



CEASEFIRE- MINI FK- 5-1-12

Handbook of Design, Installation, Operation and System Maintenance

Self-activated CEASEFIRE MINI fire detection & suppression system





**Handbook of design, installation, operation and system maintenance of
CEASEFIRE – MINI FK-5-1-12**

CEASEFIRE INDUSTRIES LIMITED

E-6, Selaqui Industrial Area, Dehradun- 248197, Uttarakhand, India
Board No : 18001203473, 9540666666

Doc. No.: CF/CA-MINI/MAN/002

Date: 10.09.2021

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Rev. 0A

Model No.s :

CF-001339A	Mini Intutive 57°C Automatic Fire Ext (FK-5-1-12) -100 Gm SS SP Red
CF-001340AA	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -100 Gm SS SP Red with 50mm barel
CF-001340AB	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -100 Gm SS SP Red with 100mm barel
CF-001340AC	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -100 Gm SS SP Red with 200mm barel.
CF-001341A	Mini Intutive 57° Automatic Fire Ext (FK-5-1-12) -200 Gm SS SP Red
CF-001342AA	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -200 Gm SS SP Red with 50mm barel.
CF-001342AB	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -200 Gm SS SP Red with 100mm barel.
CF-001342AC	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -200 Gm SS SP Red with 200mm barel.
CF-001343A	Mini Intutive 57°C Automatic Fire Ext (FK-5-1-12) -300 Gm SS SP Red
CF-001344AA	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -300 Gm SS SP Red with 50mm barel.
CF-001344AB	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -300 Gm SS SP Red with 100mm barel.
CF-001344AC	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -300 Gm SS SP Red with 200mm barel.
CF-001345A	Mini Intutive 57°C Automatic Fire Ext (FK-5-1-12) -400 Gm SS SP Red
CF-001346AA	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -400 Gm SS SP Red with 50mm barel.
CF-001346AB	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -400 Gm SS SP Red with 100mm barel.
CF-001346AC	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -400 Gm SS SP Red with 200mm barel.
CF-001347A	Mini Intutive 57°C Automatic Fire Ext (FK-5-1-12) -500 Gm SS SP Red
CF-001348AA	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -500 Gm SS SP Red with 50mm barel
CF-001348AB	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -500 Gm SS SP Red with 100mm barel.
CF-001348AC	Mini Adaptive 57°C Automatic Fire Ext (FK-5-1-12) -500 Gm SS SP Red with 200mm barel.



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Foreword

This handbook is for the sole purpose of guidelines help and procedural work to be carried out by Ceasefire's trained personnel. This handbook has been formed confirming requirements of test performance and verified by BSI (under process).

Adherence to the design and installation instruction of this handbook, ensure proper design, installation, functioning and maintenance of the Ceasefire MINI and define the limit of the system. All trained personnel must follow this handbook.

This handbook is to be read in its complete totality than in parts owing to references to various sections from chapter to chapter.

The details and information sheet in the handbook are to best of product functionality and may alter in future owing to system up-gradation.

Scope

The handbook is to be used by Ceasefire's trained personnel as a guideline for design, installation, functioning, operation and periodic maintenance of "CEASEFIRE-MINI".



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A.0. Introduction

Research shows the most fires are electrical. They start with a spark in electric mains, in the panels, in the wiring, in a Gen-set Panel or any AMF Panel used in various applications.

In case of fire in such panels/machinery, it is difficult to spot the fire immediately due to enclosed cabinets and hence it's too late because everything inside has already been destroyed by the fire. And because they go unnoticed until it is too late, and are often surrounded by sensitive, flammable material, these are perhaps the most dangerous of all fires. Therefore we need instant detection and swift firefighting to fight such fires.

In the view of the above referring to annual fire incidents electrical fires, introducing **Ceasefire-MINI**, a revolutionary firefighting solution that combines ground-breaking technology with functional simplicity to keep what's precious, safe. This technology is being introduced by Ceasefire, the country's pioneers in firefighting and fire-safety solutions.

The user should evaluate their regional laws of the land for the requirement of such a system.

A.1. Protection

Ceasefire-MINI

The system incorporates automatic protection by a quartzoid bulb detection and actuation technique.

All sensitive areas susceptible to fire such as fire due to sparks in electrical cubical, overheating of cables and sensitive parts/equipment of industrial machinery in a **single enclosure** are covered by CEASEFIRE-MINI.

CEASEFIRE-MINI(Intuitive)

The system consists of a pressurized extinguishing agent cylinder fitted with a valve.

The head of the valve has a quartzoid bulb arrangement similar to one in a sprinkler head.

Initially, the valve is closed as the quartzoid bulb keeps a pin seal in place within the valve.

The quartzoid bulb is filled with a specialized liquid that expands on heating. Within the bulb is a tiny air pocket to allow small expansion due to changes in ambient temperature.

At one point as the requisite temperature is reached at the rated temperature of the quartzoid bulb, the expansion of liquid is large enough to disintegrate the bulb.

As this bulb disintegrates the pressure within the cylinder (10 bars with nitrogen propellant) pushes the pin seal to open the valve to fill a chamber and expel the extinguishing agent out of the cylinder through the small orifices in this chamber. This gas floods the enclosure and extinguishes the fire.



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CEASEFIRE-MINI(Adaptive)

The system consists of a pressurized extinguishing agent cylinder fitted with a orifice dispersion head.

This head can be fitted to barrel extensions. Barrel extensions available:

- 50mm
- 100mm
- 200mm.

The orifice dispersion head has a quartzoid bulb arrangement similar to one in a sprinkler head. Initially, the orifice is closed by the quartzoid bulb.

The quartzoid bulb is filled with a specialized liquid that expands on heating. Within the bulb is a tiny air pocket to allow small expansion due to changes in ambient temperature.

At one point as the requisite temperature is reached at the rated temperature of the quartzoid bulb, the expansion of liquid is large enough to disintegrate the bulb.

As this bulb disintegrates the pressure within the cylinder (10 bars with nitrogen propellant) pushes the agent out of the orifice and disperse within the enclosure. This gas floods the enclosure and extinguishes the fire.

A.2. Extinguishment

FK 5-1-12 (Dodecafluoro-2- methylpentan-3-one) is a Fluorinated Ketone (CF₃CF₂C (O) CF (CF₃)₂). It is colourless, odourless and electrically non-conductive. It suppresses fire by a combination of chemical and physical mechanisms with minimal effect on the available oxygen. This allows people to see and breathe, permitting them to leave the fire area safely.

FK 5-1-12 is acceptable for use in occupied spaces when used per the United States Environmental Protection Agency (USEPA) ,Significant New Alternatives Policy (SNAP) program rules.

Although FK 5-1-12 is considered non-toxic to humans in concentrations necessary to extinguish most fires, certain safety considerations should be observed when applying and handling the agent. The discharge of FK 5-1-12 may create a hazard to people from the non-decomposed agent itself, and from the decomposition products that result when the agent is exposed to fire or other hot surfaces. Exposure to the agent is generally of less concern than is exposure to the decomposition products. Unnecessary exposure to the agent or the decomposition products should be avoided.

Note : This is especially not of any concern incase of application related to the use of Ceasefire's mini which dispel this agent into closed enclosure with definite no human presence, also the volume of gas dispersed is very miniscule for any concern (100-500 gms).



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B.0. Handbook user guide

For all users of this handbook, it is mandatory to strictly follow all design considerations, installation procedures, precautions and safety instructions as stipulated by this handbook.

No alterations will be permissible in the protected equipment and system without the consent of the Ceasefire design cell. All installations are to be carried by the Ceasefire's trained personnel only.

It is mandatory to read about hazard notices before design, installation, commissioning and maintaining the system.

B.1. General Safety instructions

Prohibition



The appearance of this sign warrants unauthorized modification is not allowed. Any kind of unsafe working is not allowed.

Caution/Note



This symbol draws attention to object and situation to one of these dangers. Possible has to life and limb. Unsafe or improper working of the system can lead to damage or injury.

CEASEFIRE is not liable for any damage/injury caused by using CEASEFIRE'S –MINI as a result of failure to comply with instructions of this handbook.

The Ceasefire-MINI has successfully passed all stringent quality control tests. The warranty of the product against any manufacturing defect under normal uses in conformity with what is stated in the handbook. This liability excludes damage caused by mishandling or relocation of the equipment by the user on its own.



To ensure correct functions as described above the system must be installed and set up according to this system handbook. It is essential to perform maintenance and service work according to the maintenance plan!

After the actuation of the system, complete servicing and re-commissioning are necessary!



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Do not expose yourself or others to hazards. Carefully read the following safety instructions before installing, operating or servicing the system equipment, to prevent accidents, Personal injuries and material damage. The fittings and the product itself may only be used for the intended purposes.

Limits and values listed in these operating instructions must be observed, particularly operating pressures and ambient temperatures of the system installation. The company Ceasefire will accept no liability for damages resulting from improper use or non-compliance with the instructions in the system handbook.

C.0. **Caution**

These operating instructions are intended for all persons installing, operating and servicing the products and fittings listed below. It is assumed that persons are aware of the general rules and safety guidelines for handling gases and pressurized units. Furthermore, it is assumed that the personnel are acquainted with handling electrical components.

In case of difficulties with operating the pressure units that cannot be resolved by consulting these instructions further information must be requested from the manufacturer.

The manufacturer reserves the right to implement technical changes, improvements and amendments, consult the newest version of this handbook.

The operating instructions must be retained.

All work must be performed by qualified personnel. Qualified personnel must be instructed according to the operating instructions. Qualified personnel means all persons appropriately qualified in the set-up, installation, assembly, start-up, operating and servicing as well as maintenance of the product, including:

- Compliance with regional, national and internal regulations and safety standards
- Appropriate safety equipment and work apparel
- Product training regarding the system.



D.1. **Intended use:**

The extinguishing system described in this handbook may only be used for the protection of equipment meeting the designated system limits, otherwise, the protective function cannot be warranted.



D.2. Extinguishing system:

- Equipment may only be operated with a properly installed and operational fire extinguishing system!
- Regular visual inspections of the vessel pressures on the pressure gauges ensure the system function and operation outside the service intervals.

The installer of the extinguishing system is responsible for the approval of the installed system from the manufacturer.



The manufacturer and/or the installer of the fire extinguishing system must deliver technical documentation and system-specific operating instructions regarding the appropriate and required safety installation at the time of commissioning of the system.

In addition, the operating instructions to the individual components (can be provided on request) complementing the information in this documentation must be observed.

Please do not hesitate to contact us in case of overlapping or missing information.

D.3. Regulations for fire extinguishing system operators



The system components must never be damaged, disassembled or readjusted during the operation of cleaning work. In such cases, a qualified installation engineer from the installing company must be called on-site!

Check the system for its functionality in regular intervals and before starting daily work!



This includes the inspection of the vessel pressure on the pressure gauges.

The operator of the system must be instructed on the functions of the fire extinguishing system; especially the instructions for actions in case of a fire or a fault must be handed over in writing in the documentation and the service records.

As part of the general supervisory obligation, the system operator is required to perform safety training for the respective staff including instructions on the operation of the extinguishing system.



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Any subsequent construction changes on the object to be protected require an adaptation of the extinguishing system. This should be done by prior approval of Ceasefire Design Cell.

The intervals and guidelines described in the section on maintenance and service must be observed without exception.

E.O. **System Design**

The most prominent feature of the CEASEFIRE-MINI is the specially designed heat-sensing quartzoid bulb arrangement that detects and actuates the system.

The quartzoid bulb opens the orifice of the extinguisher to allow the extinguishant to exit through same orifices and flood the enclosed area onto the flame, dousing the fire instantaneously. Since the extinguishing agent used is a clean agent, this system is effective to combat any kind of fire and leaves no particulate residue.

The revolutionary technology makes this system entirely self-activated and requires no human intervention once it has been installed. This makes it especially beneficial for micro-environments or areas where the fire hazard is likely to be in an enclosed space (such as an electrical panel, machines AMF panel, MCB Panels etc.).

The CEASEFIRE-MINI is ideal for situations in which fires can break out in localized areas. The MINI System is designed by the Ceasefire Design Cell and installed by Ceasefire's expert team after an assessment of the location. The most suitable option can be installed based on the assessment and requirements of the location.

FUNCTIONING

As the ambient temperature reaches the desired temperature, quartzoid bulb plays a key role in the discharge of the extinguishing agent as explained above. The choice of a particular quartzoid bulb is made on the basis of ambient temperature of the enclosure that needs to be protected. A specialized flexible dip tube allows the mini cylinder to be installed vertically or horizontally within the enclosure(Intuitive) or outside the enclosure(Adaptive).



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ADVANTAGES

The advantages are plain to see. A small fire that breaks out in small enclosures between endless rows of components in a panel may not trigger an alarm until it is much too late. This suppression system, on the other hand, can run individually to protect the enclosure, gen-set panels and electrical mains boxes. This eliminates the need for human intervention and provides a swift and comprehensive solution.

SYSTEM APPLICATION

This Ceasefire - MINI is used to suppress fires hazards or equipment which includes electricity and with following considerations :

1. Enclosure volume are small ranging from 0.13 to 0.65 cubic metre.
2. Extinguishing requirement range from 100 to 500 gms.
3. Inside volume of the enclosure do not allow conventional detection to be installed within them.
4. These enclosures house important installation which requires that they can be reset or repaired shortly post fire without the need of extensive clean up, hence the use of clean agent.

The Ceasefire - MINI is intended to protect the following applications:

- All type of cabinets with single compartment
- Data processing panels with a single partition.
- Telecommunications/AMF panels
- Electrical switchgear
- Electrical main boxes/ distribution boxes
- High-value medical equipment
- High-value industrial equipment

The Ceasefire - MINI is designed to be suitable for the following classes of fire:

- Class A - Surface types: wood or other cellulose-type material
- Class B - Flammable liquids
- Electrically started fires

The Ceasefire - MINI is not designed for explosion suppression. For hazards that might pose the risk of explosion, or an explosive environment please contact Ceasefire Design Cell.



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For hazards beyond the scope described above, it is recommended to consult with Ceasefire Design Cell, EN ISO 14520 and NFPA 2001 on the suitability of FK 5 1 1 2 for the design concentrations, necessary protection of premises and safety from effects of exposure to that concentration on occupants.

FK 5 1 1 2 should not be used on fires involving the following materials unless they have been tested to the satisfaction of the Authority Having Jurisdiction:

- Certain chemicals or mixtures of chemicals, such as cellulose nitrate and gunpowder, that is capable of rapid oxidation in the presence of air,
- Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium,
- Metal hydrides,
- Chemicals capable of undergoing auto thermal decomposition, such as certain organic peroxides and hydrazine.

E.1. SELECTION OF MINI VARIANTS

Mini is a thermal actuated automatic fire extinguishing cylinder in capacities of 100, 200, 300, 400 and 500 grams to automatically suppress fire in a small enclosed volume.

It comes in two variants:

1. Cylinder head with upright position of heat sensing quartzoid bulb (Intuitive model).
2. Cylinder head with the horizontal position of heat sensing quartzoid bulb (Adaptive model).

Adaptive models come with barrel or extensions as given below:

The barrels are available in four different sizes as given below:

1. 50mm long with 1/8" BSP end connection.
2. 100mm long with 1/8" BSP end connection.
3. 200mm long with 1/8" BSP end connection.

The Heat sensing quartzoid bulbs are available in a Quick response temperature rating of 57°C, 68°C and 93°C.



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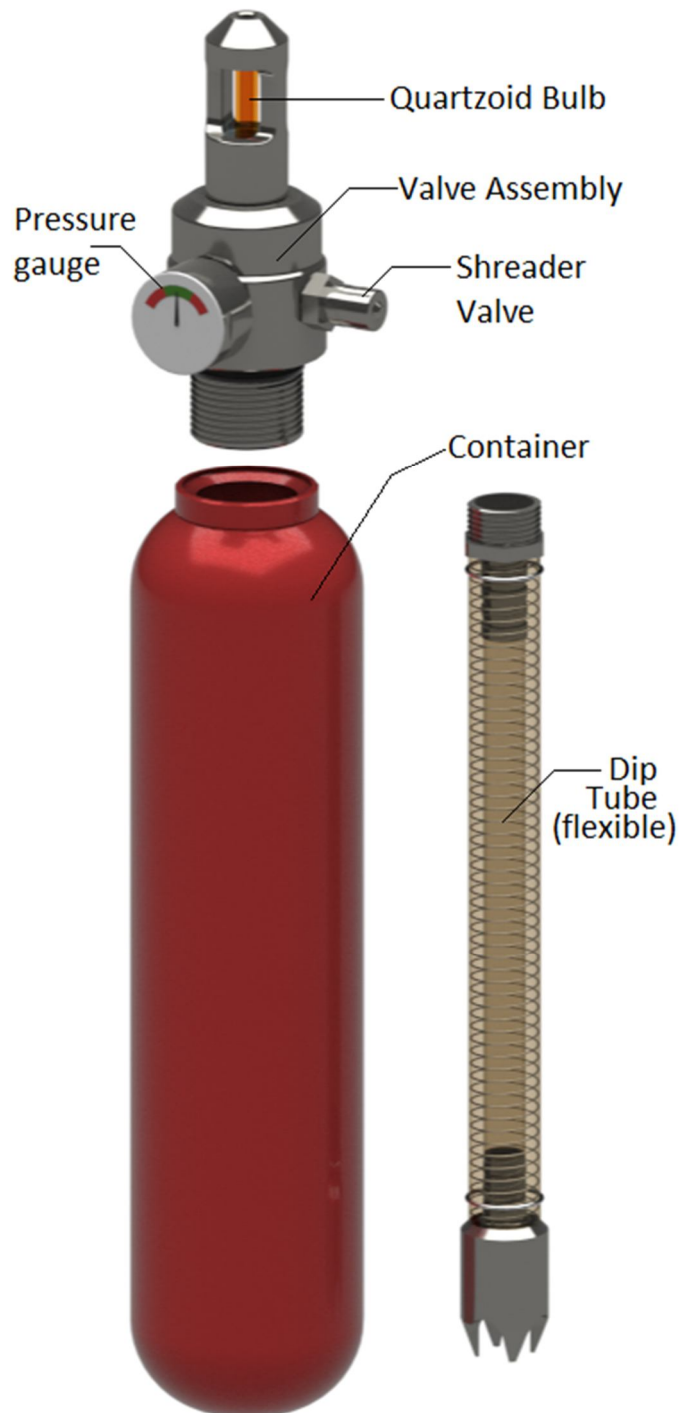


Fig E1(a): Mini(Intuitive)



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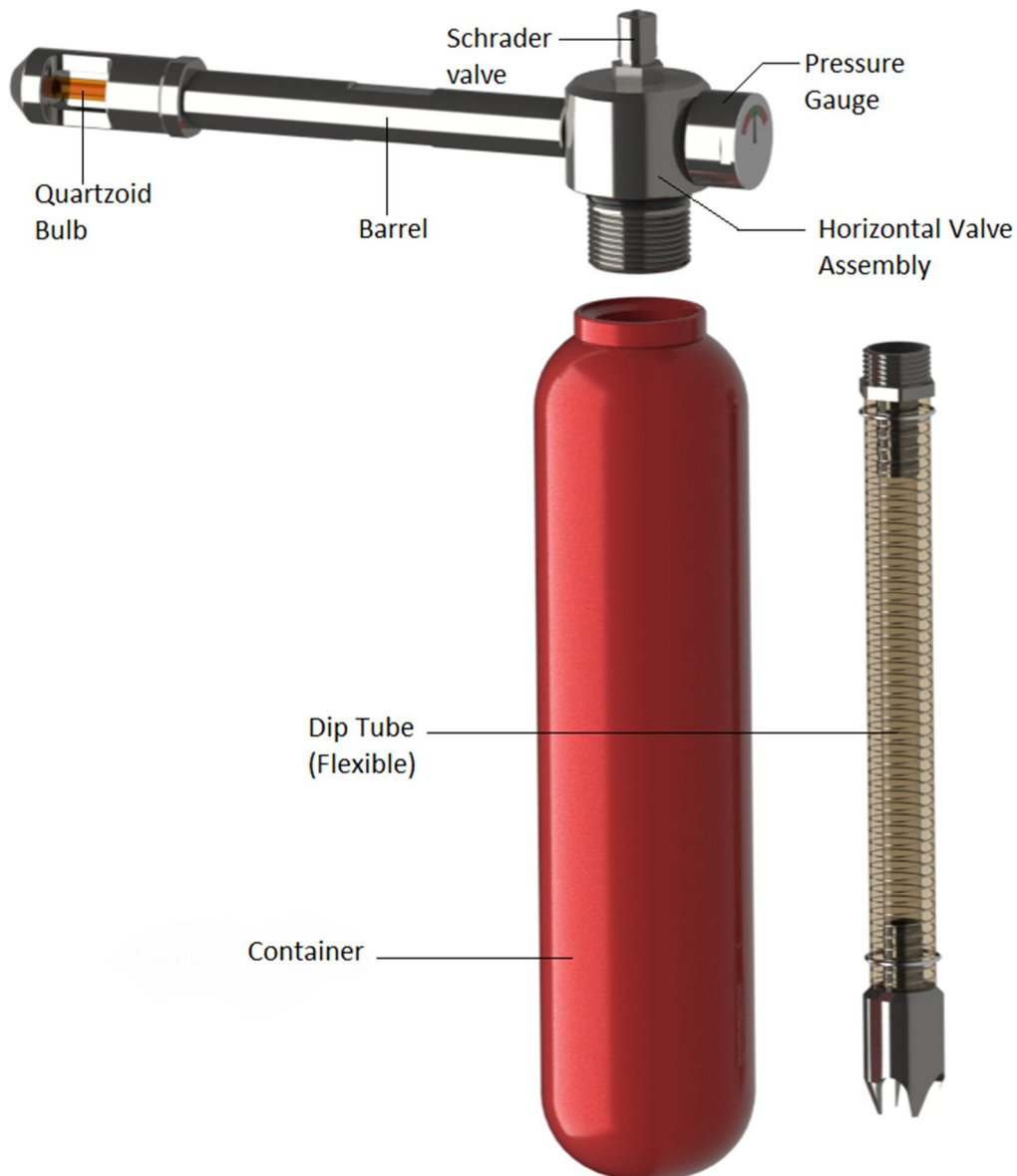


Fig E1(b): Mini(Adaptive)



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E.2. **System protection limitation**

Limitation and scope of protection of equipment

Table E-1:-

FK 5 1 1 2 AT 21 DEG CENTIGRADE.				
S. No.	Wt. in GMS	Concentration in V/wt	Maximum Single Volume coverage (M ³)	Maximum openings/leakage allowed
1	100	4.7	0.130	The cross-section area of the opening shall not be more than 2-3% of the total surface area of the enclosure.
2	200	4.7	0.260	
3	300	4.7	0.390	
4	400	4.7	0.520	
5	500	4.7	0.650	

Note: The volume in m³ is the maximum volume coverage as per the conditions mentioned in the table above. Actual verification as per site conditions to be verified by Ceasefire Design Cell (CDC) as an opening in the enclosure can result in lower coverage.



The limitations shown above are to be strictly adhered to as they have been finalized by numerous trial installations. The system is expected to work to give a complete and safe extinguishment. In case individual or several limits are exceeded protection cannot be warranted. System efficacy is maximized by the above limits thus requiring installation & design by trained personnel only. Detail specification and operating instruction of components necessitate referring to respective operating instructions. Any subsequent structural changes to the risk to be protected require design change of fire extinguishing system as per system design limitation by Ceasefire design cell.

Selection of Quartzoid bulb:

Selection of variant would be dependent on ambient temperature and type of enclosure to be protected.



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The selection of quartzoid bulb will be based on the ambient temperature of the enclosure as listed below:

S. No.	Ambient temperature of the enclosure	Temperature rating of Quartzoid Bulb recommended
1.	Up to 40°C	57°C
2.	Up to 50°C	68°C
3.	Up to 70°C	93°C

Selection of type of Mini:

- The selection of type of Mini Intuitive or Mini Adaptive depends on enclosure volume and type of enclosure. If the cylinder can be mounted inside the enclosure vertically or horizontally considering the availability of space within the enclosure we will fit Mini Intuitive.
- It is recommended to keep the bulb position on the top of the enclosure as possible keeping the bulb directly exposed to the fire source.
- Keeping the above in mind and given limited space in the enclosure, the cylinder can be mounted outside of the enclosure using a suitable length of the barrel using Mini Adaptive.

E.3. CEASEFIRE MINI SPECIFICATIONS

S.No.	Product	Product Specification
1	Ceasefire MINI 100g (Intuitive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 40mm; HT 110mm; Wall Thickness 1.2mm. Container volume:- 100cc. Product Dimension:- HxWxD - 184 x 60 x 62.5mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 100g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ²



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S.No.	Product	Product Specification
2	Ceasefire MINI 100g (Adaptive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 40mm; HT 110mm; Wall Thickness 1.2mm. Container volume:- 100cc. Product Dimension:- HxWxD - 134 x 118 x 53mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 100g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ² Length of Barrels :- 50, 100 & 200mm
3	Ceasefire MINI 200g (Intuitive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 40mm; HT 210mm; Wall Thickness 1.2mm. Container volume:- 200cc. Product Dimension:- HxWxD – 284 x 60 x 62.5mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 200g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ²
4	Ceasefire MINI 200g (Adaptive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 40mm; HT 210mm; Wall Thickness 1.2mm. Container volume:- 200cc. Product Dimension:- HxWxD - 234 x 118 x 53mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 100g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ² Length of Barrels :- 50, 100 & 200mm
5	Ceasefire MINI 300g (Intuitive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 50mm; HT 200 mm; Wall thickness 1.2mm. Container volume:- 300cc. Product Dimension:- HxWxD – 276 x 65 x 67.5mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 300g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ²
S.No.	Product	Product Specification



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6	Ceasefire MINI 300g (Adaptive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 50mm; HT 200 mm; Wall thickness 1.2mm. Container volume:- 300cc. Product Dimension:- HxWxD – 226 x 118 x 63mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 300g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ² Length of Barrels :- 50, 100 & 200mm
7	Ceasefire MINI 400g (Intuitive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 50mm; HT 255 mm; Wall thickness 1.2mm. Container volume:- 400 cc. Product Dimension:- HxWxD – 331 x 65 x 67.5mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 400g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ²
8	Ceasefire MINI 400g (Adaptive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 50mm; HT 255 mm; Wall thickness 1.2mm. Container volume:- 400 cc. Product Dimension:- HxWxD – 281 x 118 x 63mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 400g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ² Length of Barrels :- 50, 100 & 200mm
9	Ceasefire MINI 500g (Intuitive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 50mm; HT 310mm; Wall thickness 1.2mm. Container volume:- 500cc. Product Dimension :- HxWxD - 386 x 65 x 67.5mm including valve and stand. Valve Material:- Stainless steel. Valve activation:- Temperature activated at 57°C/68°C/93°C Extinguishing agent:- 500g of FK-5-1-12 Pressure Indicator:- Pressure gauge. Working pressure:- 10 Kg/cm ²
S.No.	Product	Product Specification



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10	Ceasefire MINI 500g (Adaptive)	Cylinder Material construction:- Seamed SS cylinder external powder coated. OD 50mm; HT 310mm; Wall thickness 1.2mm. Container volume: - 500cc. Product Dimension :- HxWxD - 336 x 118 x 63mm including valve and stand. Valve Material: - Stainless steel. Valve activation :- Temperature activated at 57°C/68°C/93°C Extinguishing agent: - 500g of FK-5-1-12 Pressure Indicator: - Pressure gauge. Working pressure :- 10 Kg/cm² Length of Barrels :- 50, 100 & 200mm
----	---------------------------------------	--

E.3.1. Extinguishing agent

FK 5 1 1 2 (1,1,1,2,3,3,3 - heptafluoropropane) is a compound of carbon, fluorine and hydrogen (CF₃CHF₂CF₃). It is colourless, odourless and electrically non-conductive. It suppresses fire by a combination of chemical and physical mechanisms with minimal effect on the available oxygen. This allows people to see and breathe, permitting them to leave the fire area safely.

FK 5 1 1 2 is acceptable for use in occupied spaces when used per the United States Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) program rules.

Although FK 5 1 1 2 is considered non-toxic to humans in concentrations necessary to extinguish most fires, certain safety considerations should be observed when applying and handling the agent. The discharge of FK 5 1 1 2 may create a hazard to people from the non-decomposed agent itself, and from the decomposition products that result when the agent is exposed to fire or other hot surfaces. Exposure to the agent is generally of less concern than is exposure to the decomposition products. Unnecessary exposure to the agent or the decomposition products should be avoided.



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Table-E-2: FK 5 1 12 Physical Properties

Physical Property	Units	FK-5-1-12
Molecular weight	N/A	316.04
Boiling point at 760 mm Hg	°F	120.2
Freezing point	°F	-162.4
Critical temperature	°F	335.6
Critical pressure	psi	270.44
Critical volume	ft ³ /lbm	0.0251
Critical density	lbm/ft ³	39.91
Specific heat, liquid at 77°F	Btu/lb-°F	0.2634
Specific heat, vapor at constant pressure (1 atm) and 77°F	Btu/lb-°F	0.2127
Heat of vaporization at boiling point	Btu/lb	37.8
Thermal conductivity of liquid at 77°F	Btu/hr-ft-°F	0.034
Viscosity, liquid at 77°F	lb/ft-hr	1.27
Relative dielectric strength at 1 atm at 734 mm Hg, (N ₂ = 1)	N/A	2.3 at 77°F
Solubility of water in agent	wt%	<0.001 at 70°F

E.3.2 Basis to calculate the extinguishing agent quantity

1. Calculation of Extinguishing Agent.
2. The CEASEFIRE technical team conducts a technical evaluation and survey.
3. All potential areas for fire source are identified during this survey.
4. The technical team takes the dimensions of every panel.
5. Post the dimensions, Volume for each & every panel has arrived.
6. After arriving at the volume of enclosures, the Gas requirement is calculated for FK 5 1 1 2 Clean Agent @ Design concentration 4.7% v/v with minimum assumed temperature @ 20 Degree Celsius which results in a requirement as confirmed in table E-1. In case of temperature below or above 20 deg. C, the reference has to be taken from the table –E-3 for FK 5 1 1 2.
7. Using this calculation the Capacity of the cylinder can be worked out.



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Table E-3:

Table A.5.5.1(b) FK-5-1-12 Total Flooding Quantity (SI Units)^a

Temp (t) (°C) ^c	Specific Vapor Volume (s) (m ³ /kg) ^d	Weight Requirements of Hazard Volume, W/V (kg/m ³) ^b							
		Design Concentration (% by Volume) ^e							
		3	4	5	6	7	8	9	10
-20	0.0609140	0.5077	0.6840	0.8640	1.0479	1.2357	1.4275	1.6236	1.8241
-15	0.6022855	0.4965	0.6690	0.8450	1.0248	1.2084	1.3961	1.5879	1.7839
-10	0.0636570	0.4859	0.6545	0.8268	1.0027	1.1824	1.3660	1.5337	1.7455
-5	0.0650285	0.4756	0.6407	0.8094	0.9816	1.1575	1.3372	1.5209	1.7087
0	0.0664000	0.4658	0.6275	0.7926	0.9613	1.1336	1.3096	1.4895	1.6734
5	0.0677715	0.4564	0.6148	0.7766	0.9418	1.1106	1.2831	1.4593	1.6395
10	0.0691430	0.4473	0.6026	0.7612	0.9232	1.0886	1.2576	1.4304	1.6070
15	0.0705145	0.4386	0.5909	0.7464	0.9052	1.0674	1.2332	1.4026	1.5757
20	0.0718860	0.4302	0.5796	0.7322	0.8879	1.0471	1.2096	1.3758	1.5457
25	0.0732575	0.4222	0.5688	0.7184	0.8713	1.0275	1.1870	1.3500	1.5167
30	0.0746290	0.4144	0.5583	0.7052	0.8553	1.0086	1.1652	1.3252	1.4888
35	0.0760005	0.4069	0.5482	0.6925	0.8399	0.9904	1.1442	1.3013	1.4620
40	0.0773720	0.3997	0.5385	0.6802	0.8250	0.9728	1.1239	1.2783	1.4361
45	0.0787435	0.3928	0.5291	0.6684	0.8106	0.9559	1.1043	1.2560	1.4111
50	0.0801150	0.3860	0.5201	0.6570	0.7967	0.9395	1.0854	1.2345	1.3869
55	0.0814865	0.3795	0.5113	0.6459	0.7833	0.9237	1.0671	1.2137	1.3636
60	0.0828580	0.3733	0.5029	0.6352	0.7704	0.9084	1.0495	1.1936	1.3410
65	0.0842295	0.3672	0.4947	0.6249	0.7578	0.8936	1.0324	1.1742	1.3191
70	0.0856010	0.3613	0.4868	0.6148	0.7457	0.8793	1.0158	1.1554	1.2980
75	0.0869725	0.3556	0.4791	0.6052	0.7339	0.8654	0.9998	1.1372	1.2775
80	0.0883440	0.3501	0.4716	0.5958	0.7225	0.8520	0.9843	1.1195	1.2577
85	0.0897155	0.3447	0.4644	0.5866	0.7115	0.8390	0.9692	1.1024	1.2385
90	0.0910870	0.3395	0.4574	0.5778	0.7008	0.8263	0.9547	1.0858	1.2198
95	0.0924585	0.3345	0.4507	0.5692	0.6904	0.8141	0.9405	1.0697	1.2017
100	0.0938300	0.3296	0.4441	0.5609	0.6803	0.8022	0.9267	1.0540	1.1842

The systems shall be employed in enclosed areas only. The hazard to be protected shall be surrounded by a fixed enclosure that enables the required agent concentration to be achieved and maintained for a sufficient time to afford fire extinguishment. The enclosure shall be reasonably tight and any opening should be closed as much as possible or the size of the opening should be provided to the design team to work out the extinguishant capacity.

F.O. Installation



For further information and installation, notes refer to the operating instructions. These must be observed to prevent malfunctions and faulty operations!



F.1. Mounting the pressurized Container

The pressurized vessels must be mounted and fastened securely in a vertical or horizontal position for operation; we recommend the use of the Ceasefire's specially designed brackets.

A horizontal mounting is permissible as in the case of Mini, the flexible dip tube will collect and expel the extinguishing agent in both orientations.



Use only suitable mounting means or brackets for the pressurized gas vessel and keep the vessel in the correct position!

F.1.1 Fixing the Cylinder:

- Mark the holes for the bolts to fix stand and barrel in case of Adaptive.
The holes have to be marked keeping in mind the position of the quartzoid bulb.
In case, the bulbs are placed horizontally, then, for both types of Mini the bulb should be placed such that they are closest to the ceiling of the enclosure and center to the ceiling.
In case the bulb is placed vertically, for Intuitive, and horizontally for Adaptive below the ceiling, the bulb position should be within 150mm below the ceiling and centered as possible to the side wall.
- After taking the markings, drill holes.
- Fix the mounting bracket using nuts and bolts. Keep in mind they align in a straight line.
- Mounting of the cylinder on the bracket

Note : The cylinder can be mounted vertically or horizontally keeping in mind that the heat sensor (quartzoid bulb type detector of MINI) is as close to the ceiling or a maximum of 150mm below the ceiling of the enclosure as possible for best response.



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Fig F1.1(a): Mini(Intuitive)- Horizontal Representation

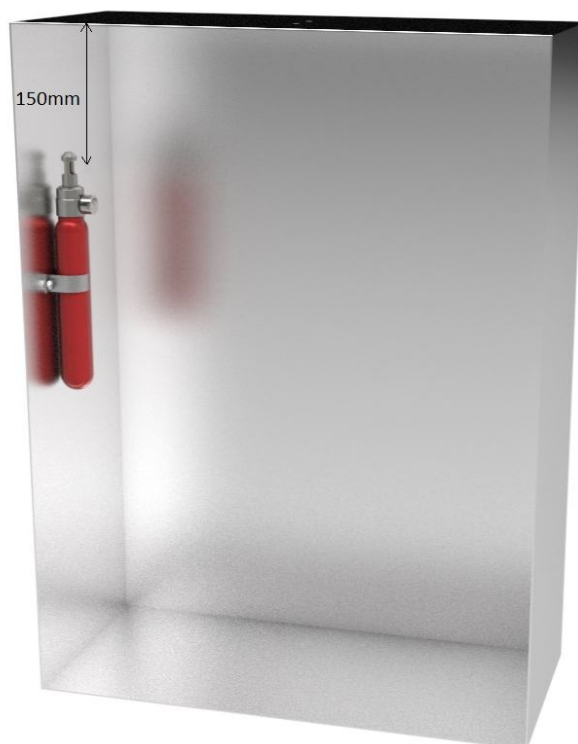


Fig F1.1(b): Mini(Intuitive)- Maximum Vertical Distance Representation



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Fig F1.1(c): Mini(Adaptive)- Vertical Side Wall close to ceiling representation



Fig F1.1(d): Mini(Adaptive)- Vertical Maximum distance from ceiling representation



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G.0. Servicing / maintenance

System maintenance and servicing are extremely important to ensure the functionality of the system on a long-term basis and to reinstate it after a fire has been extinguished.



All work may only be performed by qualified and trained personnel!

G.1 System Maintenance

MAINTENANCE CHECK FOR CYLINDER:

- Thorough Cleaning
- Check the cylinder for corrosion
- Check the cylinder for dents
- Check the pressure in cylinder ≥ 10 bar

SHELF LIFE:

1. The shelf life of the cylinder is 10 years if stored and installed in a normal condition.

G.2 Technical Details:

Technical data of MINI:

Working pressure	12 bar at 20°C
Max. test pressure of the cylinder	35 bar
Temperature range	-20°C up to +60°C
Valve MOC	STAINLESS STEEL
Extinguishing agent	FK 5 1 1 2
Materials used valve body	(plated/un-plated) stainless steel, Elastomeric sealing, brass, plastic



G.3 Maintenance schedule

After 5 years the pressure agent container needs to be hydrostatic pressure tested (refilled) and valves need to be replaced every 10 years.



Defective components must be replaced immediately.

Any problems identified during servicing or maintenance work, during operation or in any other event are to be recorded and communicated to the company Ceasefire. Upon receipt of the records, we will deal with the problem and provide solutions, either by adapting the documentation or changing individual system components.

G.4 (Annual) Checking of the functionality

To ensure the long-term functionality of the system the operational state of the extinguishing system must be inspected once per year by qualified service personnel. This inspection must also be performed daily before commencing daily use by the operator of the system.

H.0 Training

H.1. Product training

For a safe system layout and installation, comprehensive knowledge of the extinguishing system and its functions is indispensable. Therefore the company Ceasefire provides a special product training without which an installation in compliance with the approval is not possible. The planning and design personnel as well as the installation engineers must undergo special training for their future tasks. Refresher courses are required at regular intervals (at least every five years). Product training covers:

- System functions
- System layout design in respect of the equipment installation
- Component installation
- Service and maintenance instructions
- Handling of Ceasefire components and their function



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H.2. Product liability

CEASEFIRE is not liable for any damage/injury caused by using CEASEFIRE'S MINI as a result of failure to comply with instructions of this handbook.

The CEASEFIRE MINI has successfully passed all stringent quality control tests. The warranty of the product against any manufacturing defect under normal uses in conformity with what is stated in the handbook. This liability excludes damage caused by mishandling or relocation of the equipment by the user on its own.

DO'S

- ✓ Do check the cylinder pressure to be greater than/equal to 10 bar.
- ✓ Do call Ceasefire response cell if any pressure is found below 10 bar.
- ✓ Do periodically check the cylinder mounting to be stable.
- ✓ Do insure that your system is always covered under annual maintenance contract.
- ✓ Do have a Ceasefire technician present when you need to have any alteration.

DONT'S

- ✗ Don't touch any component of the system provided.
- ✗ Don't touch the quartzoid bulb.
- ✗ Don't let any unauthorized person to service or repair the system installed.
- ✗ Don't fail to call Ceasefire response cell for any service or query.

H.3. Contact

Ceasefire Industries Limited.

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