



TITLE: Integrated electronic thermometer, with or without alarm function, for vaccine refrigerators and freezers

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1. Scope:

This specification describes the performance requirements for an *integrated electronic thermometer, with or without alarm function, for vaccine refrigerators and freezers*. This product is intended for use as the primary means for monitoring storage conditions in vaccine refrigerators and freezers in intermediate stores and health facilities. It can be offered in one or more of the following configurations:

- **Type A:** Permanently integrated device, supplied by the manufacturer of an electric refrigerator or freezer with a mains power supply.
- **Type B:** Permanently integrated device, supplied by the manufacturer of a solar refrigerator or freezer powered by a battery pack charged from a photovoltaic array.
- **Type C:** Permanently integrated device, supplied by the manufacturer of a solar direct drive refrigerator or freezer or a gas or kerosene-fueled absorption refrigerator or freezer.

Cross-reference to other type-testing protocols: This specification should be read in conjunction with the relevant performance specifications from the **E003/** series for all vaccine refrigerators or freezers that incorporate an integrated thermometer of the type described herein.

2. Normative references:

- EMAS: *European Union Eco-Management and Audit Scheme*.
- EN 12830:1999: *Temperature recorders for the transport, storage and distribution of chilled, frozen, deep-frozen/quick-frozen food and ice cream. Tests, performance and suitability*.
- European Union Directive 2002/96/EC: *Waste Electrical and Electronic Equipment*.
- IEC 60529: Consolidated Edition 2.1 (incl. am1): *Degrees of protection provided by enclosures (IP Code)*.
- ISO 9001: *Quality Management Systems – Requirements*.
- ISO 14001: 2004: *Environmental management systems – Requirements with guidance for use*.
- ISO/IEC 17025: 2005: *General requirements for the competence of testing and calibration laboratories*.

3. Terms and definitions:

EPROM: Electrically erasable, programmable, read-only memory.

In writing: means communication by letter, fax or email.

LCD: Liquid Crystal Display.

LED: Light-emitting diode.

Legal Manufacturer: The natural or legal person with responsibility for the design, manufacture, packaging and labeling of a product or device before it is placed on the market under his own name, regardless of whether these operations are carried out by that person himself or on his behalf by a third party.

Montreal Protocol: Montreal Protocol on Substances that Deplete the Ozone Layer

NIST: United States National Institute of Standards and Technology.

Reseller: A commercial entity, licensed to act on behalf of a Legal Manufacturer, and which carries product liability and warranty responsibilities no less onerous than those carried by the Legal Manufacturer.

4. Requirements:

4.1 General:

Electronic thermometer for monitoring storage conditions in vaccine refrigerators and freezers. These devices are supplied by the refrigerator or freezer manufacturer as a permanently integrated component of the product. The following configurations are covered by this specification:

- **Type A1**: Electronic thermometer fitted to a mains powered refrigerator or freezer.
- **Type A2**: As Type A1, but with a high and low alarm function.
- **Type B1**: Electronic thermometer fitted to a photovoltaic refrigerator or freezer with a solar charged battery pack. This type is NOT suitable for direct drive photovoltaic refrigerators as described in PQS specification **E003/RF05**, nor is it suitable for gas or kerosene fueled absorption refrigerators.
- **Type B2**: As Type B1, but with a high and low alarm function.
- **Type C**: Electronic thermometer powered by a photovoltaic cell which forms part of the device. This type draws no power from the product in which it is installed and is therefore suitable for use with gas and kerosene fueled absorption refrigerators and freezers, and with direct drive photovoltaic refrigerators as described in PQS specification **E003/RF05** and **E003/RF06**.

4.2 Performance:

4.2.1 Operating temperature range:

Upper limit: +50°C with over-range protection as clause 4.3.1.

Lower limit: -30°C with under-range protection as clause 4.3.1.

4.2.2 Accuracy:

Type A and Type B devices: ±0.5°C or better within the range -30°C to +20°C.

Type C devices: ±1.0°C or better within the range -30°C to +20°C.

4.2.3 Resolution:

±0.1°C or better within the range -30°C to +20°C

4.2.4 *Power source:*

- **Type A:** Power is taken from the 110/240 volt 50/60 Hz mains supply. The device must be fitted with a rechargeable back-up battery in the event of power failure. The battery must be capable of powering the device for a minimum period of 72 hours in the absence of mains power.
- **Type B:** Power is taken from the main solar-charged battery pack or from the ancillary battery of a direct drive solar refrigerator with ancillary battery (PQS specification **E003/RF06**). An additional rechargeable back-up battery is not required.
- **Type C:** Power is supplied by a photovoltaic cell which forms part of the thermometer. The photovoltaic cell must be able to operate the device at an ambient lighting level of 100 lux, or when a torch is shone onto the device. A response delay of up to 30 seconds is acceptable when a torch is used to activate the device when it is dormant.

4.2.5 *Sensor:*

One or more electronic sensors permanently located in the refrigerator or freezer cabinet to give a true worst-case reading of the load temperature. The worst-case reading in refrigerators is to be the lowest temperature measured during testing and the worst-case reading in freezers is to be the highest temperature measured during testing. The reading must refer to a point lying within the zone allocated for the storage of vaccines.

4.2.6 *Product response time:*

T90 20 minutes maximum in accordance with [EN12830:1999](#).

4.2.7 *Calibration:*

Each product is to be covered by a Certificate of Traceability and Calibration. The traceability declaration is to confirm that the measurement standards and instruments used during calibration of the product are traceable to an [ISO/IEC 17025](#) accredited testing laboratory, to [NIST](#), or to another internationally recognized standards agency. The certificate must be accompanied by a copy of the reference instrument calibration certificate.

4.2.8 *Unit of measurement:*

Temperatures must be recorded in degrees Centigrade.

4.2.9 *Logging interval:*

Devices which measure the storage temperature at discreet intervals are to sample at an interval not greater than 10 minutes.

4.2.10 *Mode of operation:*

The device is to display the most recently logged temperature inside the refrigerator or freezer cabinet. If the temperature in the cabinet exceeds the high alarm setting or drops below the low alarm setting the device is to signal the relevant alarm condition(s) until the alarm is reset by the user.

4.2.11 *Alarm:*

Type A2 and **Type B2** devices must include a high breach and low breach visual alarm event indicator. An audible alarm is optional.

4.2.12 *Alarm settings:*

Upper and lower alarm settings in **Type A2** and **Type B2** devices must be factory programmed into the device as follows:

- **Version for vaccine refrigerators:**
 - a) *Low alarm setting:* Exposure to a single temperature event of -0.5°C or below for 60 minutes.

b) *High alarm setting*: Exposure to a single temperature event of +10°C or above for 10 hours.

- **Version for vaccine freezers:**

a) *High alarm setting*: Exposure to a single temperature event above -15°C for 60 minutes. A low alarm is not required.

Once an alarm event has occurred, the alarm event indicator is to remain activated until cancelled by the user, even if the temperature inside the cabinet has subsequently returned to within acceptable limits.

4.2.13 *Casing*:

Non-corrodible plastics or metal case.

4.2.14 *IP rating*:

Protection of the product not less than [IEC 60529](#): IP54.

4.2.15 *Battery*:

For **Type A** devices only: As defined in clause 4.2.4. Rechargeable batteries must be easily replaceable without need for tools.

4.2.16 *Electromagnetic compatibility*:

Operation of the device must be unaffected in the normal electromagnetic compatibility environment in which it is intended to work, taking into account disturbance generated by adjacent apparatus which is compliant with relevant ISO, EN, or other internationally recognized standards. Information required to ensure uninterrupted use of the device must be contained in the user instructions.

4.3 *Environmental requirements*:

4.3.1 *Ambient temperature range during transport and storage*:

-30°C to +55°C with device inactivated.

4.3.2 *Ambient humidity range during transport, storage and use*:

5 to 95% RH, non-condensing.

4.3.3 *Resistance to electrical storms*:

The functionality of the device must not be affected by intense electrical storm activity.

4.4 *Physical characteristics*:

4.4.1 *Overall dimensions*:

Not critical.

4.4.2 *Weight*:

Not critical.

4.5 *Interface requirements*:

The device must be capable of being incorporated into the control panel of a refrigerator or freezer in a position to be decided by the refrigerator/freezer manufacturer.

4.6 *Human factors*:

4.6.1 *User interface*:

General requirements:

- The digital temperature read-out and optional visual alarm is to be integrated into the control panel on the refrigerator or freezer cabinet.

- The display is to be legible by a person with normal vision (with or without glasses) standing in front of the cabinet, both in bright sunlight and in tungsten/fluorescent lighting at 100 lux on the working plane.

Type A1 and Type A2 devices:

- There must be a ‘replace battery’ warning display which is triggered when 10% or 90 days of battery life remains (whichever period is the longer).

Type A2 and Type B2 devices:

- The visual alarm must unambiguously show both high and low temperature breaches.
- The optional audible alarm must achieve a minimum sound intensity of 100dB(A) at a distance of one metre from the sounder. The pattern of the signal is to be an intermittent pulse.
- There must be a switch on the control panel to reset the alarm. It must not be possible to confuse this with the any other control on the refrigerator or freezer.

4.6.2 *Activation:*

- **Type A1 and Type A2:** The device is to be activated by connection of the refrigerator or freezer to a mains electricity supply. In the event of mains failure or loss of photovoltaic power it is to remain fully activated until the supply is restored or the charge on the backup battery expires.
- **Type B1 and Type B2:** The device is to be activated by connection of the refrigerator or freezer to a photovoltaic electricity supply. Backup power in low sun conditions is supplied by the main battery pack.
- **Type C:** The device is to be activated by the ambient lighting, whether natural or artificial, in the room in which the product is installed. In health facilities without electricity, nighttime activation of a dormant device will be achieved using a torch.

4.6.3 *De-activation:*

It should not be possible to de-activate the product inadvertently.

4.7 *Materials:*

4.7.1 *Ozone depleting chemicals:*

During manufacture and assembly of the printed circuit boards and final assembly of the product do not use any substance included in Annex A, B or C of the [Montreal Protocol](#).

4.7.2 *Other restricted materials:*

The product and its constituent components, including batteries, must not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated biphenyl ethers (PBDE).

4.8 *Warranty:*

The product is to be covered by the warranty offered by the manufacturer of the appliance into which the device is integrated.

4.9 *Servicing provision:*

The product is to be maintenance-free apart from routine battery replacement.

4.10 *Disposal and recycling:*

The manufacturer is to provide information to the buyer on the hazardous materials contained within the system and suggestions for resource recovery/recycling and/or environmentally safe disposal. For the European Union [WEEE](#) compliance in accordance with European Union Directive 2002/96/EC is mandatory.

4.11 Instructions:

User instructions are to be incorporated into the instruction manual issued by the manufacturer of the appliance into which the device is integrated.

4.12 Training:

No requirement.

4.13 Verification:

In accordance with PQS Verification Protocol **E006/TH06-VP.2**.

5. Packaging:

Materials used for packaging the finished product are to be free of ozone-depleting compounds as defined in the [Montreal Protocol](#).

6. On-site installation:

Not applicable.

7. Product dossier:

General note: This product will be offered as an integrated component of a refrigerator or freezer complying with one of the **E003/** series performance specifications. The product dossier requirements below are to be read as a supplement to the relevant **E003/** performance specification.

The [legal manufacturer](#) or [reseller](#) is to provide WHO with a pre-qualification dossier containing the following:

- Dossier examination fee in US dollars.
- General information about the [legal manufacturer](#) of the integrated product, including name and address.
- Unique identification reference for the product type.
- Full specifications of the product being offered, covering all the requirements set out in this document, including details of product marking and traceability.
- Certified photocopy of Certificate of Traceability and Calibration traceable to an [ISO/IEC 17025](#) accredited testing laboratory, to [NIST](#), or to another internationally recognized standards agency.
- Certified photocopies of all type-approvals obtained for the product, including CE marking and the like.
- Certified photocopies of the legal manufacturer's ISO 9001 quality system certification.
- Where relevant, certified photocopies of the legal manufacturer's ISO 14001 certification, EMAS registration or registration with an equivalent environmental audit scheme. Conformity with an environmental audit scheme is not mandatory; however preference will be given to manufacturers who are able to demonstrate compliance with good environmental practice.

- Where available, laboratory test report(s) proving conformity with the product specifications.
- Sample refrigerator or freezer incorporating the product as defined in the relevant E003/ series performance specification.

8. On-site maintenance:

Not applicable.

9. Change notification:

The [legal manufacturer](#) or [reseller](#) is required to advise WHO [in writing](#) of any changes which adversely affect the performance of the product after PQS pre-qualification has taken place.

10. Defect reporting:

The [legal manufacturer](#) or [reseller](#) is required to advise WHO and the UN purchasing agencies [in writing](#) in the event of safety-related product recalls, component defects and other similar events.

Revision history:			
Date	Change summary	Reason for change	Approved
21.09.2006	1. cross-reference clause added. 4.2.16 added. 4.3.1: upper limit changed to +55°C, 'storage' added. 4.3.2: 'storage' added. 4.6.1: 5 th bullet point changed. New clause 4.7.2. 4.7.3 and 4.7.4 deleted. 5: 'CFC' changed to 'ozone-depleting'.	Corrections. Consistency with other specifications during final review. EU RoHS Directive material restrictions incorporated.	UK (30 November 2006 - PQS secretariat)
06.07.2010	- General revision to include newly defined Type A, Type A1, Type B, Type B1 and Type C devices. - Reference to maximum/minimum thermometers removed. 2. Normative references updated.	Comments received from solar refrigerator manufacturers.	UK (July 2010)