

DOMINO TYPE CONTROL PANEL FOR RAILWAY SIGNALLING



**TECHNICAL SPECIFICATION
FOR
DOMINO TYPE CONTROL PANEL
FOR
RAILWAY SIGNALLING**

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DOMINO TYPE CONTROL PANEL FOR RAILWAY SIGNALLING

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Abstract This document specifies technical specification and acceptance criteria for Domino type Control panel for Railway Signalling.			

DOMINO TYPE CONTROL PANEL FOR RAILWAY SIGNALLING

DOCUMENT CONTROL SHEET

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Technical Specification For Domino Type Control Panel For Railway Signalling

0 FORWARD

- 0.1 This specification is issued under the fixed serial number RDSO/SPN/186/2004.
- 0.2 This specification may require reference to the following Indian Railway Standard / Indian Standard / International Standard specifications etc.:
- | | |
|-------------------|--|
| IRS: S36 | Indian Railway Standard specification for Relay Interlocking Systems |
| IRS: S23 | Indian Railway Standard specification for electrical and electronic based signalling and interlocking equipment |
| RDSO/SPN/144/2006 | Safety and reliability requirement of electronic signalling equipment |
| IS: 7088 | Recommended practice for anodizing aluminum and its alloys. |
| IS: 513 | Cold rolled low carbon steel sheets and strips - Specification |
| IS: 1606-1979 | Specification for Automobile Lamps |
| IS: 1771 | Specification for Electroplated Coatings of Silver and Silver Alloys For General Engineering Purposes |
| IS:7569 | Specification for cast acrylic sheets for use in luminaires |
| IS: 4454(Part IV) | Specification for Steel Wires For Cold Formed Springs - Stainless spring wire for normal corrosion resistance |
| IS: 319 | Specification For Free Cutting Brass Bars, Rods and Sections |
| IS: 2629 | Recommended practice for hot-dip galvanizing of iron and steel |
| IRS S76-89 | Specification for PVC insulated cable & Wires |
| IS: 1573-1986 | Specification for electroplated coatings of zinc on iron and steel |
| IS: 7814 | Specification for phosphorous bronze sheet & strip |
| IS: 13947 | Degree of protection provided by enclosures for low-voltage switchgear and control gear |
| IS: 5-1994 | Colours for ready mixed paints and enamels |
| IS: 10117 | Code of practice for passivation of stainless steel articles |
| IS: 816 | Code of practice for use of metal arc welding for general construction in mild steel |
| IS: 13360 | Method of testing plastics |
| RDSO/SPN/189/2004 | Technical specification for terminal blocks, fuse terminal blocks and miniature fuse link of international standard for railway Signaling. |
- NOTE: In case of any contradiction in any clause of this specification with any of the referred specification, provisions given in this specification shall prevail.

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- 0.3 Wherever in this specification any of the above mentioned specification is referred to by number only without mentioning the year of issue, the latest issue of the specification is implied, otherwise the particular issue referred to is meant.
- 0.4 This specification is intended to cover the technical provisions and does not include all the necessary provisions of a contract.
- 1.0 **SCOPE**
- 1.1 This specification covers the technical requirements of Domino type control panel.
- 1.2 The intent of this specification is to ensure production of a reliable control panel which meets the necessary design and quality requirements.
- 2.0 **TERMINOLOGY**
- 2.1 The terminology used in this specification is covered by the definitions given in IRS: S 23 and IRS: S 36.
- 3.0 **DESIGN CRITERIA**
- 3.1 **Domino Type Control Panel**
- 3.1.1 The Control panel shall comply with the requirements of IRS: S 36 and IRS S: 23 unless alternative provision is specified in this specification.
- 3.1.2 The yard layout should be reproduced on the top surface of the panel, referred to as "faceplate", in accordance to its geographical position. The detailed yard layout must show tracks, points, signals, level crossing gates, sand humps, platforms, stationmaster's cabin along with panel operator's position etc. The face plate of the panel shall be of domino modules as detailed later in this specification.
- 3.1.3 Reproduction of the yard layout on the faceplate of the panel, referred to as the "illuminated diagram", shall be well proportioned.
- 3.1.4 The areas covered by every track circuit shall be clearly distinguished by separate colours except red colour. Width of track layout shall be 7mm (\pm 1mm). Minimum length of any berthing track shall not be less than ~~is~~ 4 domino modules.
- 3.1.5 The illuminated diagram shall be at such level that it is conveniently visible to the operator. Angle of face orientation should normally be at an angle of 30 °- 60° (depending on width of the control cum indication panel) from horizontal plane for proper visibility and convenient operation. Height of control panel at near end shall be 0.75 m (\pm 1 cm) or as specified by Railway. In case of separate indication and control panels generally used for large yards, the indication panel shall be vertical while the control panel shall have a face plate of 30°-60° from horizontal. All group buttons which are to be operated in conjunction with certain signal & point buttons are to be repeated every 1-1.5 metres so that the operator can easily reach it during regular use. If the panel face plate is not indicating such additional group buttons, a confirmation from the indenter regarding the requirement of additional group buttons shall be taken.
- 3.1.6 The faceplate shall be easily accessible for operation.

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- 3.1.7 The control panel shall be of push button type and any operation should be possible by pressing minimum two buttons. No relay should pick up by pressing only one button, except button relays.
- 3.1.8 Push Buttons for operation of points, signals and controls etc. Shall normally be provided on the illuminated diagram itself in Geographical order as per the yard layout. In case of a specific request by Railway for a major yard, all push buttons for operation of points, signals and controls etc. may be provided on a panel in Geographical order on a non-illuminated diagram along with counters and SM's key etc. to facilitate easy operation of push buttons and illuminated diagram may be provided separately as per requirement of the purchaser.
- 3.1.9 Group buttons, emergency buttons, counters, SM's key should be provided as per the approved faceplate.
- 3.1.10 Indications on the panel shall be provided through clear white/ red/ yellow/green light emitting diodes (LEDs) as per requirement of the layout.
- 3.1.11 Faceplate shall be covered by UV stabilized (on one side) polycarbonate sheet of 4-2.54 mm thickness ± 0.5 mm with following properties.

Density	1200 ($\pm 5\%$) kg/m ³
Light transmission	> 85% (as per ASTM D1003 standard)
Izod Strength	>600 J/m (as per ASTM D256 standard)

Polycarbonate sheet should not have scratch, air bubbles, foreign material or any other marks. Datasheets and invoices of the sheet shall be submitted before type tests.

- 3.1.12 Transparent polycarbonate sheet shall be fixed on the top of the faceplate by a removable aluminum frame of minimum 2mm thickness.
- 3.1.13 Panel shall be provided with detachable back covers. Back covers shall be easily removable to facilitate access to the internal wiring, termination etc. And shall be provided with double lock and sealing facility.
- 3.1.14 The body of panel should be fabricated from at least 1.60 mm thick Drawing (D) grade cold rolled low carbon steel sheets with best surface as per IS: 513.
- 3.1.15 Body of panel should be powder coated using thermosetting type of powder so that it does not re-melt when heated. Colour of the body shall be Siemens Grey in texture. Powder coating should last for at least 15 years during the life of the panel and should have very good adhesiveness with the surface. Pre- treatment of the surface shall be done and the body shall be thoroughly cleaned, degreased, de-rusted and phosphatized before doing powder coating. The coating thickness may be in the range of 50-80 microns.
- 3.1.16 Panel shall be supported on an independent metallic frame fabricated from 40mm X 40mm X 6mm mild steel (MS) angle. Frame shall have holes in the base suitable to fix the panel on the floor securely by M12 foundation bolts. MS angle frame shall be hot dip galvanized as per IS: 2629. Weight of zinc coating in gm. per square meter should be adequate to ensure protection from corrosion for entire life of the panel and shall not be less than 1000 gm. per square meter. Test report from NABL accredited laboratory for galvanization to be submitted at the time of submission of sample for type test. Steel used in the frame shall be such that it withstands normal hot dip zinc galvanization operation without embrittlement.

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- 3.1.17 All metallic nut, bolt and washers used in fabrication of the panel shall be suitably zinc coated to ensure rust proof working for entire life of the panel. Zinc coating shall not be less than Service Grade no. 1 of IS: 1573-1986.
- 3.1.18 Metal arc welding for construction in mild steel shall be as per IS: 816. Test report for tensile strength and radiography test to be submitted at the time of submission of sample.
- 3.1.19 Panel shall conform to IP- 54 class of protection.
- 3.1.20 The panel shall comply with the provisions given in para 21.2 and 21.3 of Indian Railway Signal Engineering Manual, Part-II.

3.2 Domino module

3.2.1 Faceplate shall be made of a number of mini modules, called Domino modules. A Domino module is a mini- sized independent module provided with the panel elements like LEDs, push buttons, keys etc. and their connecting leads.

3.2.2 Following five configurations of domino modules shall be used as per design requirement-

- (i) Dummy domino module - Used to fill the vacant space of faceplate
- (ii) Indication domino module - Used to provide indication
- (iii) Push button domino module - Comprises of push button with or without indications
- (iv) Key domino module Houses key lock assembly
- (v) Counter domino module Houses counter

3.2.3 Following two types of Domino modules are covered in this specification. Suitable type of domino module shall be used in the control panel depending upon purchaser's requirements.

3.2.3.1 Type I Domino:

- (i) Domino module of this type shall consist of three parts - 1. Front cover, 2. Nylon Block and 3. PCB. These parts shall comply the design criteria as per table- I given below-

Sl. No.	Part	Design requirement
(i)	Front Cover	Size : 54 mm X34mm
(ii)		It should be fabricated using 3 metallic sheets. The top sheet shall be of CRCA steel and shall not be less than 0.5 mm thick and shall be powder coated so as not to get rusted in salty and humid atmosphere. Powder coating shall have high quality and no irregularities should be visible on it. It shall have good durability. Middle plate and bottom plate shall be of 1 mm thickness. Three plates shall have suitable slits for indications, buttons etc. and shall be jointed firmly. For indications, translucent lenses of nylon shall be sandwiched between plates.
(iii)		
(iv)		
		The markings on the face plate shall be neatly screen printed.

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		Each cover plate shall have the name or trademark of the manufacturer engraved/ embossed on bottom portion for easy identification.
(i) (ii) (iii) (iv) (v) (vi)	Nylon Block*	Material : Nylon 66 Colour : White Electrical Insulation: 100 M ohms. No. of quadrilateral chambers: 15 Rows of chambers : 3 Columns of chambers : 5 Dimensions: to match with front cover
(i) (ii) (iii) (iv)	PCB**	Material : Copper clad glass epoxy of Grade FR4 or equivalent Connector : 10 pins. / 8 pins as per design requirement Size : Matched to block.

Table-I

*For Key and Counter domino modules, 3 rows and 5 columns of quadrilateral Chambers will not apply

** For Dummy domino modules, PCB is not required

- (ii) Printed Circuit Board (PCB) shall comply clause 6 of RDSO/SPN/144/2006, as applicable.
- (iii) The printed circuit board for the module shall be fitted at the back plane of the nylon block. 8 or 10 pin male PCB connector, as applicable with silver plated pins shall be soldered at the backside of the PCB. Its female connector shall be soldered to the wires coming from terminals of the control panel provided at the bottom part of the panel to interface with relay room wiring. Provision of rigid coupling between male and female connectors shall be ensured. The PCB connectors shall have mechanical slot to ensure correct alignment during connection. The connectors shall be with the following specifications:

Pin configuration: 8 or 10 pin (silver plated)
 Contact resistance: 50-100 m ohm
 Insulation Resist: >100 M ohm
 Breakdown voltage: 1.5 KV (for 1 minute)
 Inflammability class: V0 as per UL-94
 Rated Current: Min.1.0 Amp continuous (Test to be done by passing rated current through each terminal in mated condition for 15 minutes. There shall be no damage to the connector).
- (iv) LED for indications shall be encapsulated using suitable PVC mold. Such molded LED should be so press-fitted in the domino module that no loose contact exists for electrical conductivity. Controlling resistance of LED shall be mounted on female connector of domino module with proper sleeves. Colour of PVC mold shall be same as that of light emitted by the encapsulated LED.
- (v) All contacts in the domino module with encapsulated LED indications and push buttons shall be made of phosphor bronze as per IS: 7814 with nickel plating. Test report from NABL accredited laboratory for material shall be submitted at the time of sample submission. Contact resistance shall not be more than 40 milli- ohm at 100 mA DC.
- (vi) The depth of the domino module shall not be more than 45 mm.

3.2.3.2 Type II Domino:

- (i) Domino module shall consist of 3 parts- 1. Front Cover, 2. Main body, 3- Spring Holder. The parts shall comply design criteria as given below:

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Sl. No.	Part	Design requirement
(i) (ii) (iii) (iv)	Front Cover	Size : 54 mm X34mm It should be fabricated using 3 metallic sheets. The top sheet shall be of CRCA steel and shall not be less than 0.5 mm thick and shall be powder coated so as not to get rusted in salty and humid atmosphere. Powder coating shall have high quality and no irregularities should be visible on it. It shall have good durability. Middle plate and bottom plate shall be of 1 mm thickness. Three plates shall have suitable slits for indications, buttons etc. and shall be jointed firmly. For indications, translucent lenses of nylon shall be sandwiched between plates. The markings on the face plate shall be neatly screen printed. Each cover plate shall have the name or trademark of the manufacturer engraved/ embossed on bottom portion for easy identification.
(i) (ii) (iii) (iv) (v) (vi) (vii)	Main Body*	Material: Molded from Fire Retardant Grade glass filled (30%) Polybutylene Terephthalate (PBT) Colour : Natural White Electrical Insulation: 100 M ohms. No. of quadrilateral chambers: 15 Rows of chambers : 3 Columns of chambers : 5 Dimensions: to match with front cover
(i) (ii) (iii) (iv)	Spring Holder	Material: Molded from Fire Retardant Grade glass filled (30%) Polybutylene Terephthalate (PBT). No. of chambers: 15 Each chamber shall have helical spring contact of tin plated Phosphor Bronze (36 SWG). The bottom connector of the helical spring shall be fixed to PBT holder with provision for wire soldering. The top of the spring contact shall have copper rivet to have firm contact with indications, buttons etc.

- (ii) LED for indications shall be encapsulated as barrel type with BA7S cap conforming to IS: 1606 -1979 so that these can be fitted in the holders made in the domino module just by rotating them half- round. Such molded LED should be press-fitted in the domino module. The insulating material between the cap and pin of the encapsulated LED shall be of the same color as that of the LED. Controlling resistance of LED shall be mounted within the cap.
- (iii) The connection to the encapsulated LED indication shall be through a riveted helical spring. The rivet shall be of nickel plated copper and the spring shall be made of phosphor bronze as per IS: 7814 with nickel plating. Test report from NABL accredited laboratory for material shall be submitted at the time of sample submission.
- (iv) The depth of the domino module shall not be more than 45 mm. There shall be suitable arrangement for proper lacing of wires.

3.2.4 Thickness of powder coating front cover should be adequate to protect it. Powder shall be sprayed using electrostatic spray gun. Following parameters shall be complied in powder coating.

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Coating thickness	50-80 micron.
Impact resistance	80 Kg.cm \pm 10%
Material	Epoxy resin with acrylic for better weatherability (Thermosetting type)
Colour	Siemens Grey, Semi glossy finish

There shall be no pin-holing, blistering etc. in the final finish. The surface shall be cleaned thoroughly before taking up coating job. The material shall be subjected to 8- stage pre-treatment process as below before powder coating:

Tank-1	DEGREASING using alkaline degreaser
Tank-2	WATER RINSE-I
Tank-3	DE-RUSTING using acidic solution.
Tank-4	WATER RINSE-II
Tank-5	PHOSPHATING for uniform & smooth coating of Zinc phosphate
Tank-6	WATER RINSE-III
Tank-7	PASSIVATION- for sealing pores of sheet metal surface for obtaining max. corrosion resistance over phosphate coating by DECYLITE solution.
Stage-8	Oven drying at 150 deg. C. for 10-20 minutes by hot dry air.

Powder coating shall be done within 24 hours after oven drying process. Test report from NABL accredited laboratory for coating shall be submitted at the time of submission of sample.

- 3.2.5 Front cover shall be clip fitted in the domino body. Clips of domino modules shall be made of not less than 20 SWG stainless steel wire (IS: 4454), treated for passivation as per IS: 10117 such that to ensure protection from corrosion for entire life of the control panel. The clips of the domino modules shall not have play with respect to the cover plate and shall not lose their holding after repeated use. Test report from NABL accredited laboratory for chemical composition of stainless steel used for clip shall be submitted at the time of submission of sample.
- 3.2.6 Domino module shall be molded with natural colour on automatic injection screw type molding machine. No reconstituted or recovered material should be used for its manufacture. Surfaces of molded block should be smooth, and free from molding defects such as bubbles, voids, cracks etc. All edges should be neatly finished. Test report from NABL accredited laboratory for material of the domino block for density and melting point shall be submitted at the time of submission of sample.
- 3.2.7 Domino module or its any part should not corrode, de shape or deform in worst climatic conditions. Domino modules shall withstand climatic and environmental requirements as per Sl. no. 1, 2, 3, 4, 5, 6, 7 & 12 of Cl. 9.3 of RDSO/SPN/144/2006 as applicable to indoor equipments. After climatic test, it should pass insulation resistance test as per Cl. 9.5 Of RDSO/SPN/144/2006.
- 3.2.8 Domino module or its any part should not get de-shaped or deformed if subjected to a load of minimum 25 kg on its front cover before and after climatic test as per Cl. 3.2.7.

3.2.9	Indication domino module shall be so designed to ensure proper working of LED indication in any of the 15 chambers by simply fitting the molded LED from front side after removing the front cover.
3.2.10	It should be possible to replace a domino module without disturbing neighboring domino modules.
3.2.11	There shall be provision in the domino modules so that light from one indication does not affect other quadrilateral.
3.2.12	Number and type of domino modules should be as per approved faceplate drawing supplied by the railway.

3.3.1	Push button switch is generally referred to as 'Push Button' in this specification.
3.3.2	Push button shall have provision of one NO or one NO /NC or 1 NO + 1 NC or 2 NO + 2 NC contacts as per design requirement.
3.3.3	Push button shall be free from corrosion for its entire life.
3.3.4	The cap of the push button shall be of ABS plastic.
3.3.5	Push buttons used shall be of reputed make having following broad specification:

Push Button rod used and the bush for the rod shall be of stainless steel. The rod shall not be less than 2.5 mm in diameter. Other plastic material used in the button shall be of polycarbonate or Nylon 66.
Make and specification of push button shall be submitted at the time of Type approval.

Sl. No.		Description of button		Colour
1	i	Signals	Main Stop Signal	Red
	ii		Distant Signal	No button
	iii		Route Indicator	No button
	iv		Shunt	Yellow
	v		Calling On	Red with white dot
2		Point		Black
3		Exit/Route		White
4		Alternate route		Grey

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5		Alternate overlap		White with black dot
6		Control	For crank handle etc.	Blue
7	i	Group Buttons	Group Point Button	Black with red dot
	ii		Group Slot Button	Green
	iii		Group Slot return Button	Green with red dot
	iv		Group Button for calling ON	Red with white dot
8	i	Emergency buttons	For emergency operation of points in case of failure of controlling track circuit	Black with red dot
	ii		For sub route/overlap cancellation	White with red dot
	iii		For emergency route release	White with red dot
	iv		For emergency cancellation of signal	Red
9	i	Failure acknowledgement button	For signal	White
	ii		For point	White

Table – II

- 3.3.7 Push button knob shall be cylindrical in shape. Push buttons used shall be such that the finger/ thumb do not slip during operation. Colour of knob as per Cl. 3.3.6 shall conform to IS: 5 -1994 as given below-

Sl. No.	Colour	Indian Standard Colour (ISC) number	Name of colour shade
1	Red	537	Signal Red
2	Yellow	309	Canary Yellow
3	Green	218	Grass Green
4	Blue	166	French Blue
5	Grey	694	Dove Grey

Table – III

- 3.3.8 Push button shall be self-restoring type i. e. when pressure is removed after pressing a button it should restore to its normal position. A push button should be so designed that it does not get stuck up at any position during operation. Spring of the push button shall be made of stainless steel spring wire as per IS: 4454.
- 3.3.9 Nomenclature of button shall be inscribed neatly in black color near the respective button on the faceplate.
- 3.3.10 Black button with white dot is also used for emergency sub route release to which it pertains.
- 3.3.11 Every route button, except that for the advanced starter, is positioned appropriately

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between the two stop signals of a particular line on the illuminated diagram.

3.4 Indications

- 3.4.1 Indications on the panel shall be provided through clear white/ red/ yellow/ green light emitting diodes (LEDs). LED used shall be either from Avago, Nischia, Cree, Osram, Philips, and Everlight. Datasheet and part no. of the LED used shall be submitted at the time of the type tests. LEDs of one colour used in the panel shall be of one make.
- 3.4.2 Encapsulated LEDs shall be operated at 24 volts ($\pm 20\%$) DC. Forward current drawn by the LED at this voltage should normally be within 10 to 12 mA (approx.) and in no case this should be more than average drive current recommended by the LED manufacturer.
- 3.4.3 LEDs shall be of 5 mm diameter with viewing angle of not less than 15°. An illuminated LED at 24VDC voltage should be visible from minimum 3 meter in clear day light. Part no. and manufacturer's data sheet of LEDs used shall be submitted to RDSO. It shall also be supplied with the panel.
- 3.4.4 Though, it is only indicative, following shall be provided in general. However, actual provision shall be made as per faceplate layout including illuminated diagram, approved by the railway.

Sl. No.	Function	Type of indication	Illumination Criteria
1	Power supply	Round indication slits for mains, DG & RE supply	White light
2	Flasher supply	Round indication slit on top right hand corner of panel	Flashing white light
3	24 V DC Panel supply	Round Indication slit	White light
4	i	Distant/Main stop signal Slit in symbol of main signal at signal aspects	ON aspect-Yellow light for Distant signal/Red light for main stop signal
	ii		OFF aspects-Yellow, Double yellow or Green light(as per actual aspect at site)
5	i	Direction type route indicator	Normally no light
	ii		In case any route arm is lit, white Indication.
6	i	Calling ON Slit in symbol of calling ON signal below main signal	Normally no light
	ii		OFF aspect –White light
7	i	Shunt signal below main stop signal Only diagonal indication slit (at 45° from horizontal) in symbol of shunt signal below main signal.	ON aspect – No light
	ii		OFF aspect – White light in

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				slanting slit	
8	i	Independent shunt signal	One diagonal (at 45° from horizontal) slit over one horizontal slit in symbol of shunt signal.	ON aspect – White light in horizontal slit	
	ii			OFF aspect – White light in diagonal slit	
9		A/AG marker	Round indication slit in A/AG marker	White light in case of automatic working.	
10	i	Point	Rectangular slits with rounded ends in point zone	Normal setting	White light on straight route if point is free.
	ii				Red light on straight route if point is occupied.
	iii			Reverse setting	White light on diverging route if point is free
	iv				red light on diverging route if point is occupied
	v			Point fail or during operation	Indication changes from steady to flashing light
11		Point lock	Round Indication slit near junction of turnout and straight line.	White light	
12		Route lock	Round Indication slit near route button	White light	
13	i	Track circuit.	Rectangular slits with rounded ends in track circuited portion	Normally no light when route is not set	
	ii			White light when track circuit is free and route is set	
	iii			Red light (not less than 2) when track circuit is occupied	
14	i	Timer	Round indication slit	Normally no light	
	ii			Flashing white light during timer operation	
	iii			Steady white light after completion of timer operation	
15		Control	Round indication slit	White: for locked Red: for free	
16		Signal/ Route indication	lamp failure common	Steady red indication with audible warning	

Table – IV

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- 3.5 Individual electro-mechanical counters shall be provided with every emergency button in upper portion of the faceplate. Counters should be 6 digit non- resettable type electromagnetic impulse counters with transparent cover on front and following characteristics:

Working voltage	24 V DC -10% +20%
Colour of figures	White on black
Height of figures	1.7 x 4 mm \pm 10%
Counting mechanism shaft	Stainless Steel
Operating life	>50 million operations

Datasheet from counter manufacturer shall be submitted at the time of the type tests.

- 3.5.1 Individual counters and their emergency push buttons except emergency sub route cancellation button shall, preferably, be provided at top of the faceplate for following emergency operations-

- (i) Emergency route release
- (ii) Emergency overlap cancellation
- (iii) Emergency sub route cancellation
- (iv) Emergency operation of point when it's controlling track cct. has failed.
- (v) Calling-ON signal operation counter

- 3.5.2 A key lock in series with emergency sub route cancellation button shall be provided inside the panel.

- 3.5.3 Emergency push buttons for operation of point with its controlling track circuit failed and emergency sub route cancellation shall be provided with a removable button-cover with sealing arrangement. Removable button cover when provided on emergency button should envelope the button to prohibit its operation.

- 3.6 Separate buzzer, working at 24 volts (\pm 20%) DC for audio alarm should be provided for button left pressed cases. Provision to mute the audio alarm through pressing an acknowledgement push button shall be provided.

- 3.7 Stationmaster's (SM's) key lock shall be provided at top of faceplate. The key shall normally remain locked in reverse position.

- 3.8 Actual provision of buttons, indications, counters, etc. shall be made exactly as per faceplate layout including illuminated diagram, approved by the railway.

- 3.9 Wiring etc. inside the panel should be such that it is easily accessible for maintenance staff.

- 3.9.1 PVC insulated single strand copper wire having 0.6 mm diameter conforming to RDSO specification IRS S 76-89 shall be used for internal wiring of the panel. Different colours of wires shall be used for different indications reserving yellow for track indications, Red for signal indications, Blue for point indications and black for common (+ve or -ve).

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- 3.9.2 Every wire should be terminated properly. Termination of wires shall be done on screwless connectors mounted on DIN rails as per RDSO/SPN/189/2004. Individual termination shall be marked with a unique number for easy identification.
- 3.9.3 Wiring inside the panel shall be properly bunched, laced and supported.
- 3.9.4 Any break or short circuit in wires shall not cause a wrong indication or operation of counter or pick-up of a wrong relay.
- 3.9.5 Common wire of the Domino modules shall be in a ring loop having at least 3 main common terminals.
- 3.9.6 A laminated copy of wiring diagram and termination details shall be pasted inside back cover of the panel.
- 3.10 Control panel should pass insulation resistance test before and after applied high voltage test as per Cl. 9.5 & 9.6 of RDSO/SPN/144/2006.
- 3.11 All metallic parts / components used in domino module, push button, wiring etc. shall be nonferrous and suitably coated to protect from wear & tear and corrosion for entire life of the panel. Brass wherever used shall conform to IS: 319.
- 3.12 All electronic components including connectors shall comply with Cl. 5.1 of RDSO/SPN/144/2006, as applicable.
- 3.13 A reminder collar shall be a red colored PVC molded cover which envelops a push button and prohibits its operation.
- 3.13.1 Six number reminder collars shall normally be magnetically held on top left hand corner of the faceplate. Necessary provision for magnetic holding shall be provided on the face plate.
- 3.14 Domino module remover shall be made of Stainless Steel, treated for passivation as per IS: 10117 such that to ensure protection from corrosion for entire life of the control panel.
- 4.0 MARKING AND IDENTIFICATION**
- 4.1 Clauses 12.1, 12.2 & 12.3 of Specification RDSO / SPN /144 / 2006 shall be complied.
- 4.2 The words 'Indian Railway Property' shall be engraved /embossed/ provided on anodized aluminum nameplate on every Domino Panel in letters of not less than 20 mm size at a conspicuous place.
- 4.3 An anodized name plate shall be firmly attached to the control panel and shall show the following information:
- (a) Name of the station
 - (b) RDSO's specification number

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- (c) Name or trademark of the manufacturer
- (d) Serial number of the unit
- (e) Month and year of manufacture

5.0 INSPECTION AND TESTING

5.1 Type test:

For type test, one sample of a control panel with height of 0.5 meters and with face plate of size with 12x6 domino modules as per sample layout at Annex-I having button, Indicators, Counters, keys, signals etc. shall be submitted. The panel will have one door behind it. Besides the sample of the panel, 10 samples of indications of each type shall also be provided for tests. Following type test shall be conducted-

Tests on the complete panel:

5.1.1

- i) Visual inspection & dimensional check (clause 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.8, 3.1.10, 3.1.11, 3.1.12, 3.1.13, 3.1.14, 3.1.5, 3.1.6, 3.1.17, 3.2.11, 3.2.12, 3.3.9, 3.3.11, 3.9, 3.9.1, 3.9.2, 3.9.3, 3.9.5, 3.9.6, 3.13)
- ii) Insulation Resistance test (clause 3.10)
- iii) HV test (cl. 3.10)
- iv) Functional & Operational tests on panel (clause 3.1.6, 3.1.7, 3.2.9, 3.2.10, 3.6, 3.7)

5.1.2 Tests on Domino Module:

Following tests shall be done on 4 domino modules of different types having indications and buttons taken out of the panel provided for type tests:

- (i) Visual & Dimensions checks (clause 3.2.3.1 or 3.2.3.2 as applicable)
- (ii) Markings (clause 3.2.3.1 or 3.2.3.2 as applicable)
- (iii) Powder Coating thickness (clause 3.2.4)
- (iv) Clip of domino- size and for any looseness or play (clause 3.2.5)
- (v) Load test on Domino module (clause 3.2.8)
- (vi) Insulation resistance before and after climatic test (clause 3.2.7)
- (vii) Climatic tests (clause 3.2.7)
- (viii) Fitment of indications in the domino module
- (ix) Test on PCB connectors for Contact Resistance, Insulation Resistance, Breakdown resistance, Rated current etc. as per clause 3.2.3.1 (applicable for Type I domino only),

5.1.3 Tests on Push Buttons:

Following tests shall be done on 2 domino modules having push buttons taken out of the panel provided for type tests:

- (i) Visual Inspection
- (ii) Contact Resistance Test
- (iii) Insulation Resistance Test
- (iv) Current rating: by passing 5 Amp current at 12 VDC for 15 minutes. The variation in contact resistance after passing test current shall not be more than 10%.

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- (v) Push Button rod material and diameter
- (vi) Life test on button- to be done on automated test zig for 100000 operations at 100 mA DC current. The ON-OFF operations shall be done at a rate of approximately 1 operation per second. The switch shall function properly after the test without any mechanical defect or visible electrical deterioration. The zig shall be provided by the manufacturer.

5.1.4

Tests on Indications:

The test shall be done on 2 samples of each colour of indications provided separately for type tests. Following test shall be done:

- (i) Visual Checks (clause 3.4.1, 3.4.4).
- (ii) Colour of PVC mold/ insulating material between cap & pin of indications as applicable (clause 3.2.3).
- (iii) Forward current at 24 VDC (clause 3.4.2)
- (iv) Viewing angle (clause 3.4.3)
- (v) Visibility distance (clause 3.4.3)

5.1.5

Tests on Electromechanical Counters:

Test as per clause 3.5 shall be done on one counter taken out from the sample supplied of domino panel.

- (i) Colour & Size of housing & figures & no. of digits.
- (ii) Counting mechanism shaft material: Visual and magnetic test.
- (iii) Life test on counters- to be done on automated test zig for 1000000 operations. The operations shall be done at a rate of approximately 5 Hz by impulse of 24 VDC having ON time of approx.100 msec and OFF time of 100 msec. The counter shall function properly after the test without any mechanical defect or missing count. The test zig shall be provided by the manufacturer.

5.2 **Acceptance test:**

- 5.2.1 Following test shall be conducted on samples selected randomly in accordance with Clause 5.4.

- (i) Visual inspection & dimensional check (clause 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.8, 3.1.10, 3.1.11, 3.1.12, 3.1.13, 3.1.14, 3.1.5, 3.1.6, 3.1.17, 3.2.11, 3.2.12, 3.3.9, 3.3.11, 3.9, 3.9.1, 3.9.2, 3.9.3, 3.9.5, 3.9.6, 3.13)
- (ii) Insulation Resistance test (clause 3.10)
- (iii) HV test (cl. 3.10)
- (iv)-Functional & Operational tests on panel (clause 3.1.6, 3.1.7, 3.2.9, 3.2.10, 3.6, 3.7)

5.2.2 **Tests on Domino Module:**

Following tests shall be done on 2 domino modules of different types having indications and buttons selected from each sample at random.

- (i) Visual & Dimensions checks (clause 3.2.3.1 or 3.2.3.2 as applicable)
- (ii) Markings (clause 3.2.3.1 or 3.2.3.2 as applicable)
- (iii) Clip of domino- size and for any looseness or play (clause 3.2.5)
- (iv) Insulation resistance (clause 3.2.7)

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- (v) Fitment of indications in the domino module
- (vi) Test on PCB connectors for Contact Resistance, Insulation Resistance, Breakdown resistance, Rated current etc. as per clause 3.2.3.1 (applicable for Type I domino only),

5.2.3 Tests on Push Buttons:

Following tests shall be done on 2 domino modules having push buttons selected from each sample:

- (i) Visual Inspection
- (ii) Contact Resistance Test
- (iii) Insulation Resistance Test
- (iv) Current rating: by passing 5 Amp current at 12 VDC for 15 minutes. The variation in contact resistance after passing test current shall not be more than 10%.
- (v) Push Button rod diameter.

5.2.4 Tests on Indications:

Following tests shall be done on 1 indication of each colour from each sample.

- (i) Visual Checks (clause 3.4.1, 3.4.4).
- (ii) Colour of PVC mold/ insulating material between cap & pin of indications as applicable (clause 3.2.3).
- (iii) Viewing angle (clause 3.4.3)
- (iv) Visibility distance (clause 3.4.3)

5.3 Lot & Lot Size:

Lot is a collection of Domino type control panel manufactured at one time by same process under similar conditions of production and offered for inspection at a time and the number of such domino control panel will form lot size.

5.4 For acceptance test, sampling criteria shall be as under-

Lot size	Sample Size
1No.	1 No.
2-5No.	2 No.
6-15 No.	3 No.
More than 15 No.	4 No.

5.5 Routine test:

- (i) Visual inspection & dimensional check (clause 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.8, 3.1.10, 3.1.11, 3.1.12, 3.1.13, 3.1.14, 3.1.5, 3.1.6, 3.1.17, 3.2.11, 3.2.12, 3.3.9, 3.3.11, 3.9, 3.9.1, 3.9.2, 3.9.3, 3.9.5, 3.9.6, 3.13)
- (ii) Insulation Resistance test (clause 3.10)
- (iii) HV test (cl. 3.10)
- (iv) Functional & Operational tests on panel (clause 3.1.6, 3.1.7, 3.2.9, 3.2.10, 3.6, 3.7)
- (v) Powder Coating thickness test on cover plate
- (vi) Fitment of indications in domino.

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- (vii) Insulation test on push buttons
- (viii) Life test on buttons (on 5 samples, test to be done at least quarterly)
- (ix) Life test on counters (on 5 samples, test to be done at least quarterly)
- (x) Any other test, which the manufacturer considers important for quality product.

Test record with due traceability shall be maintained.

6.0 INFORMATION TO BE GIVEN BY PURCHASER

- (i) Station panel face plate diagram (clause 3.1.2)
- (ii) Any specific requirement for angle of faceplate with respect to horizontal plane (clause 3.1.5 or height of the panel)
- (iii) Type of Domino module required as per clause 3.2.3
- (iv) Details as per clause 3.1.9 (if applicable)
- (v) Requirement of spare domino modules etc.

7.0 SCOPE OF SUPPLY

Scope of supply shall include the following material-

- (i) Control panel complete with domino modules as per drawing of faceplate approved by the railway.
- (ii) Ten no. reminder collars
- (iii) 10% spare LED indications of each type.
- (iii) Two Domino module removers.

8.0 DOCUMENTATION

Two copies of the following documents shall be supplied –

- (i) Wiring diagram and termination details
- (ii) Approved faceplate layout including illuminated diagram
- (iii) Installation and maintenance manual. This should also include following information-
 - (a) Guaranteed performance data, technical and other particulars
 - (b) Schematic block diagram showing mounting arrangement of various modules/components
 - (c) Mechanical drawings of all type of modules, control panel alongwith specification of material used and part list
 - (d) Part no. and manufacturer's data sheet of LEDs used
 - (e) Trouble shooting procedure
 - (f) Dos & Don'ts
- (iv) Installation check list

9.0 PACKING

Manufacturer/Railway contractor shall be responsible for safe transportation of control panel and its all modules. Control panel should be delivered in good condition to consignee at his depot or station to which it pertains, if so advised by the consignee. If there is any damage, manufacturer shall replace the damaged parts free of cost.

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ANNEXURE-I

