

# SFS-24 — Structural Framework for Join Semantics

## **24-Cell Structural Architecture Standard**

**Version 1.0 — 2025 Author: Usman Zafar**

## **1. Purpose**

SFS-24 defines the **structural semantics** of relational joins. It establishes the preservation guarantees, NULL propagation rules, collapse boundaries, and structural invariants that govern join behavior across analytical, operational, and ETL/ELT systems.

This standard ensures that join logic remains:

- predictable
- reproducible
- auditable
- structurally correct

SFS-24 is the structural counterpart to **JFS-24**, which governs filter safety.

## **2. Scope**

SFS-24 applies to:

- data warehouses and lake houses
- ETL/ELT pipelines
- BI semantic layers

- dimensional modeling
- fact table construction
- SQL governance and code review

It covers the structural behavior of:

- INNER JOIN
- LEFT JOIN
- RIGHT JOIN
- FULL JOIN
- CROSS JOIN
- SELF JOIN

## 3. Structural Principles

### 3.1 Joins as Preservation Contracts

Each join type defines a **contract** specifying which rows must be preserved.

Join Type	Preservation Contract
INNER	Preserve matched rows only
LEFT	Preserve all LEFT rows
RIGHT	Preserve all RIGHT rows
FULL	Preserve all rows from both sides
CROSS	Preserve Cartesian product
SELF	Preserve INNER semantics

## Architectural Principle:

A join is not an operation. A join is a contract.

### 3.2 NULL as a Structural Signal

NULLs produced by joins are not values — they are **structural indicators** representing:

- missing relationships
- incomplete dimensions
- orphaned facts
- preservation boundaries

NULL propagation determines:

- referential integrity
- dimensional completeness
- fact table grain correctness
- outer join stability

NULL behavior is a **first class architectural concern**.

### 3.3 Structural Invariants

SFS-24 defines the following invariants:

1. **Preservation is mandatory** A join must preserve the rows defined by its contract.
2. **NULLs must survive on the preserved side** Eliminating NULL extended rows collapses the join.

3. **Join semantics must remain stable** A LEFT JOIN must remain a LEFT JOIN unless explicitly changed.
4. **Matching and elimination must remain separate phases** (Matching = ON, Elimination = WHERE)

These invariants form the backbone of SFS-24.

## 4. NULL Propagation Architecture

### 4.1 LEFT JOIN

- Preserves LEFT rows
- Produces NULLs on RIGHT side

### 4.2 RIGHT JOIN

- Preserves RIGHT rows
- Produces NULLs on LEFT side

### 4.3 FULL JOIN

- Preserves both sides
- Produces NULLs on both sides

### 4.4 INNER JOIN

- Produces no structural NULLs
- Eliminates unmatched rows

### 4.5 CROSS JOIN

- Produces no structural NULLs

- No matching condition

NULL propagation is the **structural signature** of each join type.

## 5. Collapse Conditions (Outer → Inner)

A join collapses when its NULL extended rows are eliminated.

### 5.1 LEFT JOIN Collapse

Occurs when RIGHT side NULLs are removed.

### 5.2 RIGHT JOIN Collapse

Occurs when LEFT side NULLs are removed.

### 5.3 FULL JOIN Collapse

Can collapse into:

- LEFT JOIN
- RIGHT JOIN
- INNER JOIN

depending on which side's NULLs are eliminated.

### 5.4 CROSS JOIN Collapse

Occurs when an ON condition is introduced.

**Collapse is a semantic failure mode.**

## 6. The 24-Cell Structural Matrix

SFS-24 classifies join side  $\times$  filter side  $\times$  phase interactions into:

- SAFE
- COLLAPSE
- INVALID
- NEUTRAL

Code

JOIN TYPE	LEFT WHERE	LEFT ON	RIGHT WHERE	RIGHT ON
INNER	SAFE	SAFE	SAFE	SAFE
LEFT	SAFE	SAFE	COLLAPSE	SAFE
RIGHT	COLLAPSE	SAFE	SAFE	SAFE
FULL	COLLAPSE	SAFE	COLLAPSE	SAFE
CROSS	SAFE	INVALID	SAFE	INVALID
SELF	SAFE	SAFE	SAFE	SAFE

This matrix is the **structural topology** of join semantics.

## 7. The 48-Cell Semantic Structural Matrix

The full 48-cell matrix extends the structural matrix by incorporating:

- filter type (EQ, NE, GT, IS NULL, IS NOT NULL)
- filter placement (ON vs WHERE)
- join type
- preserved side
- NULL producing side

This matrix is the **authoritative reference** for structural correctness.

See: docs/30-unified-architecture/semantic-structural-48-cell-matrix.md

## 8. Structural Doctrine

SFS-24 establishes the following doctrine:

- Joins are preservation contracts
- NULLs are structural signals
- Collapse is a semantic failure mode
- ON defines matching
- WHERE defines elimination
- Preservation must never be violated

This doctrine elevates join reasoning to the level of **enterprise architecture**.

## 9. Compliance Requirements

To comply with SFS-24:

- Do not eliminate NULL extended rows on the preserved side
- Do not introduce ON conditions into CROSS JOINS
- Do not rely on implicit join behavior
- Validate all joins against the structural matrix
- Document preservation intent in design artifacts

## 10. Relationship to JFS-24

SFS-24 defines **what the join must preserve**. JFS-24 defines **how filters must behave to preserve it**.

Together, they form the **Enterprise Join Semantics Architecture Suite**.

JFS-24 Standard: [docs/20-jfs24-filter-safety/jfs24-standard.md](#)

## 11. Versioning

SFS-24 follows semantic versioning:

- **Major** — structural changes
- **Minor** — new invariants or matrices
- **Patch** — clarifications or examples

See: [docs/90-legal-and-metadata/versioning-and-changelog.md](#)

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