Filter Bypass

Why installation gasketing and sealing determine air filtration performance

For facility managers, building engineers, and HVAC service professionals

Executive summary

An air filter can capture only the particles carried through its media. Air that travels around the filter, through a damaged gasket, or through openings in the bank escapes the intended filtration process. **Filter bypass reduces installed performance even when the correct filter efficiency has been selected.** EPA identifies bypass caused by poor installation as a factor that reduces filter effectiveness. [1]

Effective filtration requires correctly sized filters, continuous gaskets, compatible retaining hardware, sound holding frames, and sealed bank connections. This paper recommends treating conventional disposable foam and closed-cell neoprene compression gaskets as **one-filter-lifecycle service items**. Where the equipment design permits, apply the gasket to the replaceable filter so each change provides fresh sealing material.

How bypass occurs

A filter bank separates contaminated upstream air from filtered downstream air. Every unintended opening across that boundary creates a parallel airflow path. Air follows the path of least resistance: flow divides between the media and leakage paths according to their resistance under the operating pressure difference.

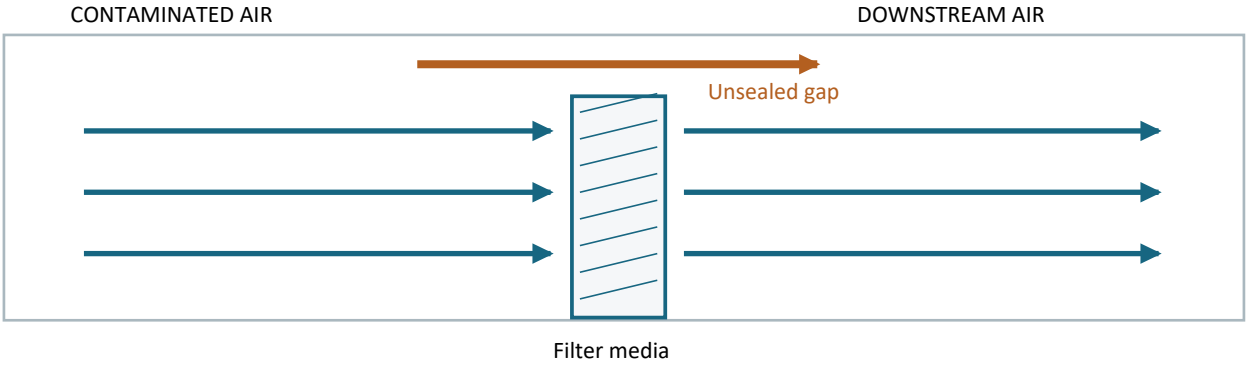


Figure 1 A gap creates a parallel path around the filter. Conceptual illustration; arrows do not represent measured airflow.

Common leakage points include missing or damaged gaskets, incorrect clips, joints between slide-track filters, frame and stiffener joints, bank perimeters, vacant positions, and access doors. A higher filter rating cannot compensate for these openings. Leakage may change as filters load; open face area is not automatically equal to bypass airflow percentage.

Gasketing and the filter lifecycle

The gasket closes the filter-to-frame interface. It must accommodate surface variation while maintaining continuous contact. Correct material, thickness, width, placement, and compression all matter. Too little compression leaves gaps; excessive compression can damage the gasket or distort the filter frame. Corners and splices need particular attention.

Foam and closed-cell neoprene can seal effectively when correctly selected and compressed. Closed-cell construction does not prevent permanent deformation. **Compression set**, or loss of recovery after prolonged compression, can reduce sealing ability after an assembly is opened and closed. Performance depends on material properties and application conditions. [2]

A practical one lifecycle replacement policy

Install a fresh gasket with every new filter, and apply the gasket to the filter rather than the holding frame wherever the equipment design permits. This is a preventive maintenance recommendation, not a claim that every gasket material fails at the same interval.

Filter-mounted gasketing makes the seal part of the replaceable assembly. Removing the used filter also removes its compressed and potentially deteriorated gasket. Specify factory-applied gasketing where available. For approved field application, attach compatible material to the designated sealing face, close corner joints, and verify uniform compression against the holding flange.

The AMF drawing illustrates a 3/4-inch sealing flange with 1/4-inch-thick by 3/4-inch-wide closed-cell neoprene or open-cell gasketing. These dimensions describe that assembly, not a universal gasket size. The drawing shows frame-mounted gasketing; conversion to filter-mounted material requires confirmation of fit, clip engagement, and compression. [9, p. 1]

For a compatible conversion, remove deteriorated frame gasketing and adhesive and clean the flange. Do not double the gasket layers unless the assembly is designed for it. A flattened, hardened, torn, detached, or nonrecovering frame gasket is not restored by installing a new filter. Replacement-filter dimensional differences can expose additional gaps.

The risk of installing filters without gaskets

An assembly designed for a compression seal can leak if the gasket is omitted, even when the filter appears snug. Clips provide seating force but cannot replace the required gasket's conformability. Additional clip force may deform an ungasketed frame without producing a continuous seal.

Consequences include higher downstream particle counts, reduced contaminant removal, and downstream equipment contamination. Small leakage paths are particularly significant with high-efficiency filtration. Assemblies designed for another sealing method must retain that specified method.

A filter change is incomplete until an effective seal has been established around the new filter.

Match clips to the complete assembly

Clips must maintain gasket contact, not merely prevent the filter from falling out. Select hardware for filter depth, header construction, holding-frame design, service access, and the complete filter combination. The supplied SCF and manufacturer charts give the following application-specific examples. [6-8]

Filter arrangement	Clip guidance for listed compatible assemblies
Standalone 1 or 2 inch panel in Type 8 frame	C-70; position changes with filter depth.
Single header bag pocket or rigid filter	C-70 engages the rigid header.
Standalone 4 inch panel in Type 8 frame	C-86 or C-77, depending on model and access.
Single header final plus 2 inch prefilter	Two C-70 clips for final; two C-86 or C-77 for prefilter at opposite corners.
Single header final plus 4 inch prefilter	C-70 and C-89 arrangement for listed applications.
12 inch box or double header filter	C-80 or C-83, depending on frame and filter.
Prefilter on compatible nonheadered final	C-79-1 for listed 2 inch; C-79-2 for listed 4 inch applications.
Other frames or combined depths	Appropriate C-78 depth variant or other specified hardware.

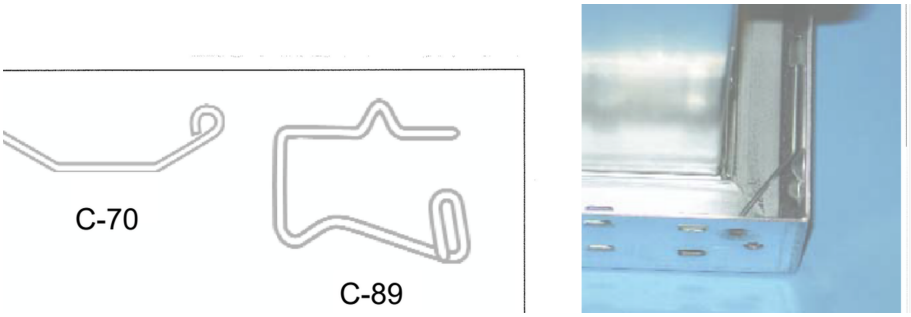


Figure 2 C-70 and C-89 hardware (left) and a C-70 installation photograph (right). Sources: C-70 and C-89 Installation, p. 1; SCF Filter Clips and Instructions, p. 3. Assembly-specific examples.

Install clips in the designated lances before inserting filters. Use every specified retaining point. The supplied Camfil tables generally specify four fasteners per filter; the AAF material recommends four latches per frame. Combination assemblies may distribute different clip types among these points.

Replacement examples are C-70 / 050025-000, C-86 / 074437-000, and C-89 / 078865-000. The AAF chart lists 315-004-000 for the stated C-86 applications and 315-004-006 for the stated C-89 applications. Verify material, frame, filter, and access before ordering. Replace bent, corroded, weakened, or missing hardware. [8]

Seal slide tracks and the entire bank

Tape adjoining pleated filter frames

Pleated filters installed side by side in a conventional slide track should be taped together at adjoining frame edges to prevent bypass, where compatible with housing service instructions. Pushing filters together does not ensure an airtight joint; tolerances, clearance, and movement can leave openings.

Apply suitable HVAC sealing tape continuously over each adjoining frame joint, with adequate adhesion to both frames. Keep tape off the media and select material compatible with temperature, humidity, and frame surfaces. Renew tape at every change. Where the housing provides a purpose-designed interfilter seal, follow that method.

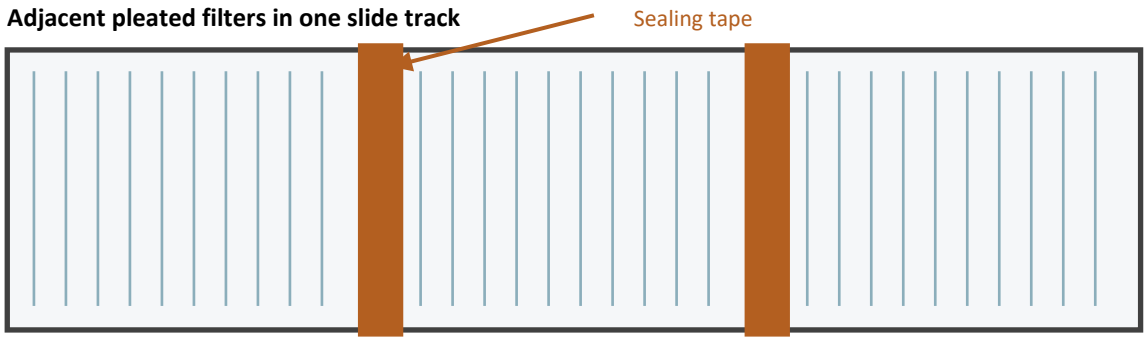


Figure 3 Tape bridges the joints between adjoining filter frames without covering media. Conceptual front view; actual track geometry varies.

Taping addresses filter-to-filter joints. Track perimeters, end stops, and access-door interfaces also require effective seals.

Close every unintended path through the bank

Frame gasketing addresses only one leakage path. Frame joints, stiffeners, perimeter closures, and enclosure connections must form a continuous barrier. Manufacturer guidance requires suitable gaskets or sealant at frame joints and duct integrations. [3]

The AMF packet details cleaning mating surfaces, applying **two continuous sealant beads to mating flanges, one on each side of the mounting-hole line**, aligning and clamping frames before fastening, and sealing frame-to-stiffener interfaces. [9, pp. 2-3]

It also details perimeter flashing with seals at both the frame-to-flashing and flashing-to-plenum interfaces. Screws and bolts join components mechanically; the joints still require sealing. **All unintended openings connecting upstream and downstream sides must be closed.** Use supported sheet-metal closures or blank-off panels for larger openings.

Frame assembly and perimeter sealing

The installation sequence below shows sealant placement at mating flanges, frame alignment and fastening, stiffener integration, and bank placement in the plenum. Use the approved project detail for the actual frame assembly.

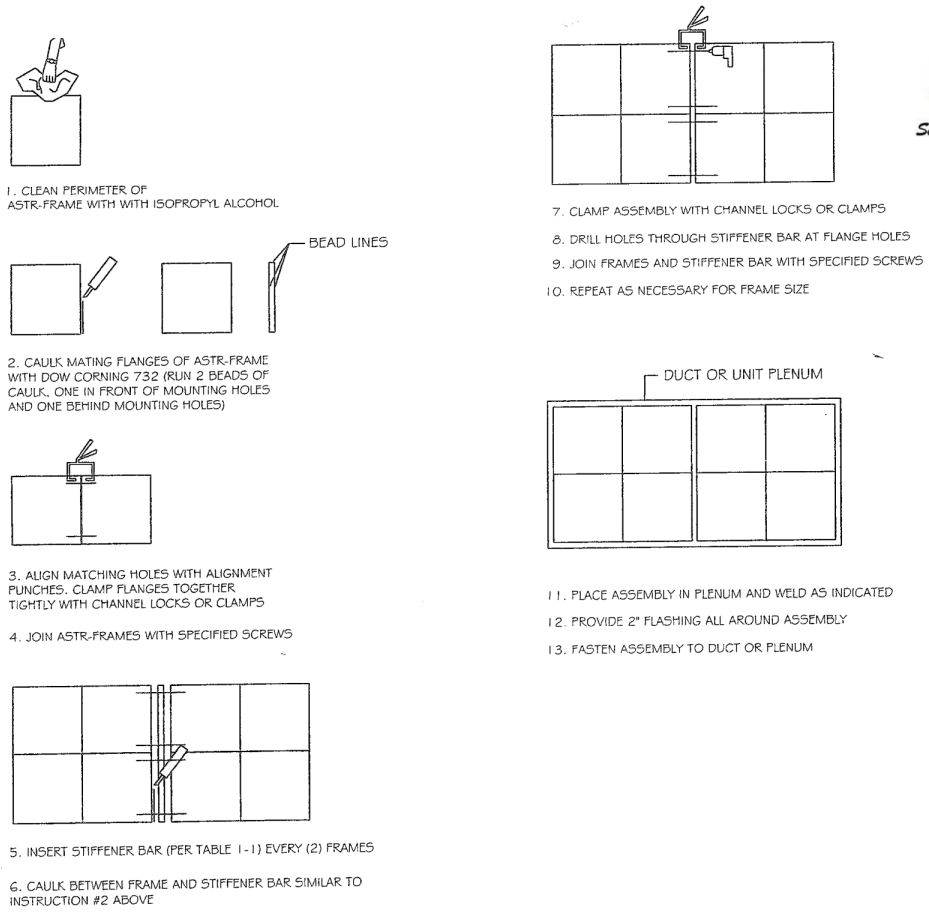


Figure 4 Frame-bank assembly sequence from the AMF Holding Frame Submittal Packet 2024, p. 2. The detailed drawing on p. 3 states not to weld ASTR-frames; confirm the approved attachment method before fabrication.

Structural support protects sealing contact

Inspect alignment, loose connections, damaged flanges, and unsupported sections that can interrupt gasket contact. The AMF detail calls for stiffeners between every other column on banks four filters high by three filters wide and larger, with stiffener depth selected by bank height. It also shows 2-inch perimeter flashing. These requirements apply to the illustrated assembly; other frames may differ. [9, p. 3]

Dow 732 application and curing

DOWSIL 732 Multi-Purpose Sealant, commonly called Dow 732, is recommended for compatible permanent filter-bank joints. The AMF packet specifies Dow Corning 732 at mating flanges and 732 or equivalent at frame-to-stiffener joints. Dow describes a one-part, moisture-curing, acetoxy silicone that cures to flexible rubber. [4, 9]

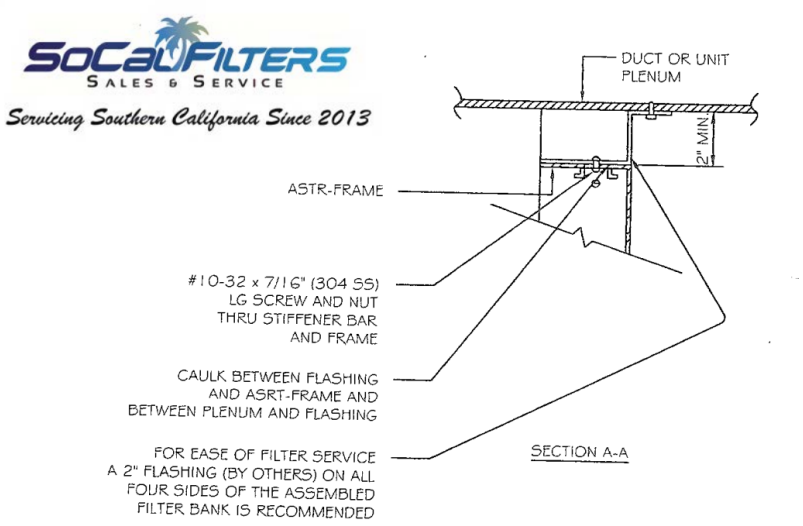


Figure 5 AMF perimeter flashing section shows seals between the frame and flashing and between the flashing and plenum. Source: Holding Frame Submittal Packet 2024, p. 3. Detail applies to that assembly.

Surface preparation. Surfaces must be clean and dry. Remove contaminants that impair adhesion and verify compatibility with metals, coatings, plastics, and cleaning products.

Cure depth. The included technical sheet reports about 3 mm of cure depth in 24 hours at room temperature and 50% relative humidity. Deeper sections, restricted moisture access, and lower humidity extend cure time. A tack-free surface does not establish complete cure. [9, p. 6]

Compatibility. Acetic acid released during curing can cause corrosion on some metallic parts or substrates, especially where curing by-products cannot escape. Verify suitability and use an approved compatible alternative where required. [9, p. 7]

Apply continuous beads and allow sufficient curing for the actual joint and conditions before service loading. The included sheet does not represent the product as suitable for medical or pharmaceutical uses; general industrial use does not establish specialized application qualification. Preserve filter access, drainage, and other intended equipment functions.

How bypass changes particle counts

Assume filter efficiency **E** in one particle-size range, bypass airflow fraction **b**, and equal particle concentrations entering the filter and bypass paths. With complete downstream mixing and no additional particle sources:

Installed efficiency = (1 - b) x E
Downstream concentration = upstream concentration x [b + (1 - b)(1 - E)]

The calculated examples below assume **100,000 upstream particles per cubic foot in the selected size range**. They are illustrations, not field measurements.

Filter efficiency	Bypass airflow	Installed efficiency	Downstream particles/ft3
90%	0%	90%	10,000
90%	5%	85.5%	14,500
90%	10%	81%	19,000
99.97%	0%	99.97%	30
99.97%	1%	98.9703%	About 1,030

For the 90%-efficient filter, 5% bypass increases downstream counts by **45%**. For the 99.97%-efficient filter, 1% bypass produces about **34 times** the count of the sealed condition. As media efficiency increases, leakage can dominate particle penetration.

These calculations do not establish a new MERV rating. A single assumed efficiency cannot represent performance across all particle sizes.

Practical effects on indoor air quality

Outdoor smoke and fine particles. Bypass allows contaminated intake air to avoid filtration, reducing the benefit of a filter upgrade. EPA's commercial-building smoke guidance identifies bypass as an issue requiring attention. [5]

Dust and particle-associated allergens. Untaped joints, missing gaskets, and unsealed bank connections can admit particles the media would otherwise capture. EPA advises preventing bypass through gaps around filter holders. [10]

Controlled environments. A small leak can overwhelm expected downstream cleanliness. Room counts also depend on particle generation, ventilation, deposition, and air distribution. Filter-bank measurements therefore do not directly predict occupied-room concentrations.

Installation and verification

1. Confirm filter dimensions, airflow direction, sealing face, and hardware compatibility.

2. Inspect frame alignment, fastening, stiffeners, and perimeter flashing.

3. Clean sealing surfaces and install fresh filter-mounted gasketing where compatible.

4. Install specified clips in the correct positions before inserting filters.

5. Seat filters, engage all retainers, and verify continuous gasket contact.

6. Tape adjoining pleated-filter frames in conventional slide tracks where appropriate.

7. Inspect and seal frame joints, stiffener interfaces, perimeter closures, and blank-off panels.

8. Verify access-door seals and allow newly applied sealant sufficient curing time.

9. Restore operation and record airflow and differential pressure.

10. Where warranted, compare representative upstream and downstream particle counts using consistent size channels.

Differential pressure alone does not prove sealing integrity. Critical HEPA applications require the installed leakage-testing procedure specified for the facility and housing.

Every filter replacement must restore both the filtration media and the integrity of the airflow boundary. Fresh gasketing, compatible clips, sealed slide-track joints, and a properly supported and sealed bank allow filters to deliver their intended performance.

Technical basis

The one-lifecycle gasket policy, preference for filter-mounted gasketing, and conventional slide-track taping guidance are recommendations in this paper. Manufacturer dimensions, clip arrangements, assembly details, and cure data apply to their identified products and configurations. Refer to the current approved equipment and product instructions when implementing them.

References and figure sources

[1] US Environmental Protection Agency. Residential Air Cleaners A Technical Summary. Third edition, July 2018. View source.

[2] Rogers Corporation. Technical Sealing Guide. Material selection, gasket compression, and sealing performance. View source.

[3] Camfil. Universal Filter Holding Frame Installation Manual. Joint sealing and filter retention guidance. View source.

[4] Dow. DOWSIL 732 Multi-Purpose Sealant product information. View source.

[5] US Environmental Protection Agency. Best Practices Guide for Improving Indoor Air Quality in Commercial and Public Buildings During Wildland Fire Smoke Events. View source.

[6] SoCal Filters and Service. SCF Filter Clips & Instructions.pdf. Four-page supplied reference; clip chart and installation drawings.

[7] SoCal Filters and Service. C-70 & C-89 Installation.pdf. One-page supplied installation drawing and photographs. Figure 2 combines clip illustrations from this sheet with the C-70 photograph from reference 6, p. 3.

[8] SoCal Filters and Service. Filter Clip PN Cross Reference - SCF-Camfill Farr-AAF-Koch.pdf. Nine-page supplied compilation; Camfil application charts pp. 4-5, AAF pp. 6-7, and Koch p. 9.

[9] AMF and SoCal Filters and Service. Holding Frame Submittal Packet 2024.pdf. Eight-page supplied packet: frame construction p. 1; assembly p. 2; perimeter and stiffener details p. 3; clip chart p. 4; Dow technical data pp. 5-8. Figures 4 and 5 reproduced from pp. 2 and 3. Included Dow sheet: Form 95-1059-01-0421 S2D, copyright 2017-2021.

[10] US Environmental Protection Agency. Should You Have the Air Ducts in Your Home Cleaned. Preventing duct contamination; archived page. View source.

Illustrations

Figures 1 and 3 are explanatory schematics created for this paper. They are not installation drawings. Source photographs and technical details retain their original product context. Numerical examples are calculated from the assumptions stated on page 7.