



BR 1651

MARCH 1991

PART ONE

SPECIFICATION FOR FIBRE OPTIC THEATRE-TYPE ROUTE INDICATORS

British Railways Board

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Specification for Fibre Optic Theatre-Type Route Indicators

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AMENDMENTS

Amd. No.	Date	Text Affected
1	AUG 1989	3.10.5 NEW TEXT 3.12.1 TYPE A2 AMENDED TO TYPE A1 APPENDIX 1 360 MAX AMENDED TO 385 MAX
2	MARCH 91	FOREWORD, REFERENCES, SECTION 1 & 3 SECTION 11 ADDED APPENDICES 1,2,3 & 4 REPLACED

British Railways Board

BRITISH RAILWAYS BOARD

SPECIFICATION NO. 1651 - PART 1

FIBRE OPTIC THEATRE-TYPE ROUTE INDICATORS

FOREWORD

This specification is issued by the Director of S & T Engineering, British Rail, Materials Management Group, Room 1103, Rail House, Gresty Road, Crewe, CW2 6EA: from whom further copies may be obtained.

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Technical queries shall be referred to:-

British Railways Board
Director of S & T Engineering Department
Mechanical Equipment Group
Macmillan House
Paddington Station
LONDON W2 1FT

Telephone:- BT (STD) 071-922-6597
BR (ETD) 00-26597

REFERENCES

Reference is made in this specification to :-

British Railways Specification	10	-	Painting schedule, Signal Boxes and Signal Dept. equipment.
	820	-	Colours of light signals, Colour Filters and Lenses.
	872	-	Flame retardent, compound insulated cables for railway signalling.
	903	-	Electrical requirements for standard colour light signals.
	924	-	Air cooled power transformers for railway signalling.
	967	-	Railway signalling apparatus: Environmental conditions.
Leaflet -			BRB Supplier Quality Assurance Requirements.

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British Standards

- 57 - B.A. Screws, Nuts, Bolts.
- 505 - Road Traffic Signals.
- 1706 - Electroplated coatings of Cadmium and Zinc.
- 3410 - Metal washers for General Engineering purposes.
- 4579 - Part 1 Compression joints in copper conductors.
- 5750 - Quality Systems

Where this specification requires reference to BR Specification, or British Standards, the latest issue shall apply unless specially stated.

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1. SCOPE

- 1.1 This specification covers the requirements of Alpha Numeric Route Indicators (Theatre) using Fibre Optic light guides.
- 1.2 Each alpha numeric indication to be illuminated only from its own designated lamp unit and individual transformer.

2. DEFINITIONS

- 2.1 Optical Fibre - An optically transparent fibre consisting of a central core surrounded by a cladding of lower refractive index and used to transmit light by means of multiple internal reflections.
- 2.2 Fibre Optic Arm - A collection of optical fibres fastened together to form a cable within a single sleeve. One end of each arm is terminated either as a plane polished surface or as a coned/lens system. The other end is connected to a collet which is shared with other fibre optic arms.
- 2.3 Fibre Optic Harness - A collection of fibre optic arms all terminating in a single collet.
- 2.4 Light Point - The optical output from the end of a single fibre optic arm.
- 2.5 Tungsten Halogen Lamp - A lamp in which the Tungsten filament is enclosed in a gas filled quartz bulb containing a quantity of a halogen.
- 2.6 Dichroic Reflector - A reflector capable of reflecting visible light and transmitting infra red radiation.
- 2.7 Signal White - The colour of the light emitted by the signal and defined as Signal White Class C in BR820, Appendix I.
- 2.8 Matrix - A screen or plate into which fibre optic arms are plugged to form an indication.
- 2.9 Engineer - The Director of Signal & Telecommunications Engineering.

3. GENERAL CONSTRUCTION

3.1 Case Units

- 3.1.1 The case units to be of rigid construction, weatherproof and corrosion resistant to last 25 years in a railway environment.
- 3.1.2 They shall be constructed from light alloy or other approved non-ferrous material with similar strength/weight/rigidity ratio.

- 3.1.3 The case shall be provided with top mounted lifting lugs or eyes.
- 3.1.4 The unit shall confirm to the dimensions shown in Appendix I.
- 3.2 Access
- 3.2.1 The case shall have a rear access door or lift off backplate as specified on the order.
- 3.2.2 The door or backplate shall be sealed with a closed cell expanded neoprene gasket and be capable of being padlocked with a 38mm BR standard padlock having a 6mm shackle and 20mm shackle clearance.
- 3.2.3 The doors should be capable of being hung from either side on the case on site but should normally be supplied hinged on the left hand side when viewed from the rear. A chain restraint at 100° should be provided.
- 3.2.4 Lift off backplates shall be positively located to ensure correct alignment and have suitable safety chains.
- 3.2.5 All internal parts shall be accessible and changeable from the rear.
- 3.3 Fixings
- 3.1.1 A flat base mounting with four fixing holes for M20 bolts at the centres shown in Appendix I shall be provided.
- 3.1.2 When mounted the indicator must be capable of radial adjustment from 0° to +6° and vertical adjustment from 0° to -6° of the line of sight.
- 3.4 Sighting Device
- 3.4.1 A simple external sighting device shall be provided.
- 3.5 Environmental Conditions
- 3.5.1 The Units shall be designed to operate satisfactorily under environmental conditions described in BR 967 Category E.
- 3.6 Ventilation
- 3.6.1 The internal temperature of the unit shall not rise under any normal operating conditions such that the plastics begin to flow.
- 3.6.2 Ventilators, if provided, shall be properly weatherproof and insect proof.

3.7 Cable Entry

- 3.7.1 A central cable entry approximately 50mm diameter must be provided as shown in Appendix I.
- 3.7.2 It shall be properly weatherproof and insect proof.
- 3.7.3 Provision shall be made to adequately support the entry cable independent of the terminal.

3.8 Hoods

- 3.8.1 Hoods shall be of non-ferrous material which does not interact with the case material and shall be of adequate strength and rigidity.
- 3.8.2 The hoods shall be retractable or shall have pivoted access plates to facilitate cleaning the front screen.
- 3.8.3 Unless otherwise stated, hoods supplied with the indicator shall be 40mm long.
- 3.8.4 The Engineer may specify longer hoods for indicators positioned more than 1.5 metres above drivers eye level.

3.9 Finish

- 3.9.1 The exterior and interior surfaces of the case and hood shall be prepared and primed in accordance with BR Spec.10 and finished with one coat of micaceous iron ore black to BR Spec.70, Item 25 or 30.
- 3.9.2 Terminals and fixings, etc. to be corrosion resistant. Pre-treatment shall be electro zinc plate and passivate to BS 1706 Class B.
- 3.9.3 Lampholders; the various materials used in these components should be selected so that corrosion reactions due to the presence of dissimilar metals are reduced to a minimum.

3.10 Lamp Lighting Transformers

- 3.10.1 The Lamp lighting transformers for AC lit fibre optic theatre indicators are housed in the indicator case. Each transformer is required to supply a single tungsten halogen lamp with a normal rating of 12V 55W. The transformers shall generally comply with BR 924A except as specified below.

Toroidal transformers may be used but must be isolated from induced currents.

- 3.10.2 Each transformer will be supplied from the nominal 110V 50Hz signalling supply.

The input voltage has an overall variation of +10%, -20% on the nominal value and it can be expected to vary by $\pm 10\%$ of the value of each tapping within the overall range.

The frequency can be expected to vary by $\pm 4\%$.

- 3.10.3 Each transformer shall have a nominal rating of not less than 60VA and shall be rated for continuous operation supplying 130% nominal power at 110% of the nominal input voltage.
- 3.10.4 Each transformer shall have the following tapplings:-
- | | |
|--------------------|-----------------|
| Input (primary) | 0/6/86/98/110V |
| Output (secondary) | 0/0.5/10/11/12V |
- 3.10.5 The voltage regulation no load to full load at unity power factor shall not exceed 10%.
The variation in voltage ratio from input to output, for all combinations of inputs and outputs, shall not exceed $\pm 2\%$ or ± 0.1 volt, whichever is the greater, from the nominal voltage ratio at the nominal load of 55 watts.
- 3.10.6 The magnetising, primary no load, current shall not exceed 0.1A with 110V 50Hz connected between the 6V and 86V tapplings.
- 3.10.7 Construction details; the maximum overall size and the fixing dimensions and the location of the terminal block are given in Appendix IV. The terminal block shall be capable of accommodating conductors of between 0.5mm^2 and 2.5mm^2 cross section. The terminal block shall have corrosion resistant clamp type connectors and shall be designed so as to avoid nicking the conductors. Suitable terminals are the Klippon BK range. A divider, acceptable to the Engineer, shall be provided between the primary and secondary terminals.

The transformer shall have a nameplate attached in a conspicuous place and provide the following information:

Manufacturer's name and serial number
Rated VA
Frequency; number of phases
Rated primary voltage
Full load secondary voltage
The number of this specification, ie. BR Spec 1651 Class of insulation.

The terminals shall be labelled in accordance with BR 924A.

3.11 Lamps

- 3.11.1 Lamps shall have the following characteristics:-
- a) Nominal luminous flux at 12V - 900 lumens.
 - b) Nominal life at 11.5V - 1000 hours (Automotive use).
 - c) Nominal colour temperature of lamp at 12V - 2850°K .

The lamps to be of type H3/12V/55W fitted in an appropriate light box.

- 3.11.2 The system must be designed so that under all normal operating conditions the lamp voltage does not drop below 8.5V.
- 3.11.3 A notice warning operators not to touch the lamp envelope shall be displayed in a prominent position inside the case.

3.12 Internal Wiring

- 3.12.1 Internal wiring to BR Spec 872 type A1 or an equivalent flame retardent insulated cable minimum c.s.a. of copper 0.65mm².
- 3.12.2 Internal wiring to be terminated with 2BA ring tongue pre-insulated compression type terminals (PIDG AMP Ltd ref 151730). Joint to conform with BS 4579 Part 1.

3.13 Terminal Blocks

- 3.13.1 Terminal blocks, generally in accordance with Appendix II, shall be fitted with two full nuts to BS 57 and two plain washers to BS 3410 to each terminal.
- 3.13.2 Incoming cables shall terminate on the terminal blocks.
- 3.13.3 Terminal blocks shall be positioned so that cables may be run in a tidy manner.
- 3.13.4 Terminals are to be adequately identified and a weatherproof wiring diagram permanently fixed in a suitable position.

4 INDICATIONS

- 4.1 The unit shall be able to display up to 10 alpha numeric indications, the exact number and type being specified by the Engineer in each case.
- 4.2 The minimum height of characters shall be 400mm.
- 4.3 All character lines shall consist of single rows of light points.
- 4.4 The design of characters shall be as specified in Appendix III.
- 4.5 Any compromises in character shape which may in some circumstances be necessary (eg. to achieve a large number of character indications) must be referred to the Engineer for prior approval.

5. MATRIX

- 5.1 The letter formats indicated in Appendix III require the use of custom drilled Matrix plates.
- 5.2 The composition of each indication shall be clearly marked on the back of the matrix plate to facilitate assembly and maintenance.

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6. FRONT SCREEN

- 6.1 The front of the indicator shall be protected by a 5mm thick clear polycarbonate screen. the surface of the polycarbonate must be of an anti-glare/non reflective type, eg. Lexan S305 or similar.

7. OPTICS

7.1 Spacing between light points

- 7.1.1 The spacing between light points shall be 40mm.

7.2 Postion of light points

- 7.2.1 The position of light points shall be as specified in Appendix III.

7.3 Diameter of light points

- 7.3.1 The diameter of the active optical area shall be 4mm.

7.4 Intensity of light points

- 7.4.1 The average on axis intensity of the light points within a harness shall be between 5 and 8 candelas.

- 7.4.2 The variance of the on axis intensity of light points with a given harness should not exceed 20%.

7.5 Intensity within 10°

- 7.5.1 The luminous intensity of each light point must be maintained at above 50% of its on axis value at all points within 10° of the axis.

7.6 Off axis intensity peaks

- 7.6.1 The luminous intensity of each light point must not exceed 1.5 times its on axis value at any off axis angle.

7.7 Wide angle intensity

- 7.7.1 The average luminous intensity at high angles is defined as follows for light points within a harness.

Angle	Intensity (Candelas)	
	Minimum	Maximum
15	1.5	7.5
20	0.15	0.75
30	0.03	0.15
45	0.01	0.05

- 7.7.2 The variance of luminous intensity of light points within a harness shall not exceed 20% at any given angle.

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7.8 Colour

- 7.8.1 The colour of each light point is to be signal white.
To BR Spec 820.

7.9 Unused arms

- 7.9.1 All unused fibre arms are to be blanked off.

7.10 Temperature range

- 7.10.1 The operating temperature is -20° to 60°C in accordance with
BR Spec 967.

7.11 Cross Talk

- 7.11.1 When an optical system is being operated it must not produce a signal
of more than 1/1000 its normal value in adjacent systems which are
not operating.

8. RANGE

- 8.1 When all the optical requirements specified above are met it is expected that
the readability range (95% certainty) will be as follows for all the
characters specified in Appendix III.

350 metres for good daytime visibility

210 metres for good night time visibility

- 8.2 The signal shall give a clear indication when viewed at an angle of 45°
from a distance of 5 metres.

9. MAINTAINABILITY

- 9.1 The design construction and layout of the components shall have ease of
maintainance as the primary objective.
- 9.2 In use the indicator will normally be in an elevated position where freedom
of movement may be limited.
- 9.3 It shall be possible to change bulbs, measure voltages and clean optical
surfaces using one hand without the use of tools.

10. MANUFACTURING APPROVAL

- 10.1 The supplier shall submit full details of the offered design for the approval
of the Engineer before commencing production.
- 10.2 Any change in the approved design shall be authorised by the Engineer before
introduction.

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11. QUALITY ASSURANCE

- 11.1 The contractor shall comply in full with the requirements of this specification and, in addition, shall comply with BRB Supplier Quality Assurance Requirements which includes compliance with BS 5750.
- 11.2 Where a BR requirement exists for a certificate of conformity to be provided with the goods, a copy is to be forwarded to the BRB QA representative.
- 11.3 For the purposes of this specification, the BRB's responsible QA representative is:-
British Railways Board
Director of S & T Engineering
Quality Assurance Engineer
Macmillan House
Paddington Station
London W2 1FT
- 11.4 Material supplied against this specification is in classification QA2.

- APPENDIX 1 Revise outline dimensions to include ... "80 MAX FOR TILT AND SWIVEL BASE ARRANGEMENT" ... so replace existing sheet with new sheet dated FEB 1991.
- APPENDIX 2 Change material to ... "MELAMINE" ... so replace existing sheet with new sheet dated FEB 1991.
- APPENDIX 3 All new Matrix Format sheet for letter 'J' dated FEB 1991.

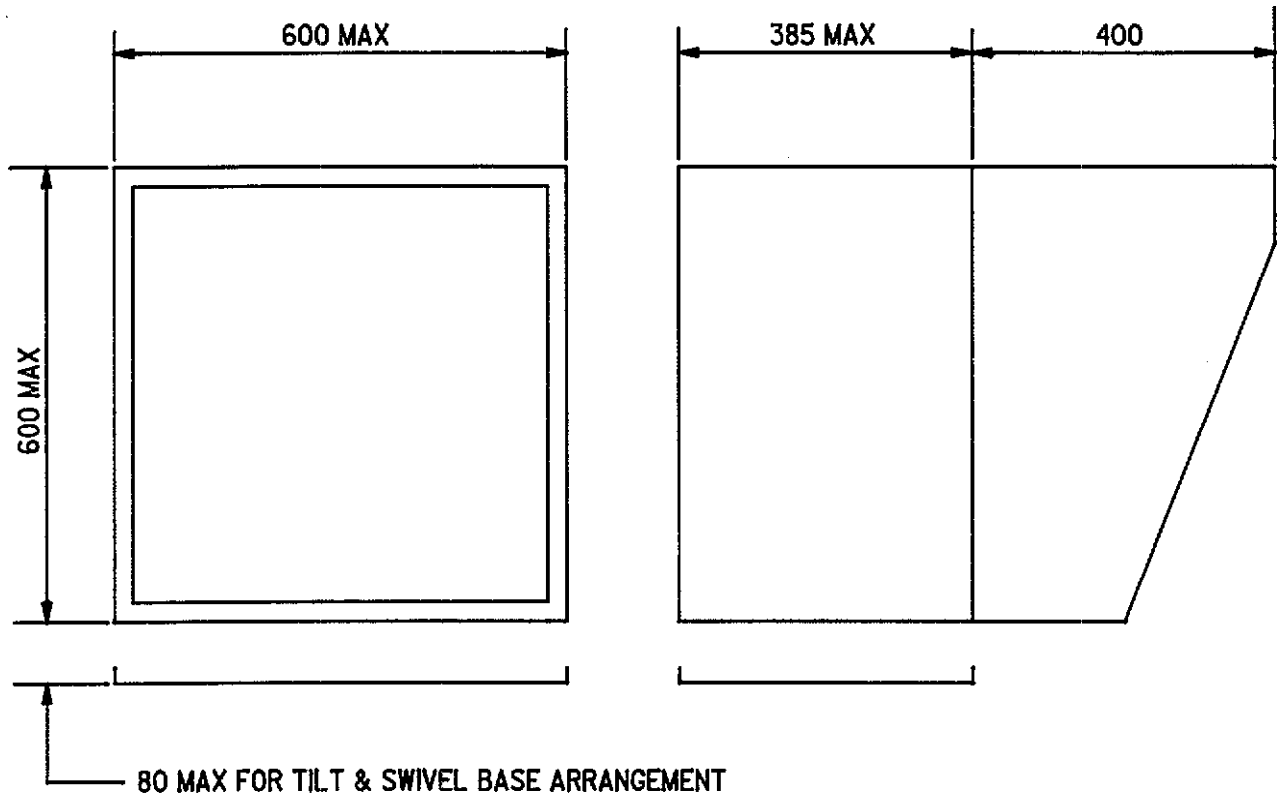
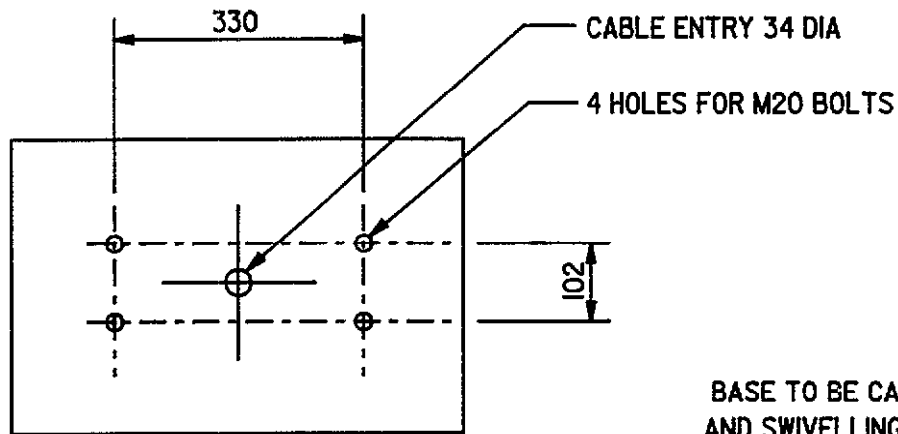
Replace each existing Matrix Format sheet with a revised sheet which additionally lists the light point coordinates and is dated FEB 1991.
- APPENDIX 4 Replace existing sheet with new sheet dated FEB 1991.

- END OF PART ONE -

R&D/CREW/ASTRAL (A.56)

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HT62



DIMENSIONS ARE IN MILLIMETRES

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FIBRE OPTIC THEATRE INDICATOR

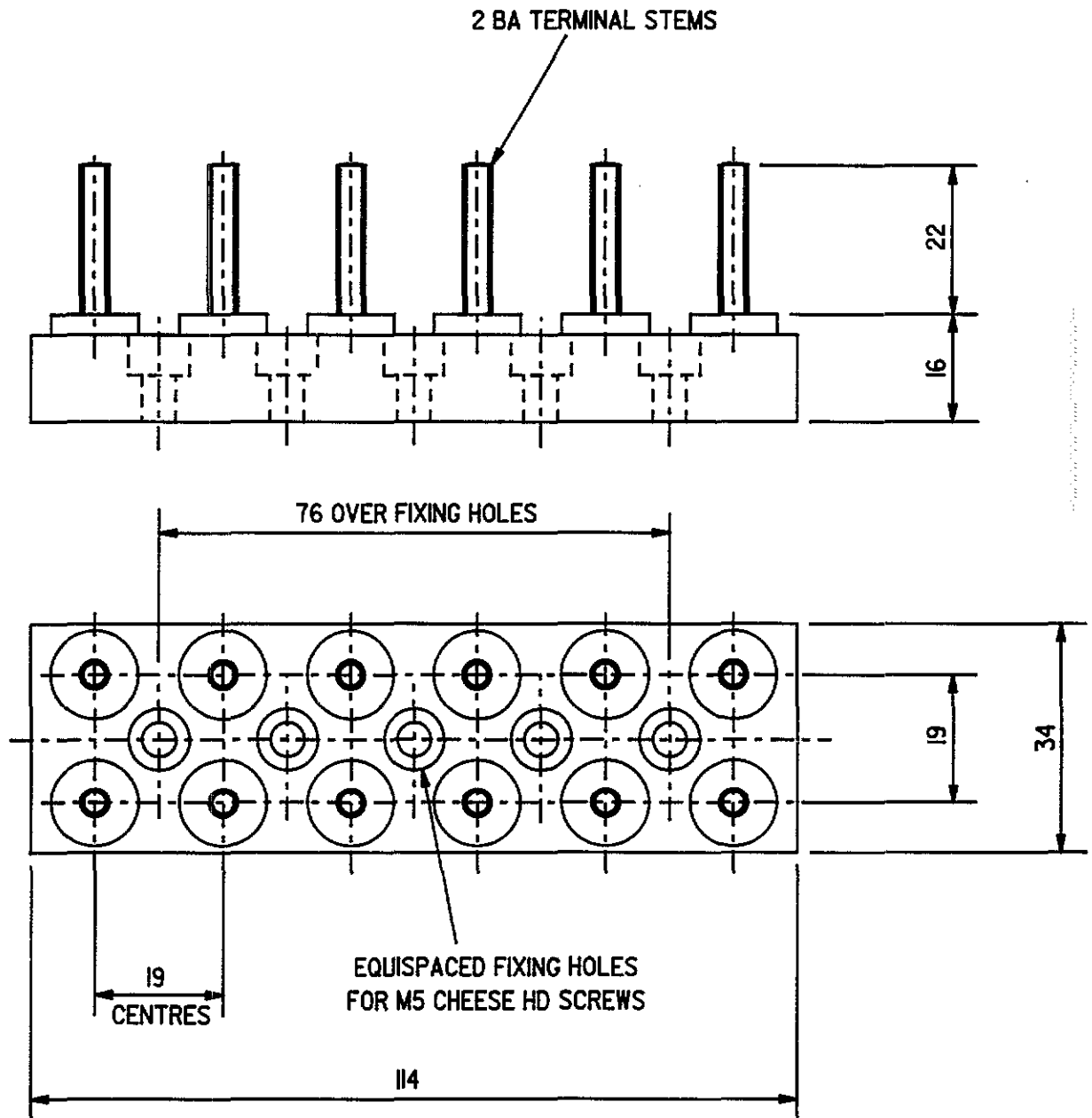
THEATRE INDICATOR



APPENDIX 1

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MELAMINE



FOR FURTHER DETAILS SEE DRG. No. BRS-SE 37

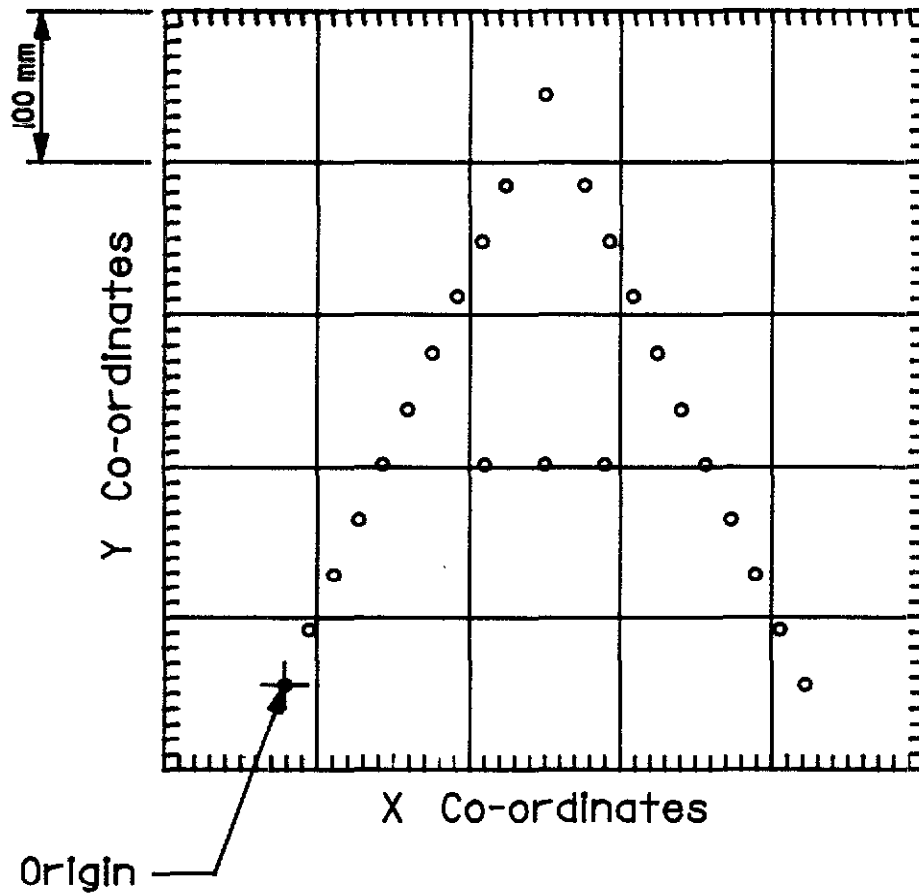
DIMENSIONS ARE IN MILLIMETRES

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BR SPECIFICATION I65I PART I
FIBRE OPTIC THEATRE INDICATOR

TERMINAL BLOCK



APPENDIX II
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Light No.	X Co-ord. mm	Y Co-ord. mm
1	171.5	388.9
2	197.7	329.4
3	145.3	329.4
4	213.9	292.8
5	129.1	292.8
6	230	256.2
7	113	256.2
8	246.2	219.6
9	96.8	219.6
10	262.3	183
11	80.7	183
12	278.4	146.4
13	64.6	146.4
14	294.6	109.8
15	48.4	109.8
16	310.7	73.2

Light No.	X Co-ord. mm	Y Co-ord. mm
17	32.3	73.2
18	326.9	36.6
19	16.1	36.6
20	343	0
21	0	0
22	131.5	146.4
23	171.5	146.4
24	211.5	146.4

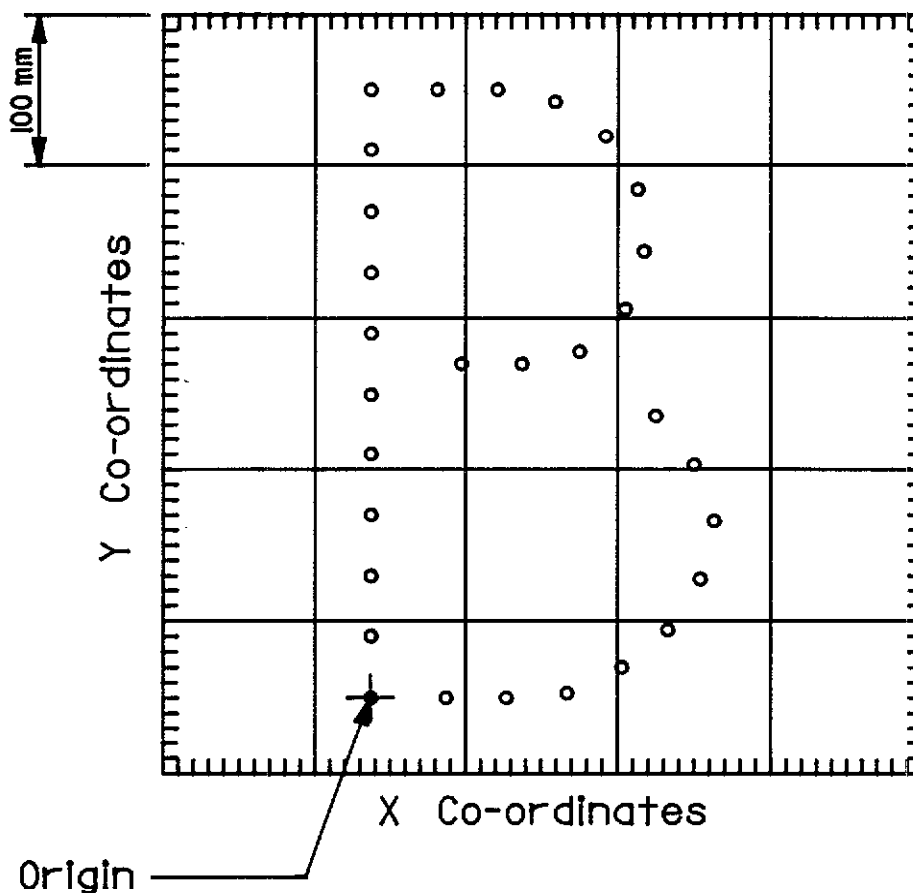
LETTERING STYLE TO BE GILL SANS LIGHT

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FIBRE OPTIC THEATRE INDICATOR

MATRIX LETTER FORMAT
"A"



APPENDIX III
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Light No.	X Co-ord. mm	Y Co-ord. mm
1	0	400
2	0	360
3	0	320
4	0	280
5	0	240
6	0	200
7	0	160
8	0	120
9	0	80
10	0	40
11	0	0
12	44	400
13	84	400
14	122	392
15	155	369
16	176	334

Light No.	X Co-ord. mm	Y Co-ord. mm
17	180	294
18	168	256
19	138	228
20	100	220
21	60	220
22	188	186
23	213	153
24	226	116
25	217	78
26	196	44
27	166	20
28	130	3
29	90	0
30	50	0

LETTERING STYLE TO BE GILL SANS LIGHT

BRITISH RAILWAYS BOARD
BR SPECIFICATION No 1651 PART 1
FIBRE OPTIC THEATRE INDICATOR

MATRIX LETTER FORMAT
"B"



APPENDIX III
Documents

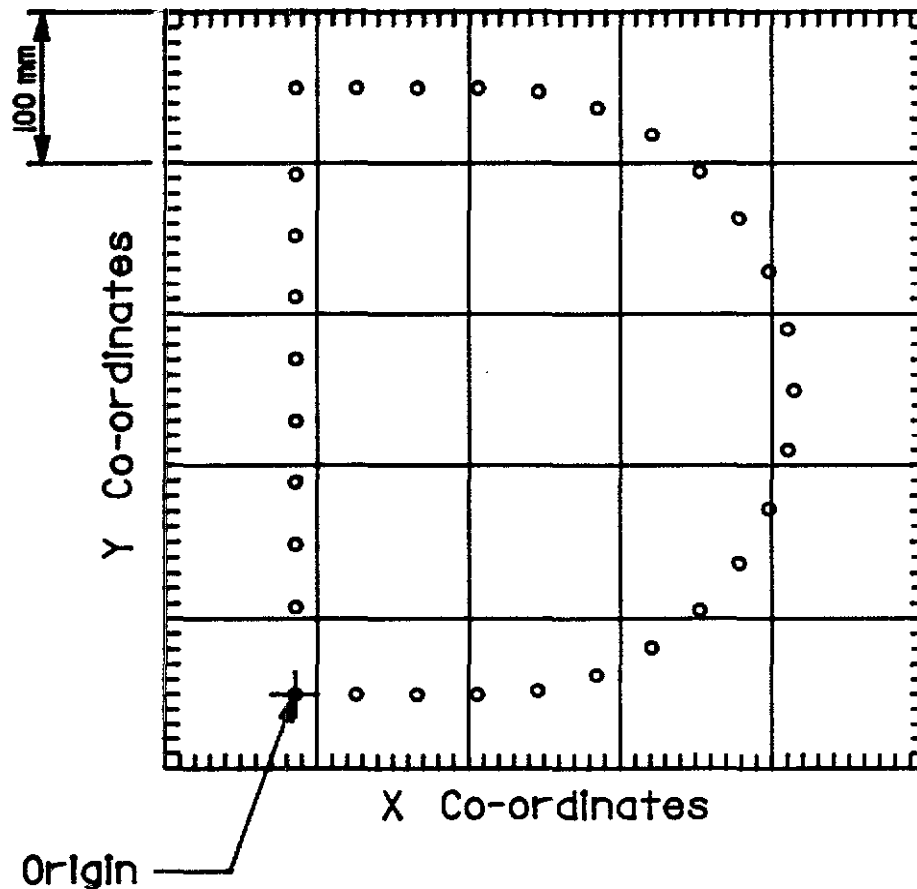
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FIBRE OPTIC THEATRE INDICATOR

MATRIX LETTER FORMAT

APPENDIX III



Light No.	X Co-ord. mm	Y Co-ord. mm
1	0	400
2	40	400
3	80	400
4	120	400
5	160	397.5
6	198.9	387.1
7	234.9	369.1
8	266.6	344.4
9	292.7	313.7
10	312.2	278.5
11	324.2	240
12	328.2	200
13	324.2	160
14	312.2	121.5
15	292.7	86.3
16	266.6	55.6

Light No.	X Co-ord. mm	Y Co-ord. mm
17	234.9	30.9
18	198.9	12.9
19	160	2.5
20	120	0
21	80	0
22	40	0
23	0	0
24	0	57.5
25	0	98.3
26	0	139
27	0	179.7
28	0	220.4
29	0	261.1
30	0	301.8
31	0	342.5

LETTERING STYLE TO BE GILL SANS LIGHT

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FIBRE OPTIC THEATRE INDICATOR

MATRIX LETTER FORMAT
"D"



APPENDIX III
Documents

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