B2 TECHNOLOGY SELECTION SERIES · AIR & ENVIRONMENT

AIR CLASSIFICATION & FILTRATION GUIDE

How to specify the air in a food factory — choosing a cleanliness class per zone, setting air-change rates and the pressure cascade, selecting filter grades to ISO 16890 and EN 1822, and specifying compressed air to ISO 8573-1 where it contacts product.

VERSION 1.0 · JUL 2026 5 REFERENCE TABLES GATES: CONCEPT · HVAC DESIGN

HOW TO USE THIS GUIDE

1. Classify **by zone, not by building**. A factory rarely needs one standard throughout — the cost is in the highest class you specify, multiplied by the area you apply it to.
2. Food is not pharma. ISO 14644 is a **particle** standard; food risk is usually microbiological. Use the ISO class to specify the air system, and control microbiology through zoning, hygiene and monitoring.
3. All figures below are **typical industry references**, not requirements. Confirm against your product risk category, your customer's standard and local regulation.
4. Decide the class before the layout is frozen. Classification drives ceiling voids, air-handling plant room, riser space and door lobbies — all of which are architecture, not services.

01 WHAT ACTUALLY DECIDES THE CLASS

Product exposure, not product value

The question is narrow: **is the product open to the room, and is there a kill step after that point?** Product exposed after its last kill step — cooked product being sliced, powder being filled, a chilled dessert being decorated — sets the class for that room. Product inside closed pipework, or product that will be sterilised in its pack later, does not, however expensive it is.

Shelf life and the distribution chain

Air specification buys shelf life. A high-care area with filtered, positively-pressured, dehumidified air is what turns a 7-day chilled product into a 21-day one. Where the commercial case rests on extended shelf life, the air system is not a compliance cost — it is the mechanism delivering the margin, and it should be justified that way.

Dry versus wet, and the humidity that follows

In dry-powder plants the enemy is dust and any moisture at all; in wet processing it is condensation on cold surfaces above open product. **Specify humidity alongside cleanliness** — a beautifully filtered room that condenses on the ceiling has made the hazard worse, not better.

ENGINEER'S NOTE

The most common and most expensive error is applying one high class to a whole production hall because it is simpler to describe in a tender. The plant is then built with an air system nobody can afford to run, so it gets throttled back in year two and the classification becomes fiction. Classify tightly, and put the money where the product is open.

02 ISO 14644-1 CLASSES & WHERE FOOD USES THEM

Particle limits are the ISO 14644-1 maxima at ≥ 0.5 µm per m³ of air. The applications column is typical food practice, not part of the standard.

CLASS	≥0.5 µm / M³	TYPICAL FOOD APPLICATION
ISO 5	3 520	Rare in food. Localised unidirectional-flow protection over an aseptic filling point or an open sterile transfer, not a whole room.
ISO 6	35 200	Surround to a filling machine handling long-shelf-life chilled product; infant formula and medical-nutrition filling areas.
ISO 7	352 000	The usual **high-care** specification: post-kill-step handling, slicing and packing of ready-to-eat product, dessert assembly, powder filling.
ISO 8	3 520 000	The usual **medium-care** specification: preparation and process areas ahead of a kill step, packing of product that will be cooked by the consumer.
Unclassified	–	**Low-care / ambient:** raw-material intake, dry stores, warehousing, engineering. Controlled by filtration and pressure, not by a particle class.

03 AIR-CHANGE RATE & PRESSURE CASCADE

Typical design references. The rate that matters is the one that holds the class in operation, with people and machines in the room.

ZONE	AIR CHANGES/H	PRESSURE	TEMP / RH
High-care (ISO 7)	30–60	HIGHEST +10–15 Pa	PER PRODUCT RH TO AVOID CONDENSATION
Medium-care (ISO 8)	10–20	POSITIVE TO LOW-CARE	PROCESS-LED
Low-care / ambient	4–10	NEUTRAL	COMFORT
Wet / washdown & allergen areas	PER LOAD	NEGATIVE TO NEIGHBOURS	MOISTURE / DUST REMOVAL

CASCADE RULE: PRESSURE STEPS DOWN FROM THE CLEANEST ZONE OUTWARD · WET, DUSTY AND ALLERGEN ROOMS ARE HELD NEGATIVE SO THEIR AIR CANNOT TRAVEL

04 FILTER SELECTION

Filters are specified in stages. A final filter without adequate pre-filtration is an expensive consumable, not a design.

STAGE	TYPICAL GRADE	PURPOSE & NOTES
Pre-filter	ISO COARSE (ISO 16890)	Protects the downstream stages from insects, fibres and coarse dust. Cheap, changed often — the stage that decides the life of everything after it.
Secondary / fine	ePM10 / ePM2.5 (ISO 16890)	The working filter for medium-care areas, and the pre-filter for any HEPA stage. ISO 16890 rates by the particulate fraction actually captured, replacing the older EN 779 classes.
Fine (high-care)	ePM1 ≥ 60–80 %	Where the finest respirable fraction matters and a full HEPA stage is not justified. Often the practical high-care specification.
HEPA — terminal	H13 = 99.95 % H14 = 99.995 % (EN 1822, MPPS)	For ISO 7 and cleaner, and over localised protection. Mount terminally, and specify **in-situ leak testing of the installed filter and its seal** — an untested HEPA is an assumption.
Exhaust / dust	PER DUTY	Dust collection on tipping, sieving and dry mixing. Check explosion risk for combustible dusts and keep discharge away from fresh-air intakes.

05 COMPRESSED AIR THAT TOUCHES PRODUCT

ISO 8573-1 states purity as three digits — particles : water : oil. Specify all three, per network.

APPLICATION	WHAT TO SPECIFY
Direct product contact (blowing, conveying, filling)	Oil-free compression at source, the tightest practical oil and particle classes, and a pressure dew point below the coldest pipework temperature. Point-of-use filtration on the P&ID, with change-out in the maintenance plan.
Indirect contact (air over open product)	Treat as direct contact unless a documented risk assessment says otherwise. Air that vents into the room above open product is in contact with it.
Utility / non-contact	A separate, lower-specification network. Keep the two physically distinct, and make cross-connection impossible rather than merely prohibited.

06 WHERE CLASSIFIED AIR FAILS IN PRACTICE

The cascade is broken by doors, not by the plant

A pressure cascade holds only when every opening between zones is managed. A single door propped open for a pallet route collapses the differential across the whole suite. **Design the material and personnel routes first** — interlocked lobbies, pass-throughs, hatches — and the cascade will hold itself. Add door alarms and a differential-pressure display the operators can actually see.

"At rest" is not "in operation"

A room certified empty on a Sunday tells you very little. Specify and verify the class **in operation** — with staff, machines running and product moving — and state which occupancy state each acceptance test refers to. The recovery test (how fast the room returns to class after a disturbance) is often the more useful number in a food plant.

Filters are a maintenance commitment, not a purchase

Specify differential-pressure monitoring across each filter bank, a change-out trigger, safe access for changing (from the clean side where possible), and the spares holding. A classified area whose filters are changed when someone remembers is not classified.

Condensation undoes the whole argument

Cold surfaces above open product — chilled-water pipework, ductwork, structural steel entering a chilled room — will condense unless dew point is controlled and the surfaces are insulated and vapour-sealed. Check this at design stage against the *actual* room condition, not the design-day average.

> **ENGINEER'S NOTE**
> Ask one question at design review: **where does the air go when it leaves this room?** Extract from a high-care area that dumps into an adjoining low-care corridor, or a dust extract discharging near a fresh-air intake, will quietly undo a well-specified supply side. Draw the whole air path — supply, transfer and extract — as one diagram before the ductwork is procured.