

ELECTRONIC INTERLOCKING

(FORMELY KNOWN AS SOLID STATE INTERLOCKING)

SPECIFICATION NO. RDSO/SPN/192/2005

(DRAFT)

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**SIGNAL DIRECTORATE
RESEARCH DESIGNS & STANDARDS
ORGANISATION
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MANAK NAGAR
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Authors: See Document Control Sheet Signed by: Name: Anurag Goyal Designation: Jt. Director/ Signal/RDSO		
Approved by Name: Shri G. D. Bhatia Designation: Sr. Executive Director/ Signal, RDSO		
Abstract This document defines Electronic Interlocking.		

DOCUMENT CONTROL SHEET

NAME	ORGANIZATION	FUNCTION	LEVEL
Anurag Goyal	RDSO	Member	Prepare
G.D. Bhatia	RDSO		Approve

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**Government of India
Ministry of Railways
(Railway Board)
INDIAN RAILWAY
STANDARD SPECIFICATION
FOR
ELECTRONIC INTERLOCKING
(DRAFT)
SERIAL NO. RDSO/ SPN/192/2005**

0. FOREWORD :

- 0.1 This specification is issued under the fixed serial No. RDSO/ SPN/192/2005 followed by the year of original adoption as standard or in case of revision, the year of latest revision.
- 0.2 This specification requires reference to the latest version of following specifications: –

1	IRS: S 36	Relay interlocking systems
2	IRS: S23*	Electrical signalling and interlocking equipment
3	RDSO/SPN/144	Safety and reliability requirement of electronic signalling equipment.
4	IS: 9000*	Basic environmental testing procedures for electronic and electrical items.
5	IS 2147-62*	Degrees of protection provided by enclosure for low voltage switchgear and control gear.
6	ISO 9001	Quality Systems- model for quality assurance in design, development, production, installation and serving.
7	EN50126	Railway applications- specification and demonstration of reliability, availability, maintainability and safety.
8	EN50128	Railway applications- signaling and communication- Software for Railway control and protection system.
9	EN50129	Railway applications- Safety related electronic systems for signaling.
10	EN50159-1 & 2	Railway applications- Signaling and Communication Safety related communication in closed and open transmission system.
11	IEC 529/ EN 60529	Specification for degree of protection provided by enclosures (IP code).
12	EN 61000.4.2	Electromagnetic compatibility (EMC)- testing and measurement techniques- electrostatic discharge immunity test and basic EMC.
13	EN 61000.4.4	Electromagnetic compatibility - testing and measurement techniques- electrostatic fast transient/ burst immunity test and basic EMC publication.
14	EN 61000.4.5	Electromagnetic compatibility - testing and measurement techniques- surge and immunity test.
15	IRS: S-99	Data Logger System.
16	RDSO/SPN/186	Domino Type Control Panel for Railway Signalling

- * Or equivalent Recognized International standard. The supplier shall submit a copy of the same for verification.

Whenever, reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification.

0.3 ABBREVIATIONS :

SNO.	ABBREVIATION	EXPANDED FORM
1.	ABS	AUTOMATIC BLOCK SIGNALLING
2.	ATP	AUTOMATIC TRAIN PROTECTION
3.	CA	CROSS ACCEPTANCE
4.	CCIP	CONTROL CUM INDICATION PANEL
5.	CD	COMPACT DISC
6.	CENELEC	EUROPEAN COMMITTEE FOR ELECTRO TECHNICAL STANDARDIZATION
7.	CIU	CENTRAL INTERLOCKING UNIT
8.	CMU	CENTRAL MONITORING UNIT
9.	CTC	CENTRALISED TRAIN CONTROL
10.	EI	ELECTRONIC INTERLOCKING
11.	EMU	ELECTRICAL MULTIPLE UNIT
12.	EPROM	ERASABLE PROGRAMMABLE READ ONLY MEMORY
13.	IBS	INTERMEDIATE BLOCK SIGNALLING
14.	I/O	INPUT/OUTPUT
15.	ISA	INDEPENDENT SAFETY AUDITOR
16.	MTBF	MEAN TIME BETWEEN FAILURE
17.	MTBWSF	MEAN TIME BETWEEN WRONG SIDE FAILURE
18.	MTTR	MEAN TIME TO REPAIR
19.	MT	MAINTENANCE TERMINAL
20.	OC	OBJECT CONTROLLER
21.	OFC	OPTICAL FIBRE CABLE
22.	PC	PERSONAL COMPUTER
23.	PCB	PRINTED CIRCUIT BOARD
24.	QA	QUALITY ASSURANCE
25.	QAP	QUALITY ASSURANCE PROGRAM
26.	SEM	SIGNAL ENGINEERING MANUAL
27.	SIL	SAFETY INTEGRITY LEVEL
28.	STR	SCHEDULE OF TECHNICAL REQUIREMENTS
29.	TOT	TRANSFER OF TECHNOLOGY
30.	UV	ULTRA VIOLET
31.	VDU	VISUAL DISPLAY UNIT
32.	VGA	VIDEO GRAPHIC ARRAY

1.0 SCOPE :

- 1.1 This specification covers the technical requirements of Electronic Interlocking.
- 1.2 The EI covered in this specification shall be a microprocessor based equipment used for the operation of points, signals, level crossing gates, block working with adjacent station, releasing of crank handle for manual operation of points and other controls like slots etc. through a control cum indication panel or VDU based control panel. It shall be capable of future interfacing with ATP & CTC systems.
- 1.3 In case of End Cabin/ Multi Cabin working, it shall be possible to interface more than one CCIP or VDU control terminal or both with the EI.

2. TERMINOLOGY:

- 2.1 For the purpose of this specification, the terminology given in latest version of IRS: S 23 and RDSO/SPN/144 shall apply.

3. GENERAL REQUIREMENTS:

- 3.1 The system shall provide all the interlocking, control and indication functions as per approved interlocking plan, selection table and panel diagram of the station.
- 3.2 The system shall have facility of monitoring of internal variables as well as status of I/O.
- 3.3 The system shall be suitable for working on sections having 25 kV AC traction and where passenger/freight trains hauled by single phase thyristor controlled or three phase induction motor controlled AC locomotives or chopper controlled EMU stock are operated.
- 3.4 The system shall be capable of working in conjunction with the control cum indication panel or a VDU or both as per clause 5.3 as required by Railways.
- 3.5 The system should have capability to interface with Block Working. It should also be capable of interfacing with IBS, ABS including interfacing with outlying yards and sidings. Supplier shall submit interface details.
- 3.6 The system shall be capable for working in non air-conditioned environment and ambient temperature range between -10° C to 70 ° C and Relative Humidity upto 95% at 40° C.
- 3.7 The system shall be provided in a dust protected cabinet. If forced cooling is required, the cooling fans shall operate on system power supply with over current protection arrangement. The failure of any one of the fans shall give an alarm to the operator.
- 3.8 The equipment shall be so constructed as to prevent unauthorized access to the system.
- 3.9 Necessary provision shall be made in the hardware and software for modular expansion of the system. For large stations, which cannot be covered by one EI, it shall be possible to connect more than one EI preferably through a serial channel. The communication channel provided between various EI shall comply with the requirements for transmission of vital safety information as laid down in relevant clause of latest version of RDSO/SPN/144/2004.

- 3.10 EI shall have user-friendly graphic based design tool to generate station specific application software to carry out future yard modifications.
- 3.11 For all vital inputs/ outputs, double cutting arrangement shall be provided.
- 3.12 Either OFC or twisted pair cable shall be used for all vital connections.

3.11 REQUIREMENT OF ELECTRONIC INTERLOCKING:

- 3.13.1 Both hardware & software of EI must meet SIL-4 as defined in CENELEC Standards. If the system is developed using any equivalent International standard other than CENELEC, a copy of standards followed shall be submitted with application. The certificate of validator certifying that the system is equivalent to SIL-4 compliant shall also be submitted.
- 3.13.2 The EI system software as well as warm/hot standby changeover software should have been independently verified and validated including its offered configuration by third party. User Railway shall verify application software pertaining to yard data.
- 3.13.3 The firm manufacturing EI, when applying for type approval or cross – acceptance approval shall submit documentary proof of independent validation as per CENELEC Standards or equivalent standard alongwith complete safety case.
- 3.13.4 The firm shall give details of all modifications carried out in the system after initial validation/ approval. Date of each modification with brief reasons for undertaking modifications shall be given. All modifications must have got approval of original validating agency/ approving agency.
- 3.13.5 The next level Signal control circuits like Cascading of Signal aspects, Red lamp protection etc. shall be achievable through Software only.
- 3.13.6 The audio-visual alarm shall be available for Approach locking. Button sticking etc. in EI.
- 3.13.7 CIU shall have log of all counters provided at Panel like Emergency Route cancellation, Calling on signal, Emergency Point operation, Overlap release operation etc. so that in case, operation commands are given through VDU in place of CCIP, then proper working of counters shall be possible and readings of all counters can be read as and when required.

4. INTERLOCKING REQUIREMENTS:

- 4.1 The system shall meet the interlocking requirements as specified in Cl.4.0 of IRS: S 36.

5. SYSTEM COMPOSITION:

- 5.1 The EI system shall consist of the following:
- 5.1.1 Microprocessor based interlocking equipment to read the yard and panel inputs, process them in a fail-safe manner as per the selection table and generate required outputs.
- 5.1.2 Cycle time and response time to read and process the input shall be fast enough to ensure safety and avoid any apparent delay. Cycle time and response time of the system shall be clearly indicated.

- 5.1.3 Requirement of spare parts of each type for the first line maintenance shall be indicated to meet system availability with Mean time to repair (MTTR) being not more than 6 hours.
- 5.1.4 Domino type Control Cum Indication Panel (CCIP) with panel processor having standby processor or VDU control terminal as required by purchaser.
- 5.1.5 Maintenance terminal (MT) with display, keyboard, printer and event logging facility for minimum 10,00,000 events. The system shall have facility for automatic serial data transfer to a central monitoring unit through data logger. The protocol for this communication shall be as per Data Logger specification No. IRS: S-99.
- 5.1.6 Relay rack along with required number of approved type of relays or OCs.
- 5.1.7 **OBJECT CONTROLLER:**
- 5.1.7.1 OC shall be a Processor based system having similar architecture as of CIU. It shall work as slave unit of CIU through duplicated serial communication and placed within 15 Km. radius from CIU. The OC shall drive the field gears (Points, Signals & Relays) and take feedback (Inputs) from various field gears without any modification/ change in the design of outdoor Signalling equipment.
- 5.1.7.2 OC shall be normally placed in field locations.
- 5.1.7.3 The medium of communication between CIU and OCs shall be OFC provided on a ring basis. In case of communication failure between CIU & OC, all the outputs shall be brought to safe state whenever two consecutive telegrams are not received in stipulated time period.
- 5.1.7.4 All the inputs and outputs of OCs shall be isolated.
- 5.1.7.5 OC shall carry out the supervisory function to check the proper level of system voltages at critical points to ensure proper working of the system and shall also check the health of the complete system.
- 5.1.7.6 Occurrence of any error in any OC or hardware fault leading to unsafe condition shall immediately withdraw all output commands and remove the source supply to outputs. Functionally, each OC should be independent from other OC. Error in one OC should not affect the working of other OCs.
- 5.1.7.7 If the system is developed using OCs, then it shall be developed in following two phases:
- (i) In first phase, the object controller shall have only Relay driver cards duly validated and meeting all safety requirements to drive Points, Signals and other field gears. The approval shall be given to provide system with this arrangement over the stations of Indian Railways.
 - (ii) In second phase, after successful testing & working of above mentioned system for specified time as decided by RDSO, Solid State Point and Signal lamp modules shall be developed to the satisfaction of validators and RDSO.
- 5.1.7.8 In case of Cross Acceptance, EI with OCs may be directly accepted provided these have performed satisfactorily for the quantity and period as specified in Cross Acceptance procedure of RDSO.

5.2 CCIP shall conform to relevant clauses of IRS: S 36 and RDSO/SPN/186. It shall be provided with push buttons/ control switches for individual operation of points, clearing of signals, releasing of crank handle/ground lever frame/ gate controls, cancellation of routes and other functions as covered by IRS: S 36 including block signalling, auto signal, IB signal, adjacent yard layout, to facilitate indication or operation cum indication as per requirement.

5.3 CONTROL TERMINAL WITH VDU DISPLAY:

5.3.1 If required by the purchaser, a control terminal with VDU display in lieu of or in addition to conventional CCIP shall be supplied. This will consist of:

- i) A latest PC, colour VDU monitor with minimum size of 17"(43 cm.) as specified by purchaser.
- ii) A Key Board & mouse and
- iii) Suitable interface to continuously display the current position/status of various field equipment and track circuits.

A flashing indication shall be provided on the VDU to indicate healthy condition of the main system, communication channel and panel processor.

Three dot markers in Red, Blue & Green colours respectively shall also be displayed prominently at conspicuous location on the VDU terminal to indicate that the colour monitor is healthy and all the three colours (Red, Blue & Green) are present in right proportion.

5.3.2 The control terminal shall work with 230V ± 10%, 50Hz AC power supply, for which an UPS of adequate capacity shall be supplied along with the system.

5.3.3 A colour monitor (minimum VGA or better) shall be used for the VDU of the control terminal. It shall be possible to display the complete yard layout including the section on the monitor. It shall also have facility for displaying a portion of the yard or section in an enlarged mode, if required.

5.3.4 The current position/ status of various field equipments and track circuits shall be displayed on the VDU using different colours/ symbols, as desired by the purchaser.

5.3.5 The system shall have suitable interface to receive and process the information for displaying the status of field equipment on the control terminal. This interface shall be of standard type like RS 232 or any other approved type.

5.3.6 Availability of communication channel shall be indicated by a constantly flashing indication. Whenever the serial channel goes faulty, a suitable error message shall be displayed on the terminal.

6. HARDWARE AND FAIL-SAFETY :

6.1 Requirements of SEM as laid down in relevant clause of latest version of RDSO/SPN/144 shall be complied.

6.2 COMPONENTS :

Components used shall comply with relevant clause of latest version of RDSO/SPN/144 and should be commercially available.

6.3 **PROTECTION AGAINST ELECTROMAGNETIC AND ELECTROSTATIC INTERFERENCE :**

The requirements laid down in relevant clause of latest version of RDSO/SPN/144 shall be complied. The equipment chassis shall be connected to suitable earth.

6.4 **PRINTED CIRCUIT BOARD :**

6.4.1 The requirements laid down in relevant clause of latest version of RDSO/SPN/144 shall be complied.

6.4.2 Each card shall be marked with running serial number for identification of individual cards.

6.5 **FAIL-SAFETY :**

6.5.1 The requirements laid down in relevant clause of latest version of RDSO/SPN/144 shall be complied.

6.5.2 Either or both of hardware and software redundancy shall be provided to ensure that any single fault does not lead to unsafe failure.

6.5.3 MTBWSF should be minimum 10⁹ hours.

6.6 The system shall have provision for accommodating additional 25% of I/O cards.

7.0 **SYSTEM ARCHITECHTURE:**

7.1 One of the following architectures shall be employed in the system.

- (a) Single Hardware architecture with diverse software. In addition, hot/ Warm standby processor(s) /system shall be provided with facility of automatic changeover.

In case of Warm standby system, the standby system should start functioning with a time delay of approximately 120 secs. of failure of main system. Preferably, the train operation shall not be affected or otherwise, there shall be no unsafe occurrence due to switching over from main system to standby system.

In case of hot standby system, train operation shall not be affected. It should also be ensured that the fault, which affected the main processor/ system, does not affect the hot standby processor/ system.

- (b) Two out of two hardware architecture with identical hardware and identical or diverse software. In addition, warm standby/ hot standby processor(s) / system using similar 2 out of 2 hardware and software architecture shall be provided with facility of automatic changeover.

In case of Warm standby system, the standby system should start functioning with a time delay of approximately 120 secs. of failure of the main system. Preferably, the train operation shall not be affected or otherwise, there shall be no unsafe occurrence due to switching over from main system to standby system.

In case of hot standby system, train operation shall not be affected. It should also be ensured that the fault, which affected the main processor/ system, does not affect the hot standby processor/ system.

- (c) Two out of three hardware architecture with identical hardware and identical or diverse software.

7.2 MAINTENANCE AND DIAGNOSTIC AIDS:

7.2.1 MT consisting of a standard PC with printer from a reputed manufacturer shall be provided for following Operations: -

- i) Display of the current status of points, signals, controls etc. of the yard.
- ii) Storage of minimum one month data or 10,00,000 events.
- iii) Display of recorded events and
- iv) Data transfer to floppy, CD, flash memory or any other storage media.
- v) Transfer of recorded events to external data logger.

7.2.2 Result of the failure of any card/module in the system should be clearly indicated. The supplier should also indicate process of replacing such defective cards / modules.

7.2.3 Control operation of yard functions shall not be possible from the maintenance terminal.

7.2.4 In case of any module/ card becoming faulty, this fact should be displayed on MT with diagnostic facility to identify faulty module/ card.

8.0 SOFTWARE REQUIREMENTS:

8.1 The software of system should have two layers :

- (a) Executive Software or System Software

This Executive Software shall define what the system can do and how the various parts of the system operate together. It shall include all start up and operational safety tests (including checking the Executive Software itself) that are the parts of the processor for continual assurance of safety operation.

- (b) Application Software

It shall be containing the logic that defines how the inputs and outputs for a particular station are related. This shall be station specific.

The Executive Software and Application Software shall be programmed into Read Only Memories (ROM) by the manufacturer. Both the ROMs shall be separated & isolated from each other. It shall not be possible to modify Executive Software. However, Application engineers should have the facility to modify application software as and when required.

8.2 Software used in EI should have been developed in conformity with a software engineering standard issued by recognized standards body such as CENELEC with special relevance to safety critical applications. Particular software engineering

standards used shall be specified and one complete set of such standards shall be made available to RDSO.

8.3 The selected EI Software should have been independently verified and validated. As specified in the software Engineering Standards, full documentation on Quality Assurance Program specially the Verification and Validation (V&V) procedures carried out in-house or by any independent agency, should be made available to RDSO to check their conformity to the standards. If the procedure and documentation for V & V is considered inadequate, RDSO reserves the right to get the verification and validation of software and hardware done by an independent agency at the cost of the supplier.

8.4 The system shall conform to software requirements and self-check procedures as laid down in relevant clause of latest version of RDSO/SPN/144.

8.5 SELF CHECK PROCEDURES:

8.5.1 Self-check of the associated functional hardware as required by the hardware design should be performed periodically as laid down in relevant clause of latest version of RDSO/SPN/144.

Sufficient self-check should be built into the system to detect possible hardware faults.

8.5.2 Integrity of the final vital output of the system for control of the field equipment should be continuously checked by reading both front & back contacts of relays to guard against inadvertent operation of the equipment.

9. POWER SUPPLY REQUIREMENTS:

9.1 The EI shall work on 110V/ 60V/ 24V/12V DC power supply.

9.2 Two different voltages shall be used, one to drive EI equipment and the other for receiving the inputs from the field gears.

9.3 The short circuit protection shall be provided.

9.4 The required protection shall be provided to protect from any malfunctioning due to false/spurious feed.

9.5 Suitable surge protection and proper earthing arrangement shall be provided in the power supply system to protect against transient voltages, lightning & spikes etc.

9.6 If CCIP and CIU are in separate building, then lightning and surge protection has to be provided for each core of copper cable connecting CCIP and CIU or else OFC cable shall be used to connect CCIP & CIU.

9.7 A detailed Power supply arrangement diagram/ circuit shall be provided.

9.8 Power supply arrangement for individual processor should be such that, in case of fault in power supply of one processor, all processors should not cease to function simultaneously. It should be possible to switch off and take out faulty processor for repairing/replacement without affecting working of the balance system.

10. INFORMATION TO BE FURNISHED BY THE MANUFACTURER / SUPPLIER:

The manufacturer shall supply the following information.

- a) Design approach for the system.
- b) Functions achieved in hardware & software.
- c) Mode of interaction between hardware & software.
- d) Salient feature through which fail safety has been achieved e.g. use of a watchdog timer, automatic shut down etc.
- e) Proof of safety in the form of process adopted for safety analysis and result thereof.
- f) Full documentation of Software Engineering followed during development.
- g) Full documentation of verification and validation procedure, Quality Assurance Program along with report and certificate from in-house Quality Assurance (QA) Group or an Independent Safety Auditor (ISA).
- h) If the Railways consider software validation necessary, the manufacturer/supplier will supply all the documents etc. to the Validator nominated by the Railways.
- i) Complete application software with facility for EPROM programming for entering yard data.
- j) In case of Cross-Acceptance, the firm should submit the performance feedback as given below :
 - Name of System/Equipment :
 - Make :
 - Model/Version No. :
 - User Railway & Section :
 - Maximum Sectional Speed :
 - Average number of Trains per day :
 - Application of System/Equipment :
 - Problems faced and solutions evolved :
 - Failure data may be submitted as per format given below :-

Location	No. of System/ Eqpt.	Date of commis- sioning	Total hours in use	No. of safe side failures	No. of unsafe failures	MTBF	MTBWSF	MTTR
Total								

Proven ness criteria of Equipment Usage of same Type/Make & Model/Version shall be as under: -

S.No.	Category of Equipment/System	Minimum no. of Equipment	Equipment Hours in use
1.	Solid State Interlocking	25	2,16,000

- (i) At least 20% of the equipment/system, with a minimum of 10, should be in continuous operation for a minimum period of 720 days.

- (ii) If the offered equipment has undergone minor hardware/software up-gradation to improve functionality/safety of the equipment in recent past, then the equipment utilisation of the earlier version (prior to minor modifications) can be considered for the proveness. However, in such cases, a minimum of 10 (Ten) equipments should be in continuous operation for a minimum period of 180 days.

10.1 The manufacturer shall supply the following documentation/ manuals:

- i) Installation & Maintenance Manual with pre-commissioning check list.
- ii) Diagnostic aids including troubleshooting charts: A trouble-shooting chart shall also be provided to indicate the step-by-step actions to be taken in case of failure of the equipment. It shall be possible to rectify the fault by replacement of defective PCB card by the maintainer at site.
- iii) Details of Hardware e.g. schematic diagrams of the system circuits/components, details for each type of assembled PCB.
- iv) Details of software algorithm flow chart along with test/validation procedure used and the results thereof.
- v) Version No. of Signalling equipment shall be as per RDSO/SPN/ 144. In case of Cross-acceptance, Version No. as per manufacturer's practice may be accepted.
- vi) Software checksum of EPROM(s) shall be provided as per RDSO/SPN/ 144.

10.2 The manufacturer shall provide the following certifications from approved validation agency:

- i) Correctness and safety of the software.
- ii) Reliability and fail-safety of the interlocking system.
- iii) Details of modifications carried out in the system and its subsequent validation.
- iv) Expected MTBF.
- v) Expected MTBWSF.
- vi) Expected MTTR.

11. TESTS AND REQUIREMENTS:

11.1 Conditions of Tests

Unless otherwise specified all tests shall be carried out at ambient atmospheric conditions.

11.2 For inspection of material, relevant clauses of IRS: S 23 and RDSO/SPN/144 shall apply.

11.2.1 TEST EQUIPMENT:

The firm should have all essential Testing Equipments as per latest STR.

11.3 TYPE TESTS:

11.3.1 Standard RDSO layout shall be used for conducting type tests.

The following tests shall constitute type tests:

- a) Visual inspection as per Clause 12.1
- b) Insulation Resistance tests as per Clause 12.2
- c) Card-level functional tests on all the cards and fail-safety tests on one card of each type.
- d) System level functional and fail-safety tests.
- e) Computerised testing for minimum two hundred thousand permutations and combinations as per Clause 12.3.
- f) Environmental/ climatic tests as per Clause No. 9.0 of RDSO/SPN/144, Revision 1 (Indoor Equipment).
- g) System Diagnostics test as per Clause 12.4.
- h) System Software tests as per Clause 12.5.

11.3.2 Any other tests shall be carried out as considered necessary by RDSO.

11.3.3 Only one EI shall be tested for this purpose. The equipment shall successfully pass all the type tests for proving conformity with this specification. If the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment/card(s) of the same type and subject it to all tests or to the test(s) in which failure occurred. No failure shall be permitted in the repeat test(s).

11.4 ACCEPTANCE TEST:

11.4.1 The following shall comprise acceptance tests:

- a) Visual inspection (Clause 12.1)
- b) Insulation Resistance tests (Clause 12.2)
- c) Card level functional test on all the cards.
- d) System level functional tests.
- e) System Diagnostics test (Clause 12.4)
- f) Verification of application software vis-a-vis selection table (This shall be done by user Railway).

11.4.2 Any other tests shall be carried out as considered necessary by the purchaser.

11.5 ROUTINE TEST:

11.5.1 The following shall comprise the routine tests and shall be conducted by manufacturer on every EI and the test results will be submitted to the inspection authority before inspection. The application software in proper format shall also be submitted to the inspection authority in advance.

- a) Visual inspection (Clause 12.1)
- b) Insulation Resistance tests (Clause 12.2)
- c) Card level functional test on all the cards.
- d) System level functional test.
- e) Computerised testing for 1,00,000 permutations and combinations (Clause 12.3)
- f) System diagnostics test as per Cl. 12.4.

11.5.2 Any other tests shall be carried out as considered necessary by the purchaser.

12 TEST PROCEDURE:

The test procedure shall be based on the system design. The methodologies to be adopted for various tests shall be decided taking into account the system design/ configuration and shall be approved by the purchaser.

12.1 VISUAL INSPECTION:

The equipment shall be visually inspected to ensure compliance with the requirement of Clauses 3 to 7 of this specification. The visual inspection will broadly include –

i) System level checking:

- Constructional details
- Dimensional check
- General workmanship
- Configuration

ii) Card level checking

- PCB laminate thickness
- General track layout
- Quality of soldering and component mounting
- Conformal coating
- Legend printing
- Green masking

iii) Module level checking

- Mechanical polarisation
- General shielding arrangement of individual cards
- Indications and displays
- Mounting and clamping of connectors.
- Proper housing of cards

12.2 INSULATION RESISTANCE TEST:

This test shall be conducted between the equipment power supply line terminals and the earth. If there is a possibility of the meggering voltage reaching the cards, these will be taken out before starting the IR test.

This test shall also be carried out after the climatic tests. The measurement shall be made at a potential of not less than 500 V DC.

The IR value shall not be less than 10 Mega ohms. After the climatic tests, this value shall not be less than 10 mega ohms.

12.3 COMPUTERIZED TESTING:

The manufacturer shall provide a computer-based test set up with the required software for automatic testing.

The following tests shall be conducted with the help of this set up.

12.3.1 FUNCTIONAL TESTING:

The system shall be tested functionally for all the signals with all routes, point operation, emergency point operation, route cancellation, emergency route cancellation, operation of G/F control points, level crossings and crank handle as per the selection table of the yard provided by the purchaser.

12.3.2 OPERATIONAL FAIL SAFETY TEST:

These tests are conducted as per procedure given below:

- i) After setting of points in main route & desired overlap, signal is cleared. Back locking of the route and overlap should be verified. It should also be checked that other yard functions are free.

The track circuit of the route should be dropped one by one and it should be verified that it is not possible to clear the signal. All the routes are checked one by one.

- ii) Conditions required for route setting should be disturbed in various permutations and combinations and it should be verified that it is not possible to set the route with the disturbed conditions. Similarly, conditions required only for signal clearance (such as track circuits) should also be disturbed and it should be verified that the route is set but the signal is not cleared.

12.4 SYSTEM DIAGNOSTICS TEST:

These tests shall be conducted by automatic test procedure through a PC. The diagnostic tests on the system shall be performed to test the integrity of the system software by verifying the checksum. It shall be possible to verify the application program vis-a-vis the selection table by the user, preferably through regeneration of the locking table from yard data.

The PC at the end of the test shall print out summary of the tests conducted.

12.5 SYSTEM SOFTWARE TEST:

Checksum of system software and format of the application software shall be verified. In case of any change in the system software/ format of application software, the same shall be validated.

- 12.6 Type test, Acceptance test and Routine test as given in para 11.3, 11.4 and 11.5 shall not be required in case of Cross- acceptance, The firm has to submit following documents to ensure that the system meets all requirements as mentioned in para 11:

- i) Certificates of Type tests done as required by RDSO specifications.
- ii) List of Routine tests done and sample copy of results to be submitted.
- iii) Acceptance tests to be done at the time of inspection of equipment to be supplied.
- iv) Performance feed back reports from user Railways.

For the verification of same, a team of RDSO officials may visit the manufacturing facility of manufacturer in its respective Country(s). Sample tests shall be carried out, if found necessary. However, at least one set of equipment shall have to be installed in Indian

Railways, to prove its performance in Indian conditions. Details of cross acceptance procedure may be referred to in concerned document of RDSO.

13. **QUALITY ASSURANCE:**

- 13.1 All materials & workmanship shall be of good quality.
- 13.2 Since the quality of the equipment bears a direct relationship to the manufacturing process and the environment under which it is manufactured, the manufacturer shall ensure QAP of adequate standard.
- 13.3 Validation and system of monitoring of QA procedure shall form a part of type approval. The necessary Plant, Machinery and Test instruments as given below shall be available with the manufacturer.

13.3.1 **PLANT AND MACHINERY:**

The firm should have all essential Plant & Machinery as per latest STR.

In case of CA, the above Plant and Machinery shall not be necessary to be available with Indian Partner if no TOT is taking place. In case of TOT, The same shall be required with Indian Partner of foreign firm.

In case of CA, when TOT is not taking place, the Plant & Machinery may be verified by the team of RDSO officials visiting the Firm premises.

- 13.3.2 All test instruments as given in Cl. 11.2.1 shall be available with the manufacturer.
- 13.4 Along with the prototype sample for type test, the manufacturer shall submit the Quality Assurance Manual.

14. **PACKING:**

As per relevant clause of latest version of RDSO/SPN/144.

15. **INFORMATION TO BE FURNISHED BY THE PURCHASER:**

- a) Approved interlocking plan, selection table and panel diagram of the station (Cl. 3.1).
- b) Whether CCIP (domino type) or VDU control terminal or both required (Cl. 5.1.4).
- c) System output required to drive field gears – relay interface or object controllers.
- d) 110V AC or DC usage for signal lamp lighting.
- e) Size of VDU monitor screen, if ordered.
