

Technical Requirements for Electrical Equipment

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Technical Requirements for Printed Boards and Printed Board Assemblies

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1 General

These technical requirements specify the requirements for printed boards and printed board assemblies for use in nuclear power plants. The Manufacturer/Supplier shall meet these requirements in order to meet the goals of the Swedish owners of nuclear power plants concerning safety and reliability.

The purpose of this document is to provide general requirements on printed boards and components, as well as the process to, from these, produce printed board assemblies, in other words mounting and wiring technology. Overall requirements on the equipment where the finished circuit boards are mounted, as well as other instructions for the Manufacturer/Supplier, are specified in other requirements in accordance with the Technical Specification.

In addition to the requirements in this document, the requirements in TBE 100:1, "General Technical Requirements and Explanations", apply in their appropriate parts.

2 Definitions

Where definitions are taken from standards or equivalent, the source is given in parentheses.

Printed Boards

The general term for completely processed printed circuit or printed wiring configurations. It includes rigid and flexible, single, double and multilayer boards.

Printed Board Assembly

A printed board with electrical or mechanical components, other printed boards, or a combination of these, attached to it with all manufacturing processes, soldering, coating etc.

3 Product Requirements

3.1 General Requirements

The Manufacturer/Supplier is required to show according to which standards printed boards and printed board assemblies have been manufactured and mounted. If the standard referred to is divided into requirement levels for different classes, the Manufacturer/Supplier is also required to show which of these classes was applied. Manufacturing and mounting standards used shall be approved by the Purchaser.

3.2 Standardisation

The product shall be manufactured according to documented standards. This document provides a list of a number of standards which can be applicable and which have normally met the purchaser's approval. The Manufacturer/Supplier can, however, use other international, national or company-specific standards, if these are documented and approved by the Purchaser.

The following documents are examples of applicable standards which can be the basis for the manufacturing of printed board assemblies:

IPC-A-600 Acceptability of printed boards

IPC-A-610	Acceptability of electronic assemblies
J-STD-001	Requirement for soldered electrical and electronic assemblies
IEC 61188-5-6	Printed board and printed board assemblies

The following documents are examples of applicable standards according to which components can be manufactured:

IEC 60747	Semi-conductor devices, discrete devices
IEC 60748	Semi-conductor devices, integrated devices
IEC 60384	Fixed capacitors for use in electronic equipment
IEC 60115	Fixed resistors for use in electronic equipment
IEC 60130	Connectors for frequencies below 3 MHz
IEC 60603-2	Two part connectors

3.3 Components for Printed Boards Assemblies

General

Components shall meet generally accepted product standards and shall as far as possible, be of models, which are normally available on the open market. As reliability and component life are of vital importance, components with some form of independent qualification, such as CECC, are preferred.

The interval at which components of limited life are to be replaced shall be provided, e.g. for electrolytic capacitors and batteries. Such components shall be mounted so that they are easily accessible when replacement is necessary.

Potentiometers

Component choice shall be based on how often settings may be changed. Any need for frequent adjustment during commissioning, troubleshooting and calibration should be taken into account. Potentiometers with carbon elements may not be used without the approval of the Purchaser. Depending on the intended use, potentiometers with resistance elements of metallized ceramic (Cermet) or conductive plastic shall be chosen. If the application requires, wire wound potentiometers may also be approved.

Capacitors

The choice of capacitor type and characteristics shall be based on life requirements. Capacitor design shall be well proven, and the casing shall be of a type that minimizes the risk of failure during the life of the printed board assembly. Electrolytic capacitors shall be of long-life types, e.g. IEC 60384-4 Long-life. Capacitors with limited life shall be marked with the manufacturing date and, may normally not be older than one year at the time of delivery to the Purchaser.

3.4 Surface Treatment

Silver as a contact material, silver-plated surfaces on components or silver as a barrier layer under gold plating is not permitted without approval from the Purchaser, since this, in combination with certain types of air pollution may cause corrosion.

Surface treatment on components shall be performed so that emergence of whiskers can be avoided.

3.5 Marking

The component side of each printed board shall be marked, in screen-printing or other durable method, with information on board type and serial number, and also revision marking. All markings shall, where possible, be legible even after the printed board has been equipped with components.

3.6 Cleaning Procedures

The Manufacturer/Supplier shall provide information on solvents and cleaning procedures for printed board assemblies.

4 Other Requirements

4.1 Special Processes

Crimping, soldering, wire-wrapping, shrinking and surface treatment are special processes and shall, therefore be performed according to qualified methods by specially trained personnel or by correctly set automatic processes.

4.2 Packaging and Handling

Printed board assemblies shall be packed, stored and otherwise handled so that they are protected from electrostatic discharges (ESD) in a satisfactory way. This means that separate boards shall always be packed in ESD-protective packages both during transport and storage. Personnel handling sensitive components shall have the necessary training and be equipped with protective devices so that the printed board assemblies are not exposed to ESD.

5 Requirements according to Nuclear Guides

Printed board assemblies used in nuclear power plants can be required to meet special nuclear requirements, e.g. performance requirements during accident conditions. These requirements are not made, however, directly on the printed board assembly, but on the equipment in which they are included. In such cases, these requirements are specified in the Technical requirements and the Technical Specification for the entire equipment.

6 Documentation

In addition to applicable parts of the documentation required in TBE 100:1 and KBE 100-X the Manufacturer/Supplier shall submit the following documents as part of the tender.

- Block diagram

The block diagram shows in an overall way the electrical function of the parts included on a printed board assembly.

- Circuit diagram

The circuit diagram shows the electrical connections between the components as well as contacts and connections to other boards or units.

- Component location diagram

The component location diagram shows the components physical location on the printed board.

- Functional description

The functional description is a detailed written explanation of the circuit diagram and the function and performance of the printed board assembly.

- Parts list

The parts list lists all the components in the circuit diagram including technical data such as type number, part number, manufacturer, rating, tolerance, etc.

- Repair instructions

If special requirements exist concerning repair work which may be carried out by the Purchaser, e.g. because of a need for special equipment for repair or testing, these shall be specified in the documentation.

Deviations from the documentation requirements in this document shall be clearly stated in the tender. Documentation that cannot be submitted until the delivery of the equipment shall also be specified in the tender.

7 Agreement between Manufacturer/Supplier and Purchaser

This checklist should be used as a base between Manufacturer/Supplier and Purchaser when discussing tenders or orders.

1	Review and completion of the Technical Specification	
2	Review of current Inspection Plan and Examination Procedures	
3	Requirements on separation - isolation	
4	Applicable standard for used products	
5	Applicable standard for test of used products	
6	Material specification	
7	Input and output signals	
8	Type of ventilation or cooling	
9	Accessibility for maintenance	
10	Description of development model (PE)	
11	Evaluation of tools for developing of FPGA, ASIC etc.	
Tools assessed and approved (PE)		
12	The equipment reliability, figures and references	
13	Performance: Response time and verification by test Measuring range, accuracy, fault display, bit resolution time resolution (PE)	
14	Documentation, used language in the document	
15	Statement of document structure and where the information according to the description can be found	
16	Product documentation	
17	Design documentation	
18	Maintenance documentation	
19	Operating documentation	
20	Inspection documentation	
21	Operating experiences	
22	Cyber security	