Position Paper: Enhancements to EN 378 for Improved Safety

Why you should get involved

The transition from non-flammable to highly flammable gases (hydrocarbons) in refrigeration systems and heat pumps offers significant opportunities for reducing greenhouse gas emissions. However, it also introduces notable safety challenges. EN 378, a key standard for safety requirements in refrigeration systems and heat pumps, must ensure better alignment with the explosion protection methodology outlined in the EN IEC 60079 series and the two associated ATEX Directives.

We see a need for the revised EN 378 to provide clearer guidance and strengthen safety requirements, particularly regarding explosion protection, zoning classification, and risk assessments. These measures will not only reduce the risk of accidents but also ensure better application of the standard and uphold the industry's reputation.

Background and Context

EN 378 has long been an essential reference for refrigeration systems and heat pumps. However, the current version contains several weaknesses that create uncertainty among manufacturers, installers, and users:

- **Lack of harmonisation with the ATEX Directives**: While EN 378 Part 2 is harmonised with the Machinery Directive, it does not fully align[1] with the two ATEX Directives, which regulate explosive atmospheres. This creates a risk of misinterpretation regarding safety requirements. Safety requirements in potentially explosive atmospheres should be based on the methodology for explosion protection outlined in internationally recognized standards from *IEC TC 31*[2]*– Equipment for explosive atmospheres*, and not on a methodology tailored for the refrigeration and heat pump industry by CEN/TC 182/WG 6.

- **Unclear explosion protection requirements**: EN 378 does not provide sufficient guidance on risk assessments, explosion protection documentation, or zoning classification, potentially leading to incorrect implementation.

[1] Guide to application of the Machinery Directive 2006/42/EC, Edition 2.3 – April 2024, §91 Specific EU legislation that may apply to machinery instead of the Machinery Directive for specific hazards. “The reference to “the specific Community Directives” in the second paragraph of section 1.5.7 of Annex I of the MD is to be understood as a reference to the ATEX Directive.”

[2] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE, Second Edition 2022, A Common Regulatory Framework for Equipment Used in Environments with an Explosive Atmosphere.

- **Complexity and readability**: The language of the standard is often complicated, hindering its proper application, particularly for less experienced users.

National authorities recognise EN 378 as an important norm but simultaneously refer to the EN IEC 60079 series for explosion protection. This methodology is not fully implemented in the current EN 378, posing challenges for compliance assessments and practical implementation.

Arguments

1. Improved integration of explosion protection

The revised EN 378 should explicitly refer to risk assessments and the requirement for explosion protection documentation for systems using flammable gases. These measures are already mandated by the ATEX Directives but should be emphasised in the standard to ensure proper compliance.

2. Inclusion of zoning classification

Zoning classification is critical for defining hazardous areas around refrigeration systems and heat pumps. The current EN 378 lacks guidance on how these assessments should be carried out, leading to misunderstandings and risks of incorrect classification.

3. Prioritising the prevention of explosive atmospheres

The revised EN 378 should focus on measures that prevent the formation of explosive atmospheres before addressing ignition sources after a leak occurs. This includes eliminating and/or minimizing leakage points and requirements for continuous ventilation to prevent the build-up or persistence of flammable gases.

4. Simplification and clarification

The language of the standard should be simplified, and its structure improved to ensure the requirements of the revised EN 378 are easily understood and applied by all stakeholders, from manufacturers to installers.

Recommendations

We recommend that stakeholders prioritise the following measures in the revised EN 378 (see details in appendixes):

- **Alignment with the ATEX Directives**: Ensure that the explosion protection requirements comply with European regulations.
- **Clarification of risk assessment and explosion protection documentation**: Include explicit references to these requirements and provide practical guidance for their implementation.
- **Guidance on zoning classification**: Incorporate details on how hazardous areas should be classified based on the risk of explosive atmospheres.
- **Strengthening preventive measures**: Highlight the importance of reducing leakage points and require continuous ventilation in hazardous areas.

- **Enhanced language and structure**: Make the standard easy to read and understand, particularly for less experienced stakeholders.

Conclusion

The revised EN 378 represents an opportunity to enhance safety in the use of flammable gases in refrigeration systems and heat pumps. By better aligning with the ATEX Directives, incorporating explosion protection and zoning classification, and improving readability, the standard can help reduce risks, protect lives and health, and maintain the industry's trust and reputation.

We encourage all stakeholders to actively participate in the public consultation process starting in April 2025 and contribute to creating a stronger EN 378 for the future.

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On behalf of:

Norwegian Refrigeration Association (NKF)

Norwegian Heat Pump Association (NOVAP)

Norwegian HVAC-R Association (VKE)

Appendixes

Lack of alignment with methodology of the ATEX directives

A hazardous area is any location where an explosive atmosphere is present or expected to occur in quantities requiring special precautions for the design, installation, and use of equipment. These areas are categorized into Ex-zones (zones 0, 1, and 2) based on the frequency and duration of the explosive atmosphere's presence. The process for assessing and defining these zones is outlined in EN IEC 60079-10-1. It's crucial to understand that during this assessment, only the presence of an explosive atmosphere is considered. Potential ignition sources are not factored into hazardous area classification.

In EN 378-3:2016 this assessment is required for machinery rooms for groups A2L, A2, A3, B2L, B2 and B3 refrigerants under clause 5.14.1, directly referencing EN IEC 60079-10-1. However, in EN 378-2, clause 6.2.14, fire and explosion hazard protection is addressed, also referencing IEC 60079-10-1. This chapter is found to be confusing, as the methodology it suggests is not harmonized with EN IEC 60079-10-1. This misalignment has led to significant issues.

Common Challenges and Misunderstandings:

1. **Lack of Assessments:** Many producers and stakeholders either skip the assessment entirely or fail to understand how it should be conducted.
2. **Incorrect Assumptions:** Statements such as:
    - "There are no ignition sources, so a hazardous area classification is unnecessary."
    - "We use a gas detector, so no hazardous area classification is needed."
      These arguments demonstrate a misunderstanding, as neither ignition sources nor gas detection are inputs for defining Ex-zones. Relying on these assumptions can lead to incorrect hazardous area classifications.

Proposed Solutions:

To address these issues, two potential approaches are recommended:

1. **Harmonize Classification Methods:** Align the hazardous area classification process with **IEC 60079-10-1**, specifically highlighting the necessary discrete steps:
    1. Identify risks for presence of explosive atmosphere
    2. Perform hazardous area classification
    3. Identify and assess ignition sources
    4. Identify protective measures
    5. Create explosion protection document
2. **Predefined Ex-Zones:** Develop predefined Ex-zones for common configurations of heat pumps and refrigeration systems. Producers wishing to deviate from these predefined zones must follow **IEC 60079-10-1** and perform their own assessments.

Widespread Use of Gas Detectors as a Safety Measure for Explosion Protection

Gas detectors for flammable gas detection in heat pump or refrigeration systems primarily serve two purposes (in addition to raising an alarm):

1. **Ventilation Control:** Activating or increasing ventilation upon gas detection.
2. **Ignition Control:** De-energizing equipment to prevent ignition.

However, there are two key issues with relying on gas detectors for these purposes:

1. Impact on Hazardous Area Classification
Ventilation is a critical factor in hazardous area classification. If ventilation is allowed to remain completely off when a leak begins, it can result in a stricter classification than if ventilation were reliably operational. Hazardous area classifications assume normal operating conditions, and inconsistent ventilation can lead to overly conservative or incorrect classifications.

2. Equipment Approval and Ignition Control
In hazardous areas, only equipment approved for the specified zone is permitted. It is not acceptable to use non-classified equipment and rely solely on gas detectors for ignition control[3]. This requirement is clearly stated in the ATEX User Directive (1999/92/EC), Annex II, Clause B.

While gas detection is an excellent safety measure for explosion protection, it must not be treated as the primary barrier. Priorities should always be:

1. Minimizing leakage points.
2. Ensuring reliable, efficient, and continuous ventilation.
3. Selecting the correct, approved equipment for the zone.

Gas detection is a secondary measure and should never be used as a substitute for proper equipment selection. Serious near misses have occurred due to the failure of gas detectors. Overreliance on detectors can significantly compromise safety.

Special Case: EN 378-3 and 2L Refrigerants
EN 378-3, Chapter 7.3 permits ignition control through detection and de-energizing for 2L refrigerants. However, as outlined above, this approach is not allowed in hazardous areas. The continued use of this practice is likely due to a lack of understanding of the rules governing hazardous areas and historical allowances for 2L refrigerants.

[3] European Commission: Directorate-General for Employment, Social Affairs and Inclusion, Non-binding guide to good practice for implementing the European Parliament and Council Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres, Publications Office, 2005, Clause 3.1.5. Gas alarms, “No dangerous conditions may arise on failure of individual functions of gas alarm systems (reliability).”

Predefined Security and safety Zones

Establishing predefined security and safety zones around refrigeration systems that use flammable refrigerants enhances safety for technicians, employees, and the public while minimizing risk as much as possible. These zones provide clear boundaries that:

- Indicate where personal protective equipment (PPE), ventilation, or explosion-proof (Ex-rated) equipment is required.
- Reduce the likelihood of unauthorized personnel entering hazardous areas.
- Facilitate compliance with regulatory requirements and simplify risk assessments and safety documentation.

Suggested Approach

Divide security and safety zones into three distinct areas. These zones are particularly important during service, repair and maintenance. These zones could be defined by the manufacturer or the steps suggested below. The safety zone distances could be based on a leakage rate of 3 g/s [4] and apply to single units or the combined effect of multiple units.

1. Hazardous Area (Ex-Zone)

- The hazardous area (Ex-zone) encompasses any installation or unit containing flammable refrigerants, and the extent must be properly defined using IEC 60079-10-1.

2. Safety Zone

- **Access:** Authorized personnel only.
- **Division into Safety Zone A and Safety Zone B:**
  Safety Zone A – Work Without Breaking into the Circuit
  - An area with a risk of flammable or explosive atmospheres.
  - No ignition sources permitted.
  - All equipment must meet the safety requirements of the environment.
  - **Safety Distance:** Suggesting 1 meter around the Ex-sone.

  Safety Zone B – Work Involving Breaking into the Circuit
  - Same conditions as Safety Zone A, but additional precautions are required.
  - A **safe work permit** must be issued to address potential ignition risks (e.g., hot work or circuit breaking).
  - **Safety Distance:** Suggesting 2 meters around the Ex-zone.
  - **Extra ventilation:** Should be considered

3. Site Security Boundary

- **Access:** No admittance; authorized personnel only.
- **Security Distance:** Suggesting a 5-meter distance from the installation.

[4] Based on EN 378-2, Annex I

Example of security zones: