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SPOORNET
A Division of Transnet Limited
INFRASTRUCTURE (Signals)

Standard Specification

Environmental specification for Spoornet railway signalling systems

This specification is complete only in certain aspects. Other aspects are in the cource of research. As and when parameters are established, they will be included in later issues of this specification. Meanwhile such missing parameters are annotated TBD (To Be Determined)

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Environmental specification for Spoornet railway signalling systems

1 SCOPE

This specification details the environmental limits against which signal equipment and systems must be tested to demonstrate compatibility with its intended environment. It presents environmental profiles which can be used as guidelines during the development of systems or equipment. Accelerated tests to determine reliability of equipment and systems are excluded from this document.

2 APPLICABLE DOCUMENTS

2.1 Integrated documents

The following documents form part of this specification to the extend specified herein.

2.1.1 MIL-STD-810E, Environmental test methods and engineering guidelines.
2.1.2 IEC 801, Electromagnetic compatibility for industrial-process measurement and control equipment.
2.1.3 IEC Standard - Publication 571, Rules for electronic equipment used on rail vehicles.
2.1.4 CSE 517/2 - Specification for the immunisation of colour-light signalling in AC electrified areas.

2.2 References

2.2.1 Specification CSE-518, Installation of AC/DC change-over systems, Installation series CE(S&T) 500, Chief Engineer, Infrastructure (Signals), Johannesburg.

3 EQUIPMENT CLASSIFICATION

This specification describes the environmental limits applicable to the signalling equipment in terms their expected life cycle. Therefore the environmental characteristics are divided into two sections. The first defines general requirements such as transportation of systems equipment and spare parts and are applicable to all equipment and systems. The second defines the requirements for the intended operational environment of signal systems and equipment.

The operational environment of systems are defined in terms of Grades of environment as indicated in Table 1.

Table 1.

Environmental grade	Environment	Equipment examples
Grade A	Control centre	Desks and diagrams
Grade B	Track side indoor	Interlocking and battery chargers
Grade C	Track side - cased	Track circuit units and equipment in apparatus cases
Grade D	Track side - outdoor	Signals and platform information displays
Grade E	Track mounted	Axle counter heads
Grade F	Rolling stock - driver cab	Token units
Grade G	Rolling stock - equipment compartment	Interference monitor unit.
Grade H	Rolling stock - external carriers	Transponders / readers
Grade I	Rolling stock - bogies	Taco generators

All signal systems and equipment shall be classified to operate in one or more of the grades of environment, and shall be tested for conformance to the requirements of that profile.

4 GENERAL REQUIREMENTS

The following requirements are applicable to all signal systems and equipment

4.1 Functional operation of the system or equipment

Depending on the test to be conducted, the successful operation of the equipment must be demonstrated either before, after or during the tests. In cases like this, the product specification of the equipment under test (EUT) must be used to determine exact methods of demonstrating successful functional operation.

4.2 Transportation requirements

The following paragraphs present environmental profiles against which all equipment and spare parts must be tested. It is based on typical environmental profiles which can be experienced during transportation thereof.

4.2.1 Equipment vibration

This test is used to simulate transportation by a common carrier to the site where the equipment is to be installed. During this test the system must be packed ready for transportation. The equipment operation must be demonstrated before commencing with the test as well as after the completion of the test.

The vibration profiles shown in Fig. 4.2.1.1 to Fig. 4.2.1.3 shall be used. The equipment shall be tested for 1 hour in each direction. The packed system shall be tested in accordance with Method 514.4, Section II, procedure I, category I of MIL-STD-810E.

4.2.2 Component vibration

The system shall be dismantled into subassemblies normally used by the maintenance staff to repair a faulty installed system. This could be in the form of P.C. boards, power supply units etc. After the vibration test, subassemblies must be tested for functionality against the product specification.

The tests shall be performed in accordance with Method 514.4, section II, procedure III of MIL-STD-810E. The standard package shall be used and tests shall be conducted without securing the test sample to the tray being used in the test. The test sample shall be vibrated with an orbital path of 2.54 cm at 5Hz. The test duration shall be 5 minutes, this representing a service road length of approximately 20 km.

4.2.3 Altitude

This test is performed in order to simulate transportation of the system by air freight. The system operation must be demonstrated after completion of the tests. The system shall be packed ready for transportation and be tested at an atmospheric pressure of 57kPa for a period of 1 hour. The tests shall be performed according to Method 500.3 section II, procedure I of MIL-STD-810E.

5 ENVIRONMENT CHARACTERISTICS.

5.1 High temperature.

The successful operation of the system must be proved continually during this test as described in section 4.1 - general requirements. The temperature test cycle for the applicable Grade of environment shown in Fig. 5.1, shall be used and repeated for at least 3 cycles.

The test shall be performed accordingly to method 501.3, section II, procedures II, of MIL-STD-810E.

5.2 Low Temperature

The successful operation of the system must be proved continually during this test as described in section 4.1 - general requirements. The temperature test cycle for the applicable Grade of environment shown in Fig. 5.2, shall be used and repeated for at least 3 cycles.

The test shall be performed according to method 502.3, section II, procedures II of MIL-STD-810E.

5.3 Humidity.

The humidity of the environment can vary extensively from location to location in South Africa and therefore it has been divided into three severity levels, ie.

H1	High humidity	For lines on the coast
H2	Medium humidity	For coastal regions
H3	Low humidity	Inland and dry areas

The successful operation of the system must be demonstrated continually during these tests as described in section 4.1 - general requirements. Fourteen cycles of that shown for the applicable Grade of environment shall be considered acceptable to demonstrate compliance.

The relative humidity test shall be performed according to Method 507.3 section II, procedure II - induced, of MIL-STD-810E.

5.3.1 High humidity

The humidity and temperature test cycles for the applicable Grade of environment are shown in Fig. 5.3.1. (TBD)

5.3.2 Medium humidity

The humidity and temperature test cycles for the applicable Grade of environment are shown in Fig. 5.3.2. (TBD)

5.3.3 High humidity

The humidity and temperature test cycles for the applicable Grade of environment are shown in Fig. 5.3.3. (TBD)

5.4 Vibration

The successful operation of the system must be proved continually during this test as described in section 4.1 - general requirements. The three dimensional vibration profiles for the applicable Grade of environment are shown in Fig. 4.1.1 to Fig 4.1.3. (TBD)

The test shall be performed in accordance with method 514.5, Section II, category 8, procedure I of MIL-STD-810E.

5.5 Shock

TBD

5.6 Altitude

The successful operation of the system must be demonstrated continuously during this test as described in section 4.1 - general requirements. The system shall be tested at an atmospheric pressure of TBD kPa for a period of 1 hour. These requirements are the same for all grades of environment. The tests shall be performed according to Method 500.3 section II, procedure II of MIL-STD-810E.

5.7 Corrosive environment.

All equipment intended for use in Grades C, D, E, H and I on coastal lines must be tested against the effect of salt spray for at least 48 hours with a 5% NaCl solution. The successful operation of the system must be demonstrated after the test as described in section 4.1 - general requirements. The equipment must also be inspected for visual damage that may have occurred.

The test shall be performed in accordance with method 509.3, section II, procedure I of MIL-STD-810E.

5.8 Radiated electromagnetic environment

The successful operation of the system must be proved continually during this test as described in section 4.1 - general requirements. These tests are performed to demonstrate compliance with the radiated electromagnetic environment that can be experienced by the system in railway applications.

The system shall not suffer any degradation in performance when illuminated with an electric field strength at a frequency of that given in Figure 5.8, for the selected Grade of environment. The results is also presented in Table 5.8 for convenience of testing.

The tests shall be performed in accordance with Part 3 of IEC standard, Publication 801, in a shielded enclosure or anechoic chamber.

5.9 Traction induced electromagnetic environment

These tests are performed in order to demonstrate that the system will be compatible with voltages induced on the signal lines of the system. These voltages are usually present due to induction from the traction system.

5.9.1 Induced voltages - D.C. traction area

Any signal lines that may make use of the signal cables running parallel with the electrified railway track must be tested against induced voltages from the traction system. The profiles are given in V/km and should therefore be adjusted according to the actual length of the signal lines. Since signal lines enter apparatus cases, relay rooms etc. the limits specified in this paragraph apply to environmental Grades B to E.

The frequency spectrum of the induced voltages a given in Figure 5.8.1 (TBD).

5.9.2 Induced voltages - A.C. traction area

All signal equipment intended for use on A.C. electrified lines shall conform to the requirements of specification CSE 517/2 - Specification for the immunisation of colour-light signalling in AC electrified areas.

5.9.3 Induced voltages - buffer areas

All signal equipment intended for use in change over yards, on dc lines close to ac traction, or ac lines close to dc traction shall conform to the requirements of specification CSE 517/2 - Specification for the immunisation of colour-light signalling in AC electrified areas. In this regard reference is also made to specification CSE-518 - Installation of AC/DC change-over systems.

5.9.4 Magnetic field - d.c. traction

TBD

5.9.5 Magnetic field - a.c. traction

TBD

5.9.6 Electric field - d.c. traction

TBD

5.9.7 Electric field - a.c. traction

TBD

5.10 Conducted electromagnetic environment.

This section describes the characteristic of Grade E environment and more specifically the traction currents that can couple with equipment galvanically coupled to the rails.
TBD

5.11 Power supply characteristics

In standard signalling installations the following nominal voltages are used.

Grade	Nominal Voltage
A	110V a.c., 220V a.c., 12V d.c.
B	60 d.c., 110V d.c., 110V a.c., 12V d.c., 380V three phase A.C.
C	110V a.c.,
D	110V a.c., 24 a.c., 12v a.c.
E	110V a.c, 380V a.c. three phase.

All a.c. voltages can have a frequency variation of +/- 5%, and a voltage vatiation of +/-10%. The characteristics of the d.c. supplies are TBD.

The power supply characteristics for Grades F to I are as specified per IEC Standard - Publication 571, paragraphs 8 and 9.

5.12 Lightning induced transients and static discharge.

5.12.1 Lightning transients.

Lightning induced transients can vary extensively depending whether it originates from induction or a direct strike. It is is also not practical to protectect equipment against all expected transients. Therefore lightning protection is required on signal lines feeding out of the installed environment and must be able to withstand an induced transient of at least xxkV at xxkA. The wave shape shown in figure 5.12.1 must be used. Tests must be performed according to TDB.

5.12.2 Static discharge

Static discharges is usually generated by operators and therefore equipment intended for grades A, B, F and G should be tested. A test voltage of 4kV shall be used during the test and the tests conducted in accordance with specification IEC 801 - Part 2.

6 Appendix 1 - Environmental profiles

Fig. 4.2.1. VIBRATION PROFILES – TRANSPORTATION

P.S.D. = POWER SPECTRAL DENSITY

FIG 4.2.1.1 VIBRATION PROFILE – VERTICAL AXIS

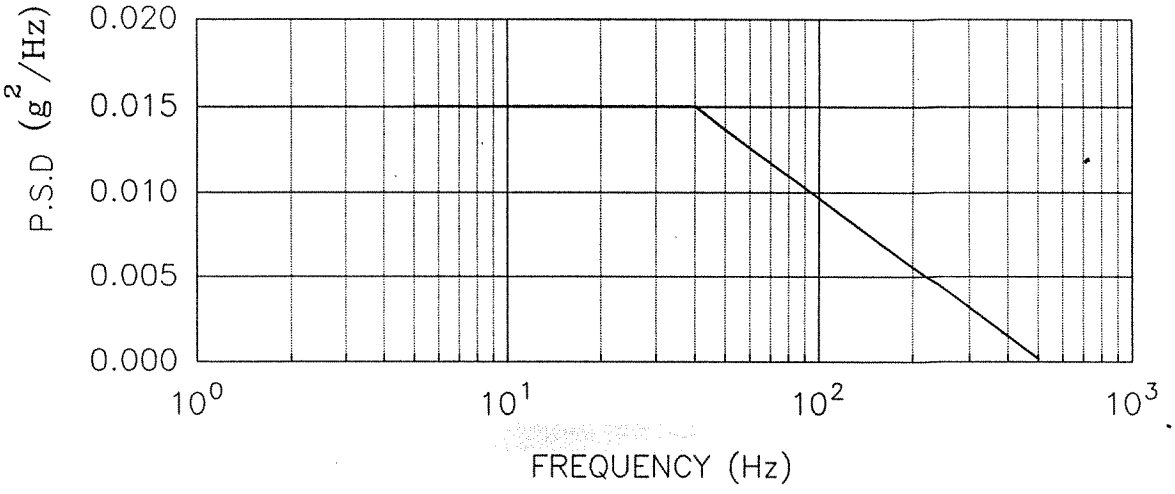

FIG 4.2.1.2 VIBRATION PROFILE – TRANSVERSE AXIS

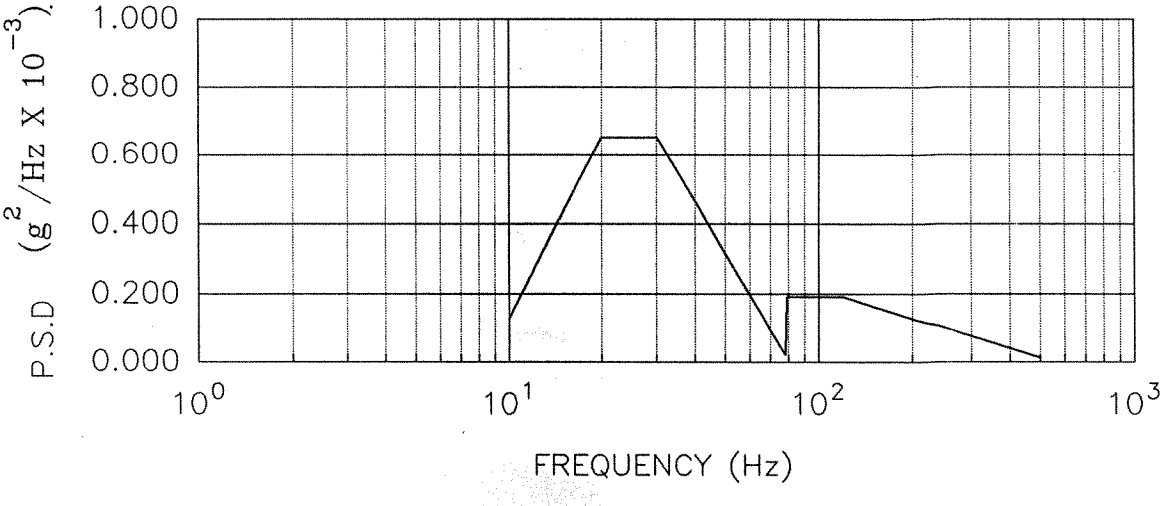

FIG 4.2.1.3 VIBRATION PROFILE – LONGITUDINALAXIS

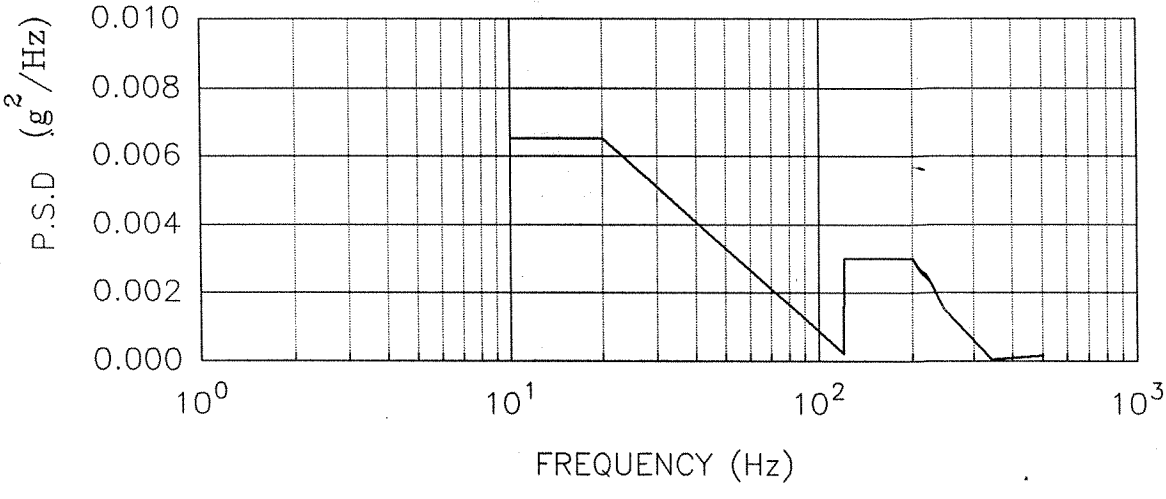

Figure 5.1 – Temperature profiles

Fig 5.1.1 Temperature profile – Grades A,B

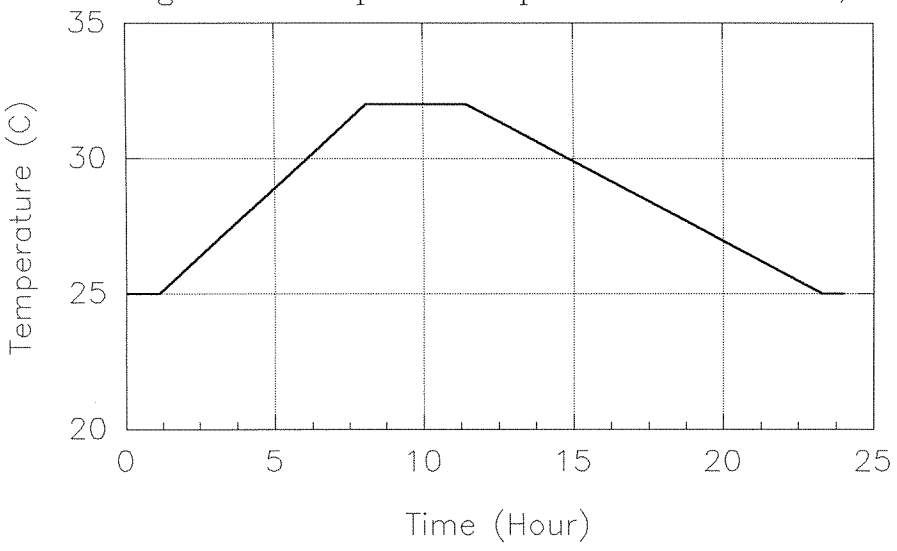

Table 5.1.1

0.00	25
1.10	25
8.10	32
11.4	32
23.3	25
24.0	25

Fig 5.1.2 Temperature profile – Grade D, E

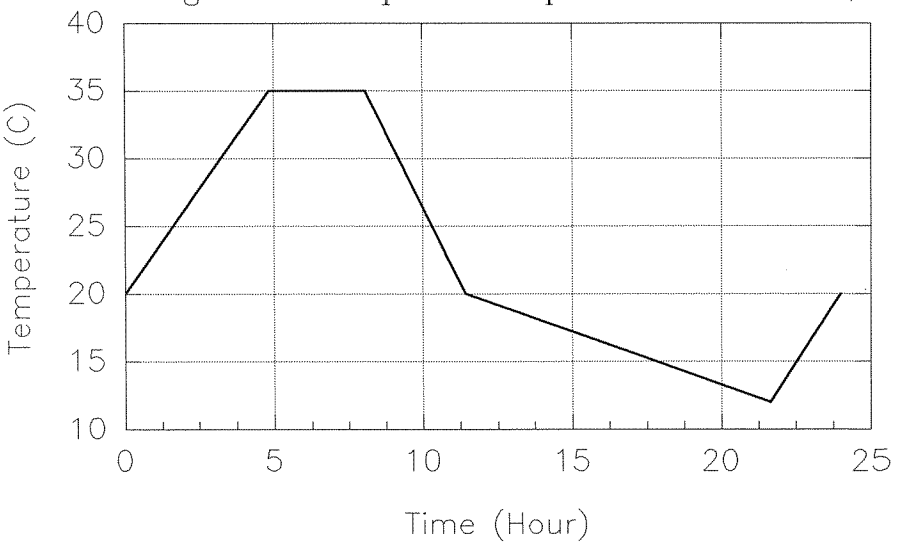

Table 5.1.2

0.00	20
4.90	35
8.10	35
11.4	20
21.6	12
24.0	20

Fig 5.1.3 Temperature profile – Grade C

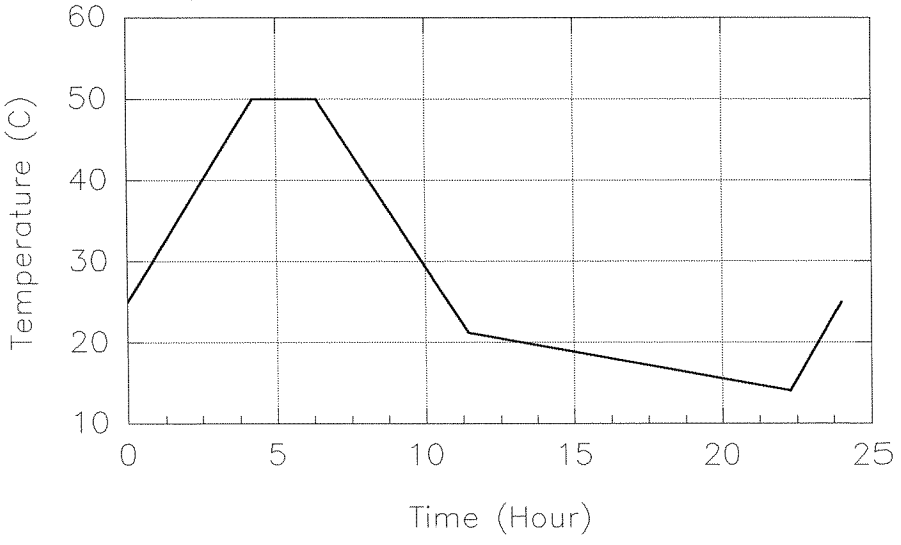

Table 5.1.3

0.00	25
4.20	50
6.30	50
11.4	21
22.3	14
24.0	25

Figure 5.2 – Low Temperature profiles

Fig 5.2.1 Temperature profile – Grades A,B

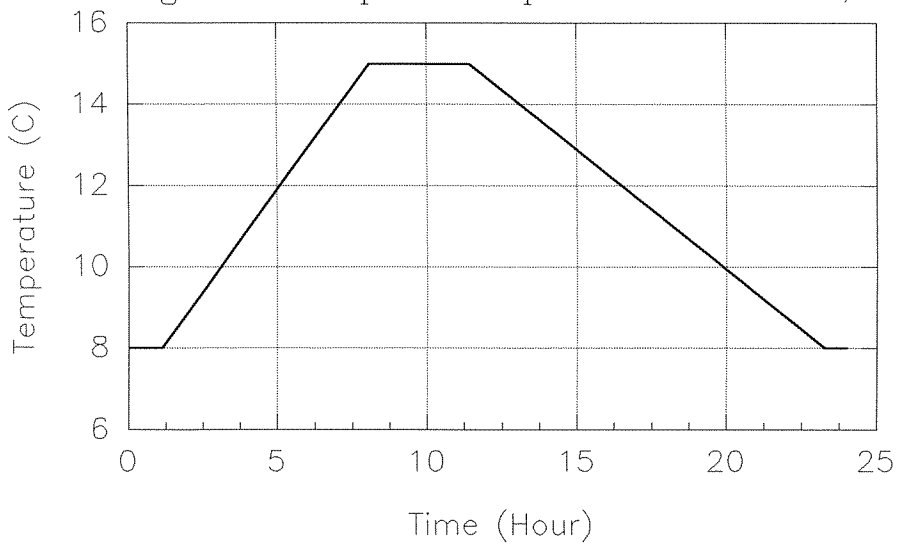

Table 5.2.1

0.00	8
1.10	8
8.10	15
11.4	15
23.3	8
24.0	8

Fig 5.2.2 Temperature profile – Grade D, E

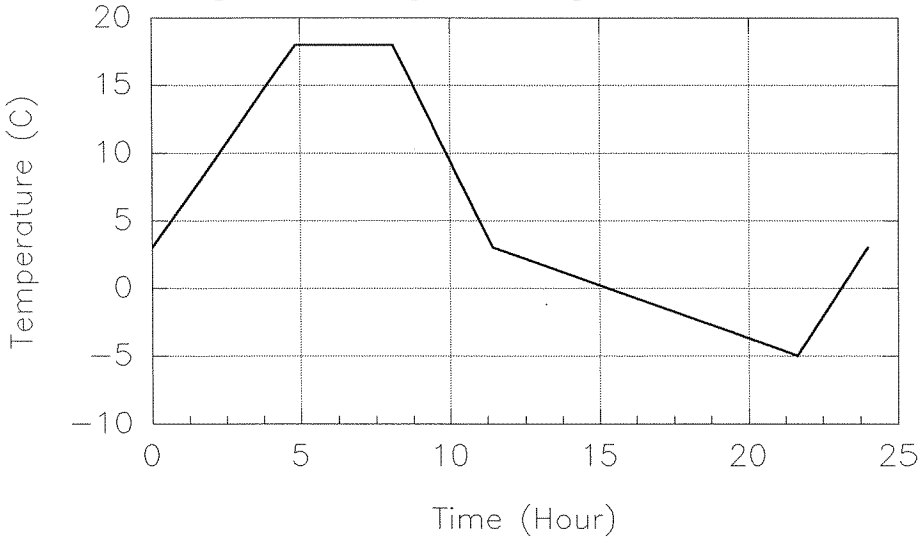

Table 5.2.2

0.00	3
4.90	18
8.10	18
11.4	3
21.6	−5
24.0	3

Fig 5.2.3 Temperature profile – Grade C

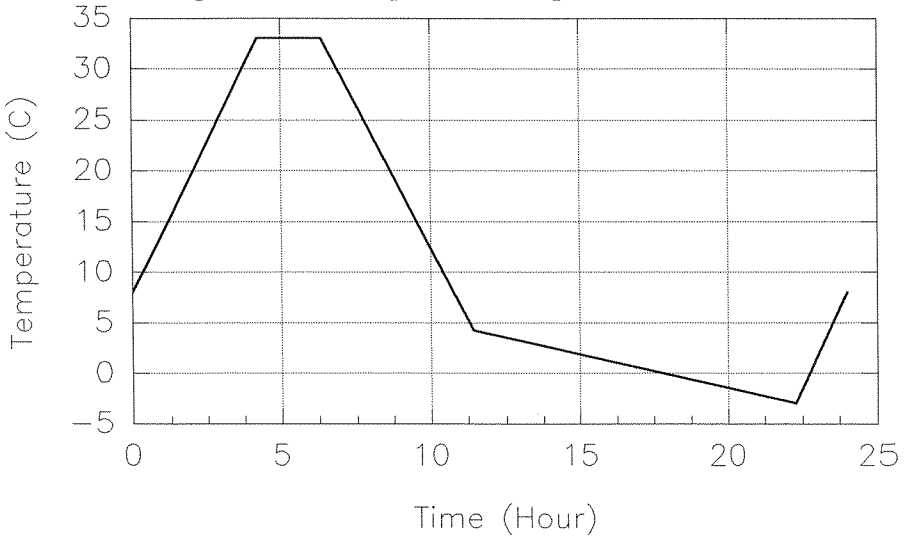

Table 5.2.3

0.00	8
4.20	33
6.30	33
11.4	4.3
22.3	3
24.0	8

Fig. 5.8 Radiated electromagnetic environment

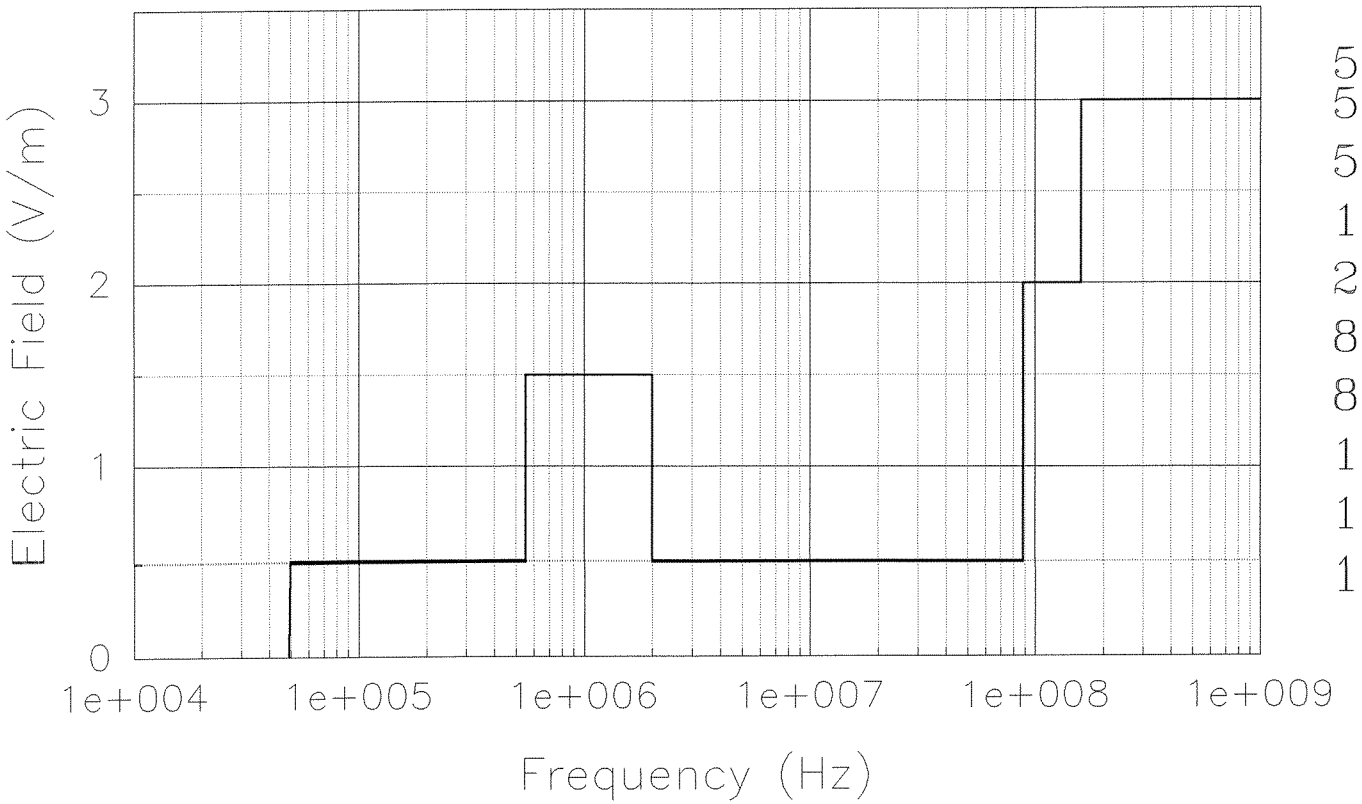

Table 5.8

50KHz	0.5
54kHz	0.5
55kHz	1.5
1.9MHz	1.5
2MHz	0.5
87MHz	0.5
88MHz	2.0
159MHz	2.0
160MHz	3.0
1.25GHz	3.0