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- b) When shortage of fluid, cooling circuit failure or electrical faults can cause hazardous boiler temperatures to be reached, a suitable thermal overload trip shall be provided designed to disconnect the electrical supply from the pump before unsafe temperatures are reached.
- c) When excessive temperatures can result in hazardous degradation of diffusion pump fluids a suitable thermal trip shall be provided.

5.4 Noise

Design considerations shall be given to noise reduction, taking into account ISO/TR 11688-1. Design shall be such that continuous full load operation is possible at the maximum specified ambient temperature, with protective means in place.

5.5 Radiation

The equivalent dose rate of unintended and stray radiation at 50 mm from the outer surface of a getter pump shall not exceed 5 $\mu\text{Sv/h}$.

5.6 Materials and substances processed, used or exhausted by vacuum pumps

Where vacuum pumps and pumping systems are supplied for processes where the pumped media and/or pump fluid could generate hazards, special actions are required to remove the risks associated with the hazards.

5.6.1 General requirements

- a) Harmful leakage of air into the system, or toxic gases leaking into the atmosphere shall be prevented by the design. The system shall be tested for leak tightness according to clause 8.4.
- b) Harmful entry of any fluid or solid particles into the pump shall be prevented by the fitting of adequate traps or separators.
- c) Fire, due to processing flammable substances, shall be avoided by:
 - The design and choice of materials to minimise sources of ignition;
 - Preventing the build-up of electrostatic charges by the choice of material and suitable earthing;
 - Preventing the ingress of foreign particles which could ignite when coming into contact with the rotating shaft.

Where water is used as the sealing medium, a flow meter shall be fitted that shall trip the prime mover if the water flow is reduced to a hazardous level.

To avoid the escape of flammable gases, the pumping system shall be tested to an appropriate degree of leak tightness in accordance with 8.4.

If appropriate, the means shall be provided for diluting any flammable substance with an inert gas.

- The accompanying instructions shall warn of the need to take precautions appropriate to the hazardous materials that may remain in the pump;
 - A warning of the possibility of harmful substances caused by the breakdown of pump lubricants or pumping fluid, remaining in the pump;
 - Instructions for the safe handling and safe disposal of spent lubricants and other waste materials shall be given;
 - All data necessary for the safe handling, use and disposal of the pump fluids;
 - Instructions shall be given for the safe maintenance of any filters and a warning of the need to take precautions appropriate to the pumped media when changing and disposing of the filter elements. The intended purpose for which the filter is suitable must be stated.
- b) For vapour pumps (additional):
- Instructions for cleaning the pump and statement of the solvents to be used and if appropriate the types to be avoided;
 - Instructions for checking the level of pump fluid;
 - Instructions for safe draining of the pump fluid including a warning on the minimum cooling time to be allowed before draining.

8 Verification

8.1 Noise measurement

^{A1)} Verification of noise emission values shall be made in accordance with the dual-number declaration in ISO 4871. ^{A1)}

The measured noise emission values shall be determined in accordance with ^{A1)} EN ISO 2151 ^{A1)}.

8.2 Pressure test

A vacuum pump or any part of a pumping system which is intended to contain a possible explosion or a rapid pressure rise due to the decomposition of the pumped media, shall at the design be proven to withstand an absolute pressure of 11 bar.

The period of application of the pressure shall be at least one minute. Distortion of the outer case and leakage may take place, but it must not rupture or be damaged in any other way.

8.3 Mechanical stability testing

A vacuum pump or vacuum pumping system shall be considered stable if, when tilted at an angle of 10° in any direction, the system does not fall over.

8.4 Testing for leak tightness

The degree of leak tightness required shall be consistent with the system, the process and the nature of the gases being pumped.

The method used shall be capable of detecting the leak rate required and shall be calibrated to national standards. Methods used may include: