AUTOMATIC FIRE SUPPRESSION SYSTEM
FOR ELECTRICAL CABINETS & ENCLOSED HAZARD AREAS

Thermal-Detection Tube — Direct Discharge

Clean Agent (CO_2) · Self-Contained · No External Power Required

Introduction

Safeco Group's Electrical Cabinet Fire Suppression System is a compact, self-contained automatic fire extinguishing unit designed for the protection of enclosed electrical and electronic hazard areas including switchgear panels, MCC cabinets, control rooms, server enclosures, and similar installations.

The system operates on the principle of **linear thermal-detection tubing** acting simultaneously as both the fire detection element and the extinguishing agent delivery conduit. Upon flame impingement or sufficiently rapid heat rise, the tubing wall softens and ruptures at the hottest point, triggering an immediate **direct discharge** of extinguishing agent through the burst aperture to the fire source — without any requirement for electrical actuation, external power supply, or control panel.

The system is supplied pre-charged, factory-assembled, and ready for installation, substantially reducing engineering and commissioning complexity on-site.



System Description & Operating Principle

Detection Mechanism

The **thermal-detection tube** (⌀ 6 mm outer diameter polymer tube) is routed throughout the protected enclosure, following the hazard area contours and all risk zones. The tube is maintained under internal gauge pressure.

The tube material is a specially formulated **modified Polyamide (PA)** with precisely engineered thermal softening characteristics. When exposed to fire or heat, the tube wall softens and bursts at the point of highest temperature — reliably before structural components of the protected enclosure are damaged.

Operating Sequence

1. Fire ignites inside the protected enclosure.
2. Detection tube ruptures at the hottest point.
3. Internal tube pressure drops; cylinder valve opens pneumatically.
4. Extinguishing agent discharges through the burst aperture directly onto the fire.
5. System remains discharged; low-pressure signal generator (optional) activates external alarm/indication.

Discharge Modes

Direct (DLP) System	Indirect System
Agent discharges directly through the burst hole in the detection tube. Best suited for single enclosed cabinets.	Agent is delivered through separate discharge pipework and nozzles aimed at the hazard zone. Tube burst triggers valve opening only.

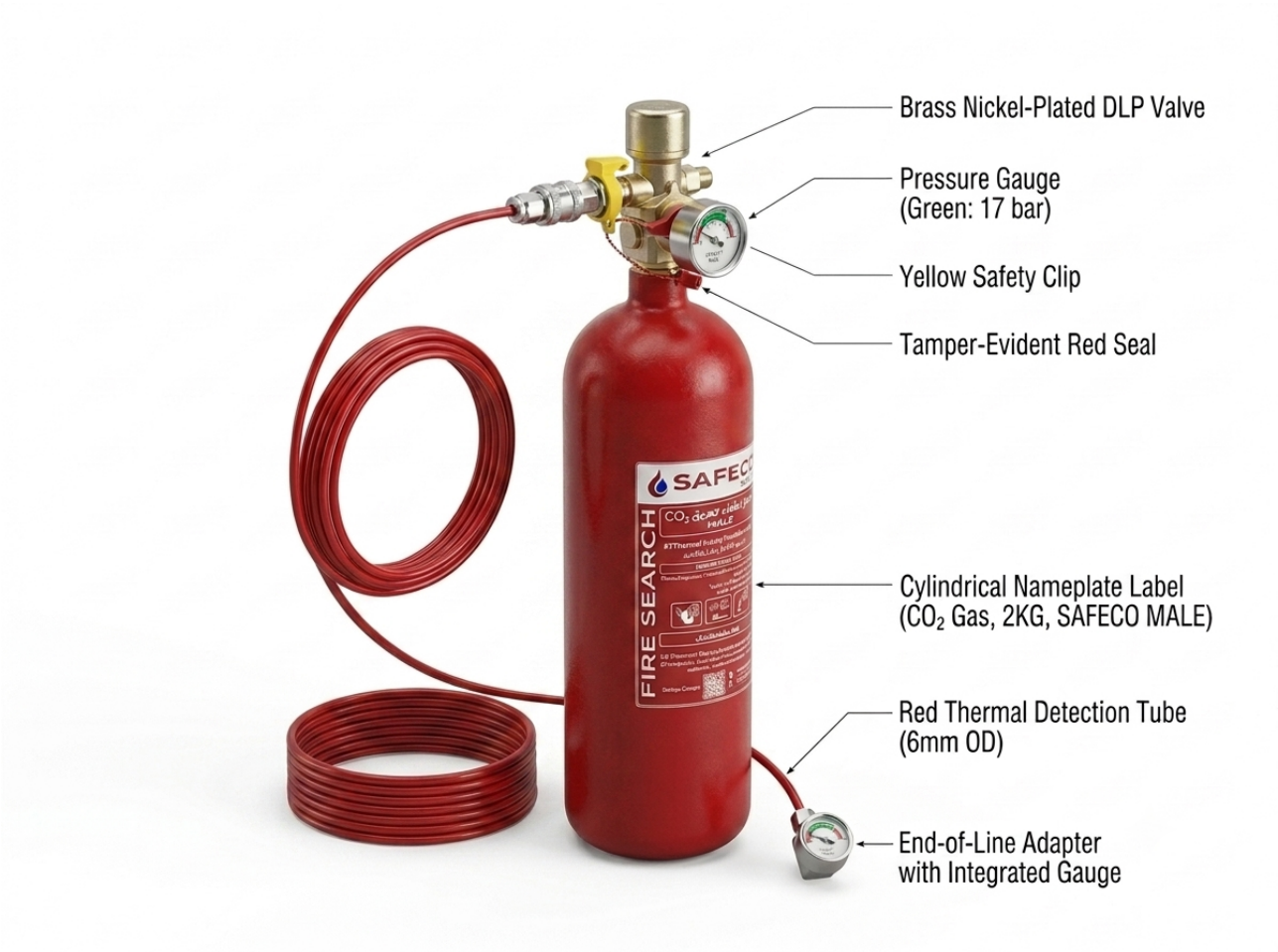
System Components

Standard Assembly

Included in Standard Supply

1. Pressure cylinder (pre-charged with extinguishing agent)
2. DLP cylinder valve (pneumatically operated)
3. Ball valve (for safe service isolation)
4. Pressure gauge (0 bar to 27 bar range, green/red zone indicator)
5. Thermal-detection tube with red quick-connector (⌀ 6 mm)
6. End-of-line adapter with integrated pressure gauge
7. Safety clip (valve open/closed position indicator)
8. Tamper seal (red)
9. Cylinder mounting bracket and clamps (CrNi steel)
10. Factory nameplate and cylinder label

Optional Equipment: Low-Pressure Signal Generator (LPSG) — SPDT microswitch, volt-free contact, IP65, rated 5 A at 250 V AC, switch point at 5 bar falling pressure. Enables external alarm integration without active electrical monitoring of the system under normal conditions.



Detection Tube Specifications

Parameter	Value / Description
Material	Modified Polyamide (PA), special thermal formulation
Dimensions	4 mm inner × 6 mm outer diameter
Configuration	Single-layer (standard)
Colour	Red
Optimal operating temperature	−20 °C to 65 °C (long-term use)
Minimum installation temperature	10 °C
Minimum bending radius	100 mm
Tube mounting spacing	Maximum 400 mm between supports
Tube burst temperature	≥ 96 °C at working pressure
Burst pressure	120 bar at ±20 °C (without flame)
Working pressure (optimal)	17 bar
Working pressure (maximum)	28 bar
Reel length	100 m per reel
Service life (indicative)	5–7 years under normal climatic conditions

Extinguishing Agents

The system is available with CO_2 and clean-agent fill is optional. Both agents are electrically non-conductive and leave no residue, making them suitable for sensitive electrical and electronic equipment.

Property	CO_2
Extinguishing mechanism	Oxygen dilution + cooling
Ozone depletion potential	Zero
Electrically conductive	No
Residue after discharge	None
Suitability for occupied spaces	Requires evacuation (asphyxiation risk)*
Post-discharge cabinet entry	Only after ventilation
Working cylinder pressure	17 bar (liquefied)
Cylinder color code	Red with white data

Carbon dioxide at suppression concentrations is lethal. When CO_2 systems are installed in or adjacent to normally-occupied spaces, appropriate safety measures including warning signs, pre-discharge alarms, and personnel exclusion procedures **must** be implemented in accordance with applicable local civil defence and safety regulations.

Cylinder Variants & Protected Enclosure Volumes

CO_2 Fill Variants

Part No.	Agent Fill	Work Press.	Tube Length
SAF-C-02	2 kg CO_2	17 bar	4 m
SAF-C-06	6 kg CO_2	17 bar	6 m
SAF-C-10	10 kg CO_2	17 bar	10 m

Key Features & Advantages

- **Fully self-contained** — no external power source required under any operating condition, including mains failure
- **No control panel required** — significantly reduces system cost and installation complexity
- **Pneumatic actuation** — eliminates dependence on electrical detection circuits, solenoids, or batteries
- **Flexible detection routing** — tube can reach locations inaccessible to conventional point detectors
- **Fast response** — especially effective in small enclosed volumes where heat build-up is rapid
- **Minimal false-discharge risk** — reliable thermal threshold of tube material virtually eliminates inadvertent activation
- **Harsh-environment capable** — detection tubing resistant to oils, hydraulic fluids, and many industrial solvents (see chemical resistance data)
- **Simple installation** — push-fit tube connectors, pre-charged cylinder, wall bracket included
- **Optional monitoring** — low-pressure signal generator enables integration with building management or fire alarm systems

Typical Applications

Electrical & Electronic	Industrial & Infrastructure
Medium/low-voltage switchgear cabinets	Hydraulic power unit enclosures
Motor control centres (MCC)	Compressor and pump control panels
Server racks and UPS rooms	CNC machine electrical compartments
Telecommunications equipment rooms	Generator control panels
PLC and SCADA control cabinets	Transformer and rectifier cubicles
Data centre sub-floor zones	Vehicle and mobile equipment engine bays



Installation Guidelines

Qualified Personnel Only. Installation, commissioning, and maintenance of this system must be performed by trained and authorised personnel. Mishandling of pressurised components can cause serious injury or death.

Detection Tube Routing

- Route the detection tube throughout the entire hazard zone, ensuring all risk areas are covered. The tube must be the **first element to be destroyed** by fire, before any structural component of the enclosure.
- Maintain a minimum bending radius of **100 mm**.
- Secure tube to cabinet surfaces using tube mounting clips at intervals not exceeding **400 mm**, with an additional clip at the apex of each bend radius.
- Do **not** route the tube adjacent to sharp edges; use through-panel rubber grommets at all panel penetrations.
- Install at ambient temperatures **above 10 °C** to ensure tube flexibility during routing.
- Damaged areas exhibiting stress whitening (bright discolouration at kinks) must result in **replacement of the complete tube** — partial section replacement is not acceptable.

Tube End Connections

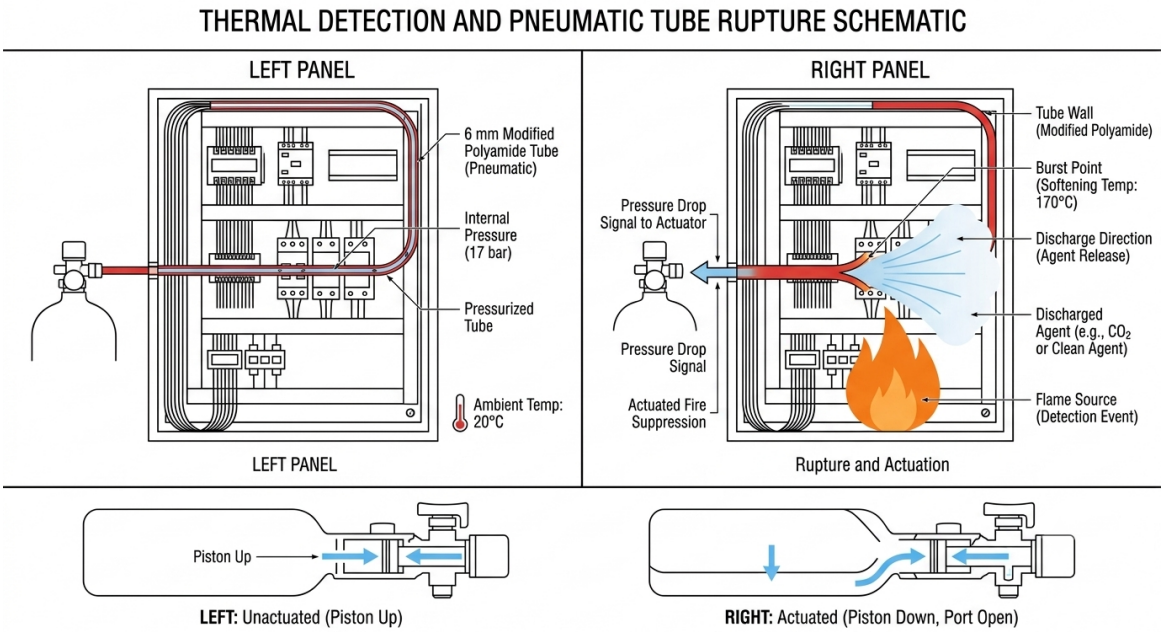
- Cut tube ends **square and clean** using the dedicated tube scissors (part no. FLD 4000781 equivalent). No debris or swarf permitted.
- Deburr cut ends before insertion into push-fit connectors.
- Insert tube by hand until a well-defined mechanical stop is felt; confirm by gently pulling the tube — it must not withdraw.
- Maximum angular discrepancy at connection entry: **5°**.
- Use **only** Safeco Group approved tube connectors. Incompatible third-party fittings will void the warranty and may cause system failure.

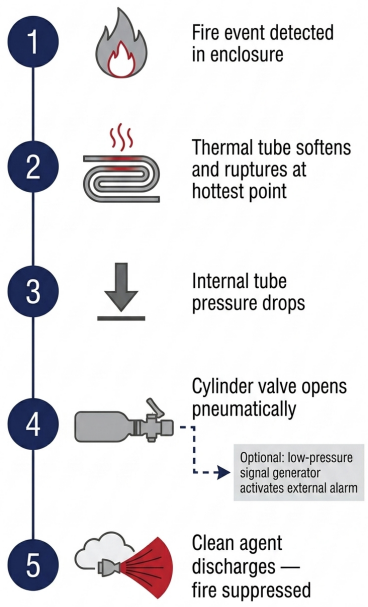
Cylinder Mounting

- Mount the cylinder vertically using the supplied wall bracket and CrNi stainless steel band clamps.
- Select the correct bracket and clamp set for the cylinder capacity being installed — refer to product code table in Section 5.
- Ensure the cylinder is accessible for periodic inspection and replacement.

Low-Pressure Signal Generator (Optional)

System Operation — Schematic





Technical Specifications — Summary

Parameter	Specification
System type	Direct low-pressure (DLP), pneumatically actuated
Detection principle	Linear thermal tube — no electrical detection
External power required	None
Control panel required	None
Extinguishing agents	CO_2 or HFC-227ea (FM-200)
Cylinder working pressure	17 bar (optimal)
Detection tube OD	6 mm
Tube material	Modified Polyamide (PA)
Tube burst temperature	$\geq$ 96 °C
Operating temperature (system)	−20 °C to 60 °C
Pressure gauge range	0 bar to 27 bar
LPSG switch point	5 bar falling pressure
LPSG protection class	IP65
LPSG contact rating	5 A at 250 V AC, SPDT
Valve body material	Brass, nickel-plated
Valve seals	NBR hybrid seal
Cylinder material	Seamless steel
Cylinder finish	Red polyester electrostatic paint
Cylinder mounting	Vertical, wall-bracket with CrNi band clamps
Detection tube service life	5–7 years (indicative, normal conditions)
Warranty	2 years from date of delivery, manufacturing defects

Maintenance & Inspection

Recommended Inspection Intervals

Interval	Action
Monthly (visual)	Check cylinder pressure gauge — pointer must be in green zone. Check detection tube for visible damage, kinks, discolouration, or stress whitening. Verify safety clip and tamper seal intact.
Annually (technical)	Full inspection by qualified personnel. Check tube condition, connector integrity, cylinder weight/pressure, and valve function. Replace detection tube if any sign of deterioration is observed.
Every 5–7 years	Replace the complete detection tube assembly as a preventative measure, regardless of visual condition.
After discharge	Do not re-enter enclosed space (CO_2) until fully ventilated. Contact Safeco Group for cylinder refilling and system re-commissioning. Replace detection tube in full.

Detection Tube Replacement

When replacement is required, the **complete detection tube** must be replaced. Partial section replacement is not acceptable, as sections not visibly damaged may already have sustained degradation that compromises burst integrity.

All replacement tubes and connectors must be genuine Safeco Group parts. Substitution with commercially available polyamide tubing is strictly prohibited — standard commercial PA tube does not possess the required thermal characteristics, gas permeability, or pressure stability for this application.

Detection Tube — Chemical Resistance Summary

The modified Polyamide tube base material is resistant to a wide range of substances commonly found in industrial environments, including organic solvents, benzines, mineral oils, hydraulic oils, fats, and alkaline solutions.

Substances causing degradation (avoid contact):

- Strong mineral acids: sulfuric acid, nitric acid, hydrochloric acid (concentrated forms) — rapid hydrolytic degradation
- Formic acid (concentrated)
- Cresol, hexafluoroisopropanol, trifluoroacetic acid — may dissolve PA
- Methanolic calcium chloride solution
- Zinc-coated surfaces (contact corrosion risk — see Section 3)

For a full chemical resistance table covering 100+ substances, refer to the Safeco Group engineering reference file SG-FP-CR-001, available upon request.

Applicable Standards & References

- **NFPA 12** — Standard on Carbon Dioxide Extinguishing Systems
- **NFPA 2001** — Standard on Clean Agent Fire Extinguishing Systems
- **NFPA 10** — Standard for Portable Fire Extinguishers (for reference)
- **EN 3-8 / PED 2014/68/EU** — Pressure Equipment Directive (cylinder construction compliance)
- **Egyptian Standard ES 6115/2007** — Fire extinguishing equipment, capacities 3–10 kg
- **ISO 9001:2015** — Quality Management System (manufacturing partner)
- **ISO 14001:2015** — Environmental Management System
- **ISO 45001:2018** — Occupational Health and Safety Management System
- **Egyptian Civil Protection Regulations** — Ministry of Interior, General Administration of Civil Protection

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