Adopting R-32 VRV technology

A practical guide to the relevant safety standards

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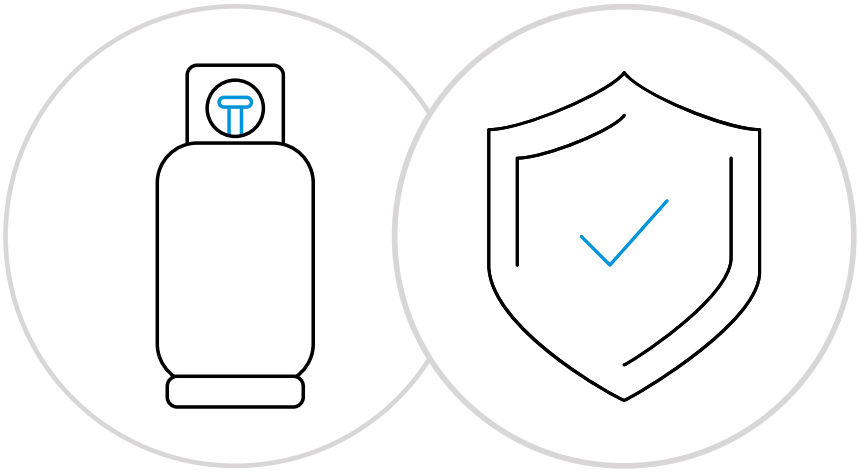
Where **a specific product standard is in place and sets refrigerant charge limits**, those limits take **precedence over** those defined in **general standards**.

In recent years, growing awareness of environmental impact — and specifically the role of refrigerants — has accelerated the adoption of R-32 VRV systems across Europe. As this transition gains momentum, industry professionals increasingly seek clarity on how to correctly apply the various standards governing F-gas safety.

Through our leading position in R-32 VRV solutions and our close collaboration with installers, designers, compliance experts, and policymakers, Daikin has developed a deep understanding of the practical implementation of these safety standards. We have consolidated this knowledge to provide clear, actionable guidance for all stakeholders involved in the design, installation, and assessment of VRV systems.



Which standards regulate refrigerant safety?

IEC 60335-2-40 is a product standard, setting the safety requirements for electrical heat pumps, air-conditioners and dehumidifiers.

EN 378 is a general standard, setting requirements for refrigeration systems, covering design, manufacture, installation, operation, maintenance and disposal.

Within their scope, both IEC 60335-2-40 and EN 378 state that where a **specific safety product standard** exists, for example IEC 60335-2-40, it **takes precedence over a general standard** such as EN 378 (excerpts 1 and 2).

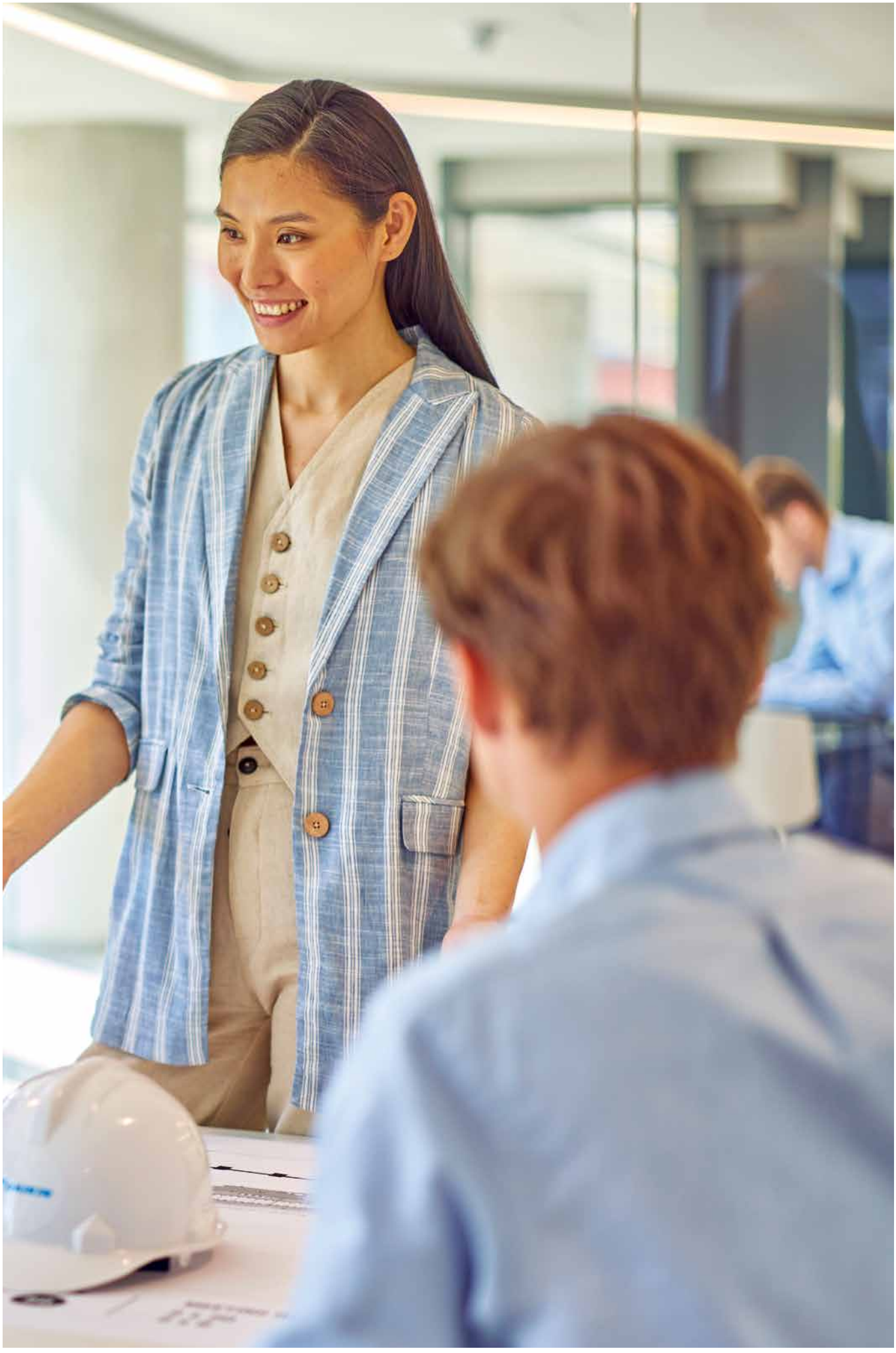
EN 378 further reinforces this principle when defining permitted refrigerant charge limits (excerpt 3).

Conclusion: IEC 60335-2-40 takes precedence over EN 378.

Excerpt 1 – EN378 scope: *"Product family standards dealing with the safety of refrigerating systems take precedence over horizontal and generic standards covering the same subject."*

Excerpt 2 – IEC 60335-2-40 scope: *"This part of IEC 60335 deals with the safety of electric* ***heat pumps, sanitary hot water heat pumps and air conditioners****, incorporating motor-compressors as well as* ***hydronic fan coils units, dehumidifiers*** *(with or without motor-compressors),* ***thermoelectric heat pumps and partial units****. Their maximum* ***rated voltage*** *being not more than 300 V for single phase appliances and 600 V for multi-phase appliances."*

Excerpt 3 – EN 378 (part 1): *"Article 6 Quantity of refrigerant: Where product standards exist for particular types of systems and where these product standards refer to refrigerant quantities limits, such quantities shall overrule the requirements of this standard."*



Applying the relevant standards to **R-32 A2L systems**

IEC specifies that the most stringent requirement (flammability or toxicity) shall apply [excerpt 4].

Overview of permitted concentration limits for R-32

Safety standard		Max. allowed concentration
IEC 60335-2-40	Flammability (LFL)	75% of the Lower Flammability Limit (LFL) = 0.75 x 307 g/m³ → **230 g/m³**
EN 378	Toxicity (ATEL/ODL)	**300 g/m³**

As the flammability limit of 230 g/m³ is lower than the toxicity limit of 300 g/m³, the more stringent flammability limit applies. Compliance with this limit inherently ensures that toxicity limits are not exceeded, so no additional checks are required.

What does this mean for the design of your R-32 systems?

If the calculated refrigerant concentration is below 230 g/m³, no additional safety measures are required.

Where the concentration exceeds 230 g/m³, Daikin's Shîrudo Technology supports compliance with IEC 60335-2-40 and EN 378, helping you meet the required safety standards with confidence.

Excerpt 4 – IEC 60335-2-40: "Toxicity charge limits shall be determined per ISO 5149-1:2014, ISO 5149-1:2014/AMD1:2015, and ISO 5149-1:2014/AMD2:2021. If the toxicity-based charge limits are less than the flammability-based charge limits, the toxicity-based charge limits shall take precedence."

Applying the relevant standards to **R-410A (A1) systems**

Related to charge limits, IEC only covers flammable refrigerants (A2L, A2, A3).
→ Therefore IEC cannot be used for these evaluations for systems using non-flammable refrigerants (A1).

Overview of permitted concentration limits for R-410A

Safety standard		Max. allowed concentration
IEC 60335-2-40	Flammability (LFL)	N/A – IEC only covers flammable refrigerants (A2L, A2, A3)
EN 378	Toxicity (ATEL/ODL)	**440 g/m³**

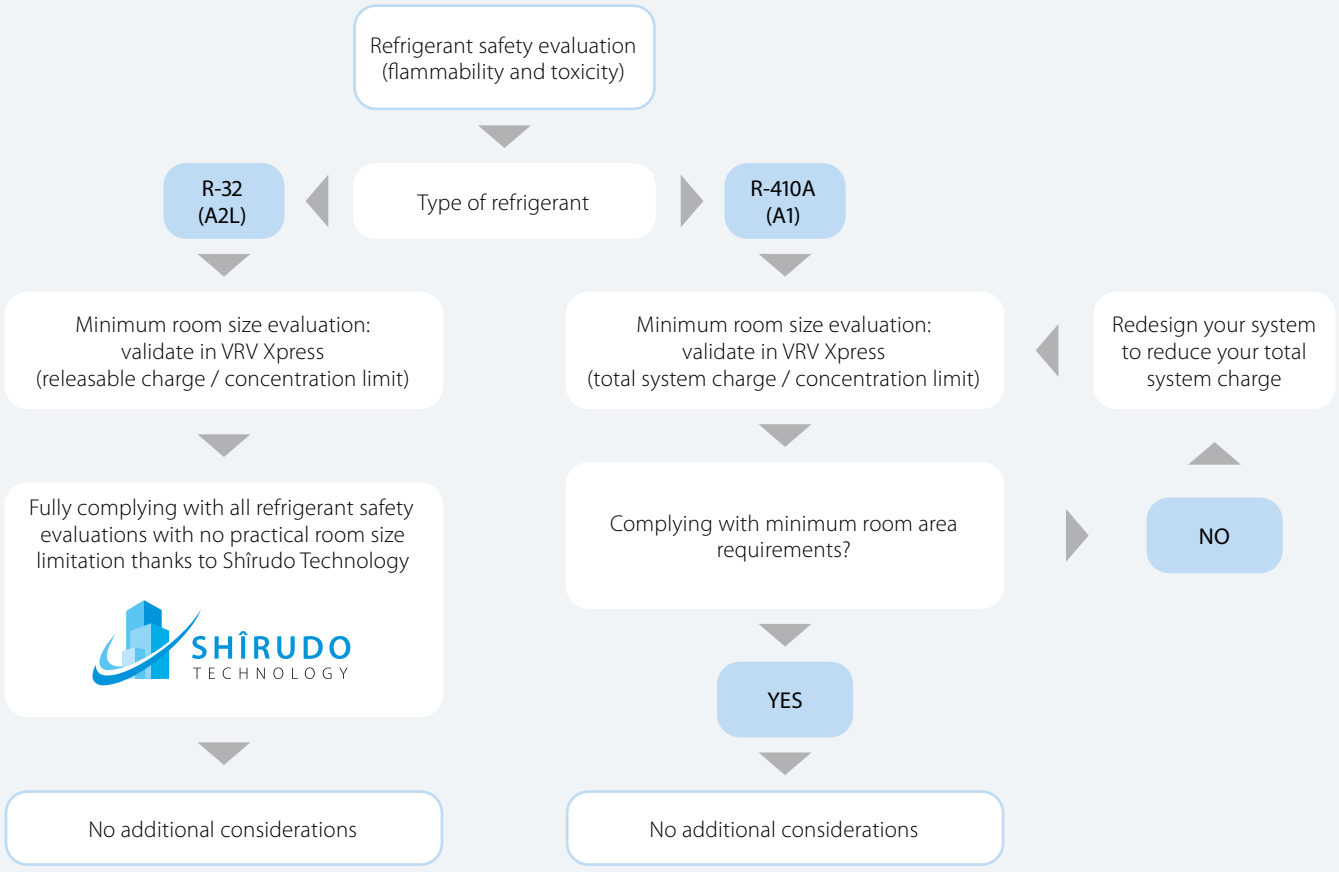
The toxicity limit specified in EN 378 for R-410A, classified as an A1 non-flammable refrigerant, is 440 g/m³ and should be applied.

What does this mean for the design of your R-410A systems?

As R-410A does not fall within the scope of the IEC standard relating to refrigerant safety, EN 378 applies as the governing standard.

Refrigerant concentration for R-410A must remain below 440 g/m³. Where this limit is exceeded, appropriate field-supplied safety measures are required in line with EN 378.

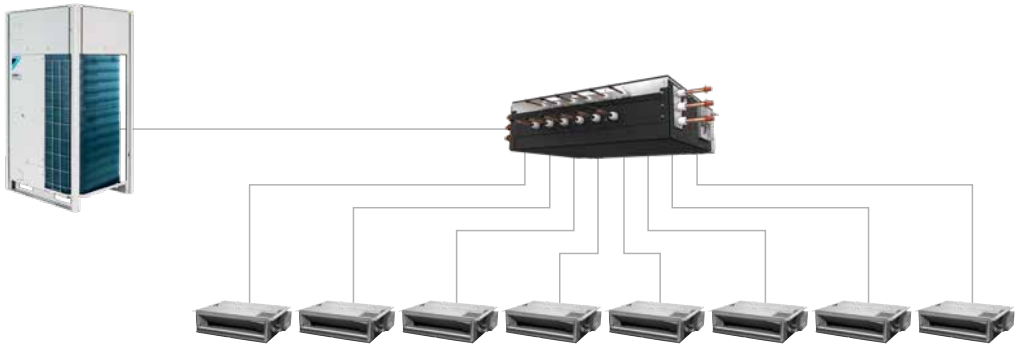
Practical application for Daikin systems



Design comparison: Calculation example for a hotel application

- Eight guest rooms, each 25 m^2, with a ceiling height of 2.5 m. Total cooling capacity 20 kW
- One indoor unit per room, with a single outdoor unit serving the floor
- Identical piping layout for both the R-410A system (VRV IV), and the R-32 system (VRV 5)

With R-32, VRV 5 offers greater design flexibility, supported by Shîrudo Technology.



R-32 VRV 5

Configuration

1 × REYA8U
8 × FXDA25A
1 × BS8A14AV1B9

Resulting system refrigerant charge

13.57 kg of R-32

Minimum room size verification

STEP 1 – Flammability (IEC): Maximum allowable concentration in a room is 230 g/m^3

STEP 2 – Toxicity (EN 378): 300 g/m^3, but the more stringent (lower) flammability limit (230 g/m^3) of IEC apply

Daikin Shîrudo Technology ensures that the room concentration does not exceed 230 g/m^3, ensuring compliance with IEC 60 335-2-40 and EN 378.

Following IEC 60335-2-40, the minimum room area is calculated (logic in VRV Xpress) considering the refrigerant charge from the shut-off valve to the indoor unit, the indoor unit size and the flammability limit (being lower than the toxicity limit).
For this specific system: Room 8 (most stringent situation in this layout) > **3.08 m^2**

Conclusion

The minimum room area is **3.08 m^2** following IEC 60335-2-40 and applying Shîrudo Technology

R-410A VRV IV

Configuration

1 × REYQ8U
8 × FXDQ25A
1 × BS8Q14AV1B

Resulting system refrigerant charge

13.94 kg of R-410A

Minimum room size verification

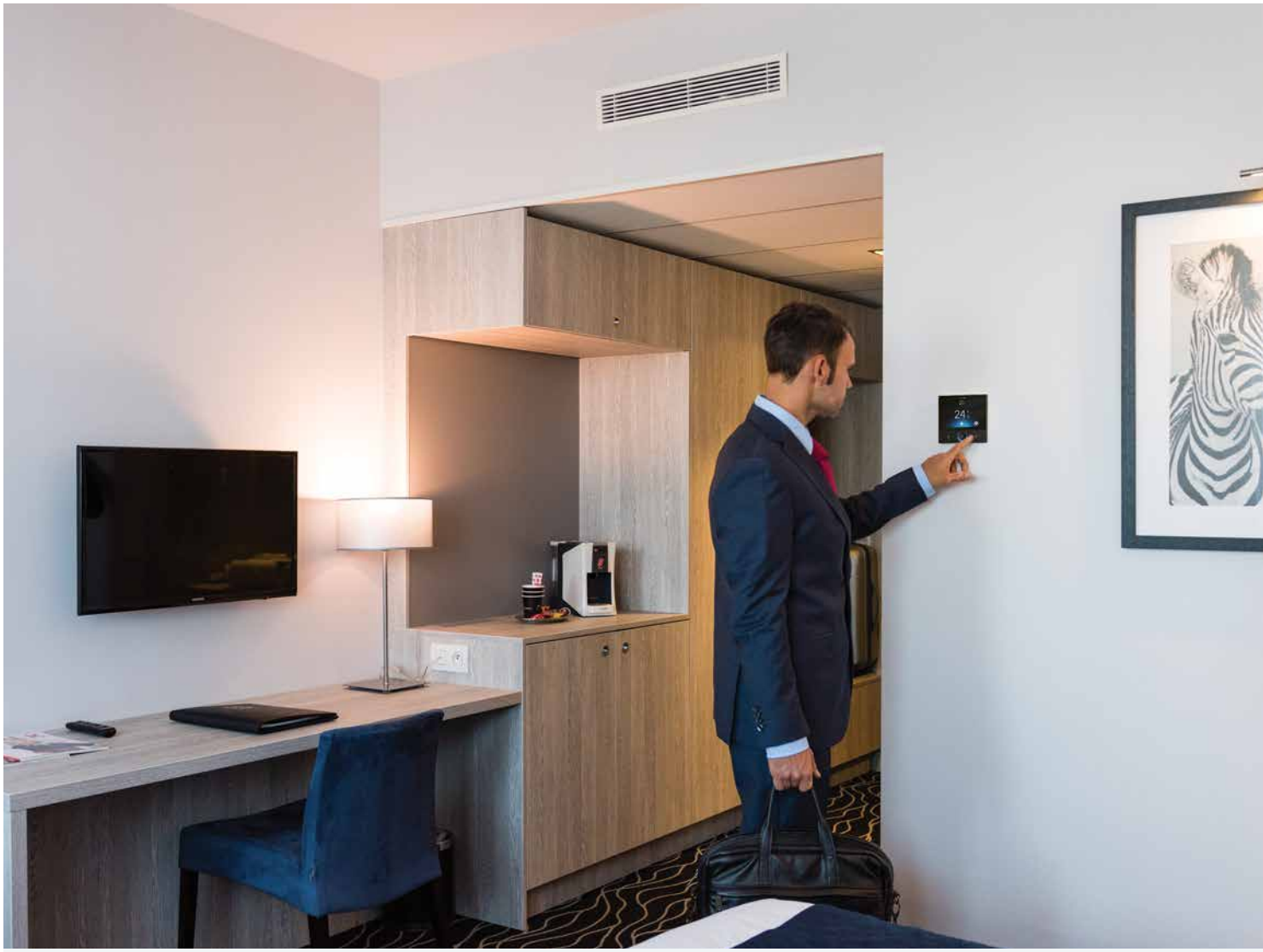
STEP 1 – Flammability (IEC): not applicable (A1 refrigerant is non-flammable)

STEP 2 – Toxicity: EN 378 applies as IEC 60335-2-40 defines toxicity limits only for A2L refrigerants

Following EN 378, the minimum room area is calculated by dividing total system refrigerant charge to the toxicity limit.
For this specific system: 13.94 kg / (0,440 kg/m^3) = 31.7 m^3
Divided by a ceiling height of 2.5 m, the result is **12.7 m^2**

Conclusion

The minimum room area is **12.7 m^2** following EN 378



Frequently asked questions

Should I refer only to IEC for my installation when using VRV 5?

Yes. By designing in line with IEC 60335-2-40, (we ensure compliance) **you also meet the relevant requirements of EN 378, including checks on maximum refrigerant concentration per room. Daikin's Shîrudo Technology** further ensures that refrigerant concentration **does not exceed 230 g/m³**, equivalent to **75% of the lower flammability limit**, as defined in IEC 60335-2-40.
For comparison, a system designed strictly to the EN 378 toxicity limits could allow concentrations of up to **300 g/m³**, around **30% more refrigerant** in a worst-case leak scenario.
For aspects not covered by IEC 60335-2-40, such as the installation of outdoor units in open air, you should refer to EN 378 for guidance.

If we follow IEC only for R-32 systems, are we compliant with EN 378?

Yes. EN 378 is a general standard and, within its scope and Clause 6, **it refers directly to applicable product standards, in this case IEC 60335-2-40. Compliance with IEC 60335-2-40 therefore constitutes compliance with EN 378 for the areas covered by that product standard.**

Is an independent power supply required for the leak detection system or other safety measures?

No. Compliance with **IEC 60335-2-40, and consequently EN 378 Parts 1 and 2**, is sufficient. There is no requirement to apply EN 378-3, including provisions such as an independent power supply for the leak detection system.
EN 378 Table C.1 sets charge limits based on the toxicity limit multiplied by room volume, or as defined in Clause C.3. In practice, the applicable charge limit is always determined using the **more stringent criterion**. The toxicity limit is therefore not exceeded.
As a result, the additional safety measures described in **EN 378-3, Clause C.3**, are **not required**.
This approach aligns with established practice for **A-class refrigerants**, such as **R-410A**, where no additional safety measures are needed provided toxicity limits are not exceeded.

Daikin's unique Shîrudo Technology addresses all relevant IEC requirements, delivering compliant system design and peace of mind straight out of the box.

- No complex safety measure calculations required
- No additional installation or commissioning work
- No visual impact from extra sensors or components
- No additional work or redesign if the layout changes
- No requirement for periodic safety checks

Check out the Shîrudo Technology

What is included in Shîrudo Technology?

- Factory-integrated refrigerant control measures, designed to comply with IEC 60335-2-40 and third-party certified by a Notified Body, providing complete peace of mind

Leak detection sensor in every indoor unit

Audible & visual alarm in Madoka controller or via iTM

Shut-off valves in the outdoor unit or SV box

Specially developed algorithms

- Full project validation using our Xpress software

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