LED strip light extinguishes. Then yellow lamp/LED strip light starts flashing. Buzzer sounds.	(a) Brake application if driver does not acknowledge the warning within 4 secs. (b) Train speed reduces to predetermined level if driver acknowledges the warning within 4 secs but does not reduce the speed of his train.
3.	Yellow	Blue lamp/LED strip extinguishes. Then yellow lamp/LED strip light lights up steadily. Buzzer sounds.	(a) Brake application if driver does not acknowledge the warning within 4 seconds. (b) Train speed reduces to predetermined level if driver acknowledges the warning within 4 secs but does not reduce the speed of his train.
4.	Red	Blue lamp/LED strip light extinguishes. Then red lamp/LED strip light lights up. Buzzer sounds.	Brake application if the driver does not bring his train to stop short of signal.

3.3 The AWS equipment shall be capable of identifying missing track magnets, giving suitable indication to the driver and reducing the speed of the train to a predetermined level at these locations;

3.4 The AWS equipment shall have provision to enable passing of a defective signal at a restricted speed by pressing a suitable bypass button provided in the panel for this purpose.

3.5 In case of penalty brake application, it shall not be possible to release the brakes until the train stops. In such cases, the brakes can be released by pressing a reset button/lever, working in conjunction with suitable electronic circuit provided in the loco cab, which shall be effective only after the train has come to a stop.

3.6 Every instance of the penalty brake application (effected by this equipment) shall be recorded on a suitable electronic counter, which shall not be affected by interruption of power supply.

automatic signal with 'A' aspect showing a red aspect. If passed, a red lamp/LEDs strip light shall be lit up on the indication panel and it shall remain lit up until it passes the other track equipment ahead. This red indication reminds the driver that he should proceed ahead cautiously at a speed not exceeding 15 kmph. If the train speed exceeds 15 kmph but is less than 20 kmph, a hooter shall sound intermittently. If the speed exceeds 20 kmph, the hooter shall sound continuously and brakes shall be applied by the system to reduce the speed below 20 kmph. Hereafter, the brakes shall release automatically but the sounding of the hooter intermittently shall continue till the speed of train is brought within 15 kmph by the driver. Provision should be made in the equipment to vary the speed limit of 15 kmph to a higher value at a later date to comply with the changes in GSR.

3.8 It shall not be possible to mute the warning and automatic brake applications by prior operation of vigilance button.

3.9 It shall not be possible to cancel the penalty brake application by switching 'on' & 'off' of the power supply.

3.10 The equipment shall be designed to apply automatic braking in case of rolling back by more than 10 metres, if specified by the Purchaser.

3.11 The system shall also be capable of being used for giving information regarding speed restrictions covering "actual and permissible speeds", "admissible track speed", "end of speed restriction", "remaining distance upto the target" etc, if specified by the Purchaser.

4. TECHNICAL REQUIREMENTS

4.1 The system shall be capable of providing a minimum of twenty-sets of information. The details of the actual informations required by the Purchaser shall be indicated.

4.2 The device shall be of Intermittent ac Inductive type working on the principle of point control system.

4.3 The locomotive device and evaluation equipment shall work on 'Permanently Energised' principle and in the event of occurrence of a fault, the train must be brought to a stop as per conditions specified in clause 3.4.

4.4 Track side equipment shall be designed in such a way that for any disconnection, low insulation or short circuit fault in the connecting cable, a visual indication shall be given in the engine equipment and these failures shall be on the safe side.

4.5 The design of track side equipment shall have an intrinsic cascading arrangement so that in the event of simultaneous display of two conflicting aspects caused by a defective component like signal lamp, the more restrictive of the two aspects would be passed on to the engine magnet. Likewise, in the case of blank signal, the information corresponding to red aspect shall be transmitted to the engine magnet.

4.6 The system shall facilitate programming of the braking characteristics of the system. It shall be programmed based on the various informations like signal aspect, predetermined limit of the speed, point of speed control, inter-signal distance, braking distance available etc. and the same shall be got approved by the Purchaser.

4.7 Facility shall be provided for release of the speed control by the system, at intermediate locations where additional track magnets have been provided, to avoid loss of running time when the concerned signal ahead has assumed less restrictive aspect.

4.8 The system shall be immune to electro-magnet interference generated by thyristor/chopper controlled locomotives, traction return currents or because of any other extraneous currents.

4.9 It shall be suitable for use on steam, diesel and electric locomotives of 1500V dc and 25 KV, 50 cycle ac type. It shall be capable of being used on Electrical Multiple Unit stock/ Diesel Multiple Unit stock also.

4.10 In the case of steam locomotive, it would be sufficient if brakes are caused to be applied by:-

(a) Venting the train pipe to the atmosphere;
and

(b) Stopping steam supply to ejector.

In the case of diesel and electric locomotives the system shall not only operate the brakes but also cut off power.

4.11 The engine-magnet on the locomotive shall be so located and mounted that it would function correctly over the limits of transverse and vertical movements on the appropriate parts of the locomotive/ E.M.U/D.M.U relative to the centre of track. These limits are:

- | | |
|----------------|---------|
| (a) Transverse | + 40 mm |
| (b) Verticals | + 50 mm |
| | - 78 mm |

4.12 Where the system does not tolerate sufficient air gap, the mounting of the engine-magnet shall be adjustable within ± 45 mm minimum to cater for the static displacements like wheel tyre wear etc.

4.13 The adjustments shall be secured against severe vibrations.

4.14 Each operation of isolating device shall be counted in a sealed electronic counter.

4.15 Power Supply:

The locomotive equipment shall be capable of working from any of the following DC supplies:-

- (i) 24 V dc battery supply (fluctuation $\pm 20\%$ to -10%) in case of steam locomotive.
- (ii) 110V dc nominal varying from 68V to 136V dc in case of electric locomotive and EMU stock.
- (iii) 72V dc nominal varying from 43V to 87V in the case of diesel locomotive.

The design of the engine equipment shall be such that power consumption is very low from the engine power supply.

5. EQUIPMENT SPECIFICATION

5.1 General

5.1.1 The design of the track magnet shall be such that it is not damaged by infringing parts of the rolling stock. Suitable ramps, where necessary, shall be provided for the purpose.

5.1.2 The track magnet, engine magnet and tachogenerator shall be robust and housed in casings which are water-proof and their operation shall not be affected by vibrations, shock, temperature changes, humidity and other severe operating conditions to be expected in railway working.

5.1.3 The track magnet shall function satisfactorily even when submerged in flood waters. Suitable gaskets shall be used for the track magnet to prevent seepage of water inside.

5.1.4 The evaluator unit shall be solid state and the same should be designed based on fail-safe principle.

5.1.5 The evaluator unit shall be fabricated with hardware modular construction. Each hardware module shall have a unique configuration so as to avoid insertion of any PCB module in a wrong slot.

5.1.6 The evaluator unit shall preferably use regular mother-board PCB in place of back panel wiring.

5.1.7 Highly reliable components conforming to one of the approved specifications shall only be used. The components used in the system shall be selected for the worst case conditions having wide margin of supply voltage and temperature.

5.1.8 Chassis and cabinets shall be so designed that chassis assembly can be readily replaced.

5.1.9 All component parts shall be so arranged and mounted as to be easily accessible and replaceable without appreciable disturbance to other parts of the unit.

5.1.10 The various types of relays used shall conform to the relevant RS, MRS, AAR or any other specification to be approved by the Purchaser.

5.1.11 The system shall use high reliability components tested to PEP level III grade of Texas Instrument or equivalent international standard. The MTBF of the system shall not be less than 10^5 hours.

5.2 Chassis, front panels and mounting details.

5.2.1 Chassis, front panels and mounting details shall be either aluminium alloy or steel.

5.2.2 If steel is used, all parts shall be given a corrosion resisting treatment after all machine operations have been completed.

5.2.3 If aluminium is used, front surface shall be etched prior to finishing.

5.2.4 Adequate rigidity shall be provided to prevent undue distortion.

5.2.5 Terminal boards, printed circuit boards and module circuit cards shall be of non-hygroscopic insulating material of such nature that under any specified service condition, or in the process of etching, mounting of components and soldering, the insulating material shall not be damaged.

5.3 Wiring:

5.3.1 All external wiring inside the cab shall be done with the PCF type of cable as per EDSO specification E13-03-78. All other wiring shall be done with PVC insulated cable complying with IS:694, Part I.

5.3.2 Wiring shall be colour coded or otherwise marked to differentiate between various types of circuits.

5.3.3 Where insulated leads pass through holes in the chassis, the hole shall be equipped with ebonite grommets having a smooth finish.

5.3.4 Only non-corrosive solder shall be used.

5.3.5 All wires connected to terminals which require soldering shall be securely fastened to the terminals by crimping the terminals firmly on the wire or the wire on the terminals before soldering, and shall not depend on solder for mechanical strength. Special care shall be taken to avoid dry solders.

5.3.6 Wire size and electrical connections shall be consistent with service requirements.

5.3.7 The length and type of the connecting cable between the track magnets and the interface to the signalling system shall be indicated by the Purchaser so that the tenderer shall provide suitable arrangements in the track magnet to compensate the effects of the cable.

5.4 Accessibility of parts.

5.4.1 All circuit components shall be so mounted in the chassis assemblies as to permit their replacement without appreciable disturbance to other components.

5.4.2 All switches and controls shall be mounted in such a manner as to permit their convenient replacement without removal of other units.

5.4.3 All sub chassis, modules or circuit boards shall be mounted in such a manner as to permit their convenient replacement without appreciable disturbance to either assemblies or components.

6. INSPECTION AND TESTING.

6.1 Inspection and tests shall be carried out to ensure that all requirements of this specification and all the specifications mentioned and drawing supplied, if any by the Purchaser, are complied with.

6.2 Conditions of Tests: Unless otherwise specified, all tests shall be carried out at ambient atmospheric conditions.

6.3 Type tests: The following shall comprise type tests:

- (a) Visual inspection (Clause 6.5)
- (b) Applied High Voltage Test (Clause 6.6)
- (c) Insulation Resistance test (Clause 6.7)
- (d) Performance Test (Clause 6.8)
- (e) Temperature rise test. (Clause 6.9)
- (f) Test for continuous operation (Clause 6.10)
- (g) Climatic Tests (Clause 6.11)

6.2.2 Two equipments of each type shall be taken for type testing purpose. The equipment shall successfully pass all the tests for proving the conformity with this specification. There shall be no failure.

6.3.2 At the end of the validity period of 3 years or earlier, if necessary, the testing authority may call for fresh sample for type testing.

6.4 Acceptance Tests: The following shall comprise acceptance tests:

- (a) Visual inspection (Clause 6.5)
- (b) Applied High voltage test (Clause 6.6)
- (c) Insulation Resistance Test (Clause 6.7)
- (d) Performance Test (Clause 6.8)

6.4.1 Acceptance test shall be carried out on all the equipment submitted for inspection.

6.5 Visual Inspection

The equipment shall be examined for provision of all facilities, stipulated in this specification, correct wiring, proper mounting of components, marking, workmanship and finish.

6.6. Applied High Voltage Test.

With electronics unit removed, the equipment shall withstand for one minute without puncture and arcing a test voltage of 2000 V rms applied between power components and the body of the equipment which shall be earthed. The test voltage shall be approximately of sinusoidal wave form and of any frequency between 50 and 100 Hz.

6.7 Insulation Resistance Test

After conducting applied High Voltage test as per clause 6.6 above, the insulation resistance between the terminals and body of the equipment shall be measured and recorded. It should not be less than 10 Megohms when measured at 500 V dc at ambient temperature.

6.8 Performance Test.

The equipment to be accepted shall be tested so as to comply with operational requirements as specified in clause 3 and also against clause 4.11 when installed according to clause 2.12.

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6.9 Temperature Rise Tests:

Temperature rise of the transformer and components used in the equipment shall not be more than 50°C above ambient when tested in full load connected.

6.10 Test for continuous operation:

The equipment shall be subjected to continuous run for 48 hours with maximum input voltage specified. After this test the equipment shall satisfy the requirements of clause 6.8.

6.11 Climatic Tests.

The equipment shall be tested for climatic and environmental test as per IS:9000 to the severity conditions laid down in the Appendix 'C' of this specification.

At the end of each climatic test and after recovery the equipment shall satisfy the requirements as per clause 6.8 of this specification.

7. MANUFACTURE

7.1 The manufacturer shall ensure that in addition to all the provisions of this specification, the requirements of other specifications referred to in this specification as far as they are applicable and any specifications prescribed by the Purchaser are fully complied with.

7.2 Workmanship, limits and fits, insulating materials, electromagnetic coils, electrical contacts and springs, terminals, wiring, rejection, marking and identification, packing and warranty shall be in accordance with the requirements in IFS Specification No.S23.

7.3 The manufacturer shall have suitable inspection facilities and testing equipment at their works.

7.4 A detailed instruction manual shall be supplied along with the equipment incorporating the following information:

- (i) Installation instructions.
- (ii) Guaranteed performance and technical and other particulars of the equipment.
- (iii) Wiring diagram showing components and their values.

Mark circuit available;

.....12/-

(iv) Drawings showing the general mounting arrangements, various tolerances, trouble shooting procedures, etc.

(v) Detailed note on operation, maintenance & adjustment procedures.

The number of instruction manual to be supplied at the time of supply of equipment shall be decided by the Purchaser.

INFORMATION TO BE SUPPLIED BY THE PURCHASER

- A-1 The type of locomotive including brake system (Clause 2.8(a)).
- A-2 The type of application of the equipment whether signalling of line signals or signalling of speed restricted section or both.
- A-3 Information regarding the following :-
 - (i) Signalling details of the section.
 - (ii) Details and number of the informations corresponding to the various aspects of the signalling system, location of intermediate track magnets, speed restriction etc. for which the AWS system is to be wired.
 - (iii) Available braking distance in the section.
 - (iv) Information regarding various speeds like maximum sectional speed, limit of the speed control corresponding to various aspects etc.
 - (v) Various speed control points and limit of speed control within specified distances.
 - (vi) Any other information required in connection with the programming of braking characteristics in the evaluation unit.
- A-4 The length of the multi-core cable required (Clause 2.7).
- A-5 The length and type of the connecting cable (Clause 5.3.7).

APPENDIX 'B'

INFORMATION TO BE SUPPLIED BY THE TENDERER

- B-1 The load on the battery for locomotive equipment.
- B-2 Various mechanical tolerances for efficient operation of the system (clause 4.16 and 4.17).
- B-3 Minimum induced voltage in the engine magnet for reliable working of AWS.
- B-4 Records of safety and performance analysis of the system if required by the purchaser.

-12-

APPENDIX 'D'

OUTLINE OF TESTS AND DEGREE OF BYTEST
FOR CLIMATE TEST OF EQUIPMENT (CLAUSE 6.1.1)

6.11

C-1 Dry Heat:

This test shall be done at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 16 hours with equipment operational for last 4 hours and the measurements to be taken at the end of 16 hours. The test shall be conducted as per IS 9000 Pt. III.

C-2 Cold:

This test shall be done in two phases - i.e. operation and storage. The operational test shall be done at 0°C for 16 hours with equipment operational for last two hours and the measurements to be taken at the end of 16 hours. Storage test shall be done at $-10^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for 1 hour with a recovery time of 8 hours. The test shall be conducted as per IS 9000 Pt. II.

Note: Hot and cold cycles to be repeated alternatively 3 times each.

C-3 Damp heat (Steady State):

The equipment shall be subjected to $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ with RH not less than 95% for 4 days with the equipment operational for last 4 hours and the measurements to be taken at the end of 4th day. The test shall be conducted as per IS 9000 Pt. IV.

C-4 Damp heat (Tropical Exposure):

The equipment shall be kept at 25°C at RH 95% for 5 hours and 40°C at RH 95% for 12 hours with 2 1/2 hours rise and 4 1/2 hours fall time from 25°C to 40°C and from 40°C to 25°C . The equipment shall be operational. There will be 21 cycles and the measurements shall be taken at the end of 21st cycle. The test shall be conducted as per IS 9000 Part V.

C-5 Vibration:

Vibration test shall be conducted to withstand severity of acceleration by the different units as given below in the frequency range 1 Hz - 200 Hz.

(a) Tacho generator and track magnet = 300 m/s^2 .

(b) Engine magnet = 50 m/s^2 .

(c) Evaluation unit = 20 m/s^2 .

Test shall be conducted on all the axis for two hours duration on each axis as per IS 9000 Pt. VIII. Duration of endurance for critical frequencies shall be 10 hours.

Appendix 'D' Contd

C-6 DESI

The equipment shall be checked for proper functioning after the test. The duration of the test shall be 2 hours. A temperature of $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ with a relative humidity not exceeding 30% shall be maintained during the test. The test shall be conducted as per IS 9000 Pt. XII.

C-7 Water Immersion (For track magnet only):

The duration of the test shall be 48 hours. The equipment shall be tested after the test. The test shall be conducted as per IS 2106 Pt. X.

C-8 Driving Rain (For track side equipment only) and Trolley

The equipment shall be subjected to water spray test to simulate the effect of driving rain. The duration of the test shall be 2 hours and the equipment shall be operational during the test. At the end of test, the equipment shall be visually inspected. The test shall be conducted as per IS 9000 Pt. XVI.

C-9 Impact (For track magnet only):

The purpose of the test is to produce in the equipment effect similar to those produced by the hanging coupler of a moving train when it hits the track equipment. The equipment shall be tested for a momentum of 1350 kg m/s. The test shall be conducted as per IS 9000 Part VII.