	<b>Flame Arrester</b> <b>933-SE 400.1/9x0.5/D3IIAP1T1</b> <b>Instructions for Operation and Maintenance</b>	<b>REV 3</b>
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This Instruction for Operation and Maintenance (IOM) is applicable for the following products:

**Table 1:** Type description

Size	Type	EU-Type Examination Certificate Number
DN400 / 16"	933-SE 400.1/9x0.5/D3IIAP1T1	IBExU21ATEX2077 X

This IOM may also be accompanied by other data sheets with dimensions and pressure drop/volume flow rate diagram for consultation.

## 1. Use

The Flame Arresters listed above meet the requirements of the ATEX Directive 2014/34/EU and the harmonised standard for flame arresters EN ISO 16852:2016 as autonomous protection system for intended use in potentially explosive atmospheres.

The general suitability as an **in-line stable detonation flame arrester** for use with inflammable gas/air mixture and vapour/air mixture of inflammable liquids of the explosion group IIA (MESG > 0.90 mm) has been verified by tests performed at the Institut für Sicherheitstechnik GmbH IBExU Freiberg, EUROPEAN NOTIFIED BODY no. 0637 according to Article 9 of the Directive 2014/34/EU. Always use it within the purview of the entire safety concept of the corresponding system and combine additional explosion safety measures, if required.

For preventing flame transmission, these in-line detonation arresters can be used at atmospheric conditions [pressure: 0.8 bar (absolute) to 1.1 bar (absolute), temperature: -20°C to +60°C] for protection against stable detonations, deflagrations and short time burning at the flame arresters for explosive vapour/gas-air mixtures of the explosion group IIA.

For all applications, the customer shall observe the operational limits of the product, with special attention to the limits for maximum allowable operating pressure ( $p_0$ ) and maximum allowable operating temperature ( $T_0$ ):

**Table 2:** Operational limits

Size	$p_0$ MPa (absolute)	$T_0$ °C
DN400 / 16"	0.11	60

An in-line Flame Arrester has two sides, which are called protected and unprotected side respectively. The protected side is the side where no deflagration/detonation can occur. The unprotected side is the side where a deflagration/detonation may occur. Bi-directional flame arresters, in an operational context, are flame arresters that are installed in systems where a deflagration/detonation may occur at either side.

Uni-directional Flame Arrester must be equipped with a temperature sensor (RTD) at the unprotected side only, the sensor has the function of detecting temperature increases. A flame arrester can only operate as Bi-directional if it is equipped with at least one operational temperature sensor at each side of the flame arrester.

In the case of continuous burning (stabilized burning) at any side of the Flame Arrester, or if the temperature increases above the operational limits, the system must be immediately shut down. The customer shall have the temperature sensors integrated with their plant control systems to immediate trigger a shut down of the process and contingency measures (inertization for example) as appropriate.

A Flame Arrester certified for short time burning (BC rate: "b") is designed and certified to resist a continuous burning for a certain amount of time classified as  $t_{BT}$ , which is 1min, after this time the Flame Arrester may lose its capacity of retaining the flame on the unprotected side, consequentially exposing the protected side to the incident. As per ISO 16852 the customer/end user plant shutdown apparatus must take measures to eliminate the continuous burning within half the time for which the device is short-time burn proof ( $0.5 \times t_{BT}$ ).

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As part of the documentation package, the product is delivered with a factory Test Certificate according to EN 10204, which includes the technical features of the product as well as the EU-type examination certificate number. Also, as part of the documentation package, a Declaration of Conformity is issued, assuring compliance with standards EN ISO 16852 and EN 1127-1, as well as compliance with the ATEX directive 2014/34/EU.

## 2. Construction

The Flame Arrester consists of one Element Bank (3) chucked between the Covers (1 & 2), having O-rings (4) for the external sealing and bolts (5) and nuts (6) to secure the assembly together. The nuts may be provided with Nut Caps for protection against weather effects.

The Flame Arrester Element Bank is equipped with Arrester Elements (9 & 10) produced with a specific gap width spec and different winding directions. The Arrester Elements are strategically arranged for a proper diversion of flow that will help to quench the flame.

The Element Bank is equipped with Spacers (11 & 12) in between the Arrester Elements. These spacers are properly aligned so that they don't interfere in the flow area of the Flame Arrester, and they must not have their position or format changed or modified in any way.

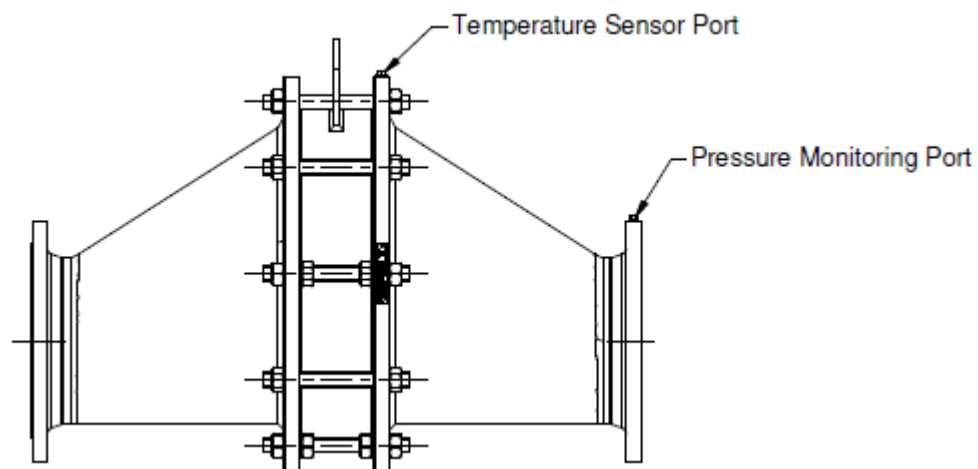
To close the Element Bank, the Element Bank is fitted with Stars (13 & 30). These Stars are also strategically aligned to the Spacers and a Bolt (14) is used to secure the assembly together. This Bolt is equipped with a safety washer at its head and it is installed with thread locker adhesive at the thread engagement portion.

The Element Bank is provided with Lifting Lugs, these lugs have small holes where some of the external Bolts are passed through, helping on centering the Element Bank concentrically in relation to the covers' big flanges.

As illustrated in Figure 2, some of the external Bolts (5) are fitted with nuts and washers on the inner side (Jackscrew Nuts). These nuts and washers are there to allow the user to use these specific Bolts as Jackscrews, to open a gap in the line to facilitate the removal of the Element Bank for maintenance or replacement works.

The Temperature Sensor Ports on the Cover(s) are supplied plugged. After installation of the Flame Arrester in the pipeline, and before operation, the plug shall be removed, and the Temperature Sensor(s) (21) must be installed at the unprotected side(s) and connected to plant shutdown apparatus.

For Flame Arresters where the customer orders pressure monitoring ports, they are also supplied plugged and the customer may remove them after installation of the Flame Arrester in the pipeline, and before operation, and the pressure monitoring device may be installed.



**Figure 1 – Connection Ports**

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### 3. Marking

The product is supplied with nameplate and labels that provide important information to the customer about the product and its limitations. Below are some of the information provided:

Nameplate:

- Name and address of the Manufacturer
- Product Type (including element configuration)
- EU-Type Examination Certificate Number
- Serial Number and year of manufacture
- Number of the design standard: ISO 16852
- EX mark, followed by the device group information II and the letter “G” (for classified areas where explosive gases, vapors and/or air mixtures are present)
- Explosion group
- CE mark, followed by the Notified Body number (2460)

Warning Label / Hazard Sign:

- **Warning Flame arresters have installation and application limits.**  
**Type designation in accordance with ISO 16852**
- Flame Arrester Type mark: **DET3**  
(Stable Detonation with Restriction)
- Burn rating mark BC: **\*\*\*** (Please see below)
- Explosion Group: **IIB3**
- Maximum Operational Temperature T<sub>0</sub>: **60°C**
- Maximum Operational pressure p<sub>0</sub>: **ATM** (Atmospheric)  
(≤ 0.11 MPa absolute)

The Element Bank is marked on the outside with “BS&B-9x0.5”

The Arrester Elements are marked on the outside with the following information:

- Name of the manufacturer
- Gap width
- Material designation number
- Winding direction

Example: **BS&B-0.5-1.4571-R**

The protected side of the Flame Arrester is identified by a Red Dot sticker.

\*\*\* The burn rating sign “BC” defines for what type of continuous burning the Flame Arrester is suitable for.

- “b” – Short time burning (followed by the max permissible burning time: t<sub>BT</sub>= 1 min).
- “c” – No burn time (not suitable for continuous burning).

If a Flame Arrester is supplied for use without a temperature sensor, it will be supplied with the burn rate as “c”, even if it was technically certified for short time burning. A Flame Arrester can only be used as short time burning if equipped with suitable temperature sensor to trigger the mandatory shutting down measures outlined in part 1 of this IOM.

If the Flame Arrester is certified for short time burning and supplied with a sensor at the unprotected side, it will also have an Informative Label stating that “This Flame Arrester is safe for short time burning”.

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#### 4. Installation

The position of the Flame Arrester as well as the pipeline arrangement shall be defined by the customer/end user, observing guidelines of relevant regulations and applicable standards. The installation of the Flame Arrester shall be conducted by the customer following this IOM and the applicable standards. Customer shall observe the requirements and limitations of use outlined on relevant standards.

Accident prevention measures and risk assessment should take place before installation. Health and safety guidelines are to be followed.

Before installation the flange protection covers may be removed.

The following assembly instructions must be observed:

- The Flame Arrester can only be installed in pipelines where the connecting pipe diameter:
  - on the unprotected side is not greater than the flame arrester connection size
  - on the protected side is not smaller than the pipe diameter on the unprotected side
- If there is a chance of continuous burning at the unprotected side of the Flame Arrester, then the Flame Arrester must be equipped with at least one functional Temperature Sensor at the source of ignition side. If ignition may occur at either side, then the Flame Arrester must be equipped with Temperature Sensor at both sides, as already instructed in this IOM (refer to part 1).

The Flame Arrester is supplied with process connections with specification as per customer request. Standard types are flange connections according to EN 1092, ISO 7005, ASME B16.5 and JIS B 2220. Other types may also be offered upon special request.

For flanges with flat sealing faces it is recommended to use flat-ring gaskets with suitable specification for the connecting flanges and process fluid media. BS&B recommends the use of low stress gaskets (DIN 2501  $k_0 k_D \leq 25 b_D$ ) such as compressed fibre gaskets (e.g., KLINGERSIL® C-4400 or technically equivalent). A low stress spiral wound gaskets (e.g., Flexitallic® Style CGI or technically equivalent) can also be used.

Before installation, customer must make sure the sealing surfaces are in perfect condition and free from any foreign objects, oil, or grease. Appropriate gaskets and torque shall be applied for a proper and leak tight installation. After installation and before operation it is recommended that the customer performs a leak tightness test at the connections to assure leak tightness. The Flame Arrester must not be pressurized with pressure higher than the test pressure value, given in the test certificate of the product.

The Flame Arrester can be installed in a vertical or horizontal orientation.

The Flame Arrester must not be subject to bending stresses, such as those developed by misaligned piping, unsupported piping or improper torque application to the connection flanges. Mating flange faces shall be parallel to the Flame Arrester flange faces.

To avoid the risk of damage during transport the Temperature Sensor is shipped dismantled from the Flame Arrester. The Sensor must be installed to the Flame Arrester after the unit is installed in the pipeline and before operation begins. To install the Temperature Sensor, the plug at the Temperature Sensor port (refer to Figure 1) must be removed and the sensor then installed. For the thread connection, an appropriate sealing method must be used, according to the type of thread connection chosen by the customer. Some types of thread may require the use of additional sealant, please follow the technical recommendations for the threads in use.

The electrical connection of the sensor must be performed following the sensor manufacturers recommended instructions. The sensor must be integrated to the plant shutdown apparatus to trigger shutdown and contingency measures as appropriate in the case of a prolonged fire at the unit as detailed at the above paragraphs. The system must be setup in a way that the sensor(s) must detect the increase in temperature above the limit and trigger the plant shutdown apparatus within 30 seconds of the point where the temperature increased above the temperature limit ( $T_0$ ).

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## 5. Maintenance

The Flame Arrester must be periodically maintained, and the periodic maintenance shall include a visual inspection of the Element Bank, especially at the Arrester Elements area. The Arrester Elements shall be inspected against deformation and contamination/blockage by any foreign bodies and/or process particles that may affect the gap width spec. The time intervals for maintenance/inspection works depend on the operating conditions and contamination level of the process media. The maintenance/inspection frequency must be established by the customer/end user.

For inspecting the Arrester Elements, the Element Bank shall be removed from the Flame Arrester. The Flame Arrester is designed in a way that the Element Bank can be removed from the unit without having to remove the complete Flame Arrester from the process/pipeline. The customer shall remove all the Cover Bolts (5) from the upper half of the Flame Arrester (half opposite from where the Jackscrew Nuts are located) and use the Jackscrew Nuts to create small gap between the Covers and the Element Bank that will allow the Element Bank to be lifted and removed from the Covers. To be able to completely remove the Element Bank without obstructions the customer shall anticipate and maintain a clearance on the upper half side of the Flame Arrester that would be at least the size of the Element Bank. This dimension is given below on Table 3 as reference, please refer to Figure 2 for illustration.

**Table 3:** Minimum clearance for the removal of the Element Bank

Size		DN400
<b>D</b>	<b>mm</b>	1050
<b>E</b>	<b>mm</b>	1600
<b>Element Bank Weight (SS)</b>	<b>kg</b>	450

After removing the Element Bank, the Arrester Elements at both ends shall be inspected against corrosion, contamination and blockage. If light contamination is found, the Arrester Elements can be cleaned by blowing compressed air or hot steam in the opposite direction of the normal flow direction of the Element Bank.

If the contamination level is high or there are impurities stuck to the surface of the Arrester Elements, the customer/end user may also rinse using a liquid cleaning agent/detergent. The cleaning agent/detergent must be suitable for the materials of the Flame Arrester and must not corrode or damage any of the Flame Arrester parts in anyway. After rinsing, all parts shall be blown dry with clean compressed air.

The Element Bank must be replaced if even after cleaning its flow area still presents contamination/blockage of 30% or more of its flow area.

**NOTE:** Customer/end user must never remove the Stars (13 & 30) and open the Element Bank. The Element Bank can only be opened by BS&B FlameSaf qualified personnel.

After finishing the cleaning works on the Element Bank, the customer shall ensure that no deformation or mechanical modifications were made to the Arrester Elements and customer shall check the torque of the Element Bank Centre Bolt (14), and rectify it if it is below the spec. Please refer to table 4 for the torque spec for the Centre Bolt (14).

**Table 4:** Element Bank Centre Bolt Torque:

Size	DN400
<b>Torque (Nm)</b>	600

Detonations and/or deflagrations, followed by continuous burning can cause considerable mechanical and thermal stresses to the Flame Arrester parts. If any deformation to the internal parts of the Flame Arrester is found or if any parts are damaged, the Flame Arrester must be sent to BS&B FlameSaf Ltd for refurbishment or replaced by a new unit.

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The Element Bank shall be replaced if any of the situations listed below occur:

- If any fire occurs at the Arrester Elements
- If the metal ribbons of the Arrester Elements show any signs loosening/slackening
- If there are damages caused to the Arrester Elements due to corrosion
- If even after cleaning, the Arrester Elements still have 30% or more of their flow area contaminated/blocked

Whenever the Element Bank is removed for inspection the O-rings (4) should be replaced by new ones. The O-rings shall be lubricated before installation to avoid damage, O-ring lubricant Dow Corning 111 or technically equivalent is recommended.

NOTE: For applications where no lubricant can be present at the parts of the Flame Arrester, the customer shall take measures to clean the unit thoroughly before operation.

After installing the Element Bank back in the Flame Arrester, the Stud Bolts (5) shall be replaced and it is recommend to use anti seize lubricant at their ends before installing the nuts (Loctite LB 8009 or technical equivalent is recommended). The Cover Bolts (5) and Nuts (6) shall be torqued in a criss-cross pattern with a final torque according to Table 5. If the torque is higher than 100 Nm, it is recommended to apply the torque in different torquing sessions. For torque values between 100 and 300 Nm, two sessions are recommended, applying half of the final torque at the first session to all bolts in a criss-cross pattern and applying the final torque in the subsequent session. For torque values between 300 and 500 Nm, three sessions are recommended applying one third of the final torque at the first session to all bolts in a criss-cross pattern and applying the other two thirds of the torque in the subsequent sessions.

**Table 5: Cover Bolts and Nuts Torque**

<b>Size</b>	<b>DN400</b>
<b>Torque (Nm)</b>	<b>300</b>

After completing the installation steps above it is recommended that the customer performs a leak tightness test at the connections to assure leak tightness. The Flame Arrester must not be pressurized with pressure higher than the test pressure value, given in the test certificate of the product.

After any maintenance works and/or any deflagration/detonation at the Flame Arrester, the Temperature Sensor(s) must be checked and its functionality and integration with the plant shutdown apparatus shall be assured by the customer/end user.

All maintenance works on the Flame Arrester shall only be performed by qualified and trained personnel.

It is recommended to always keep one spare Element Bank (3) in stock for each Flame Arrester in operation.

Only genuine parts, supplied by BS&B FlameSaf Ltd, may be used for any maintenance/repair work performed on the Flame Arrester. Please refer to Table 6 (Spare Parts List) for the part numbers to be used to re-order parts.

NOTE: The last page of this IOM provides a drawing to help on the identification of parts. For illustration purposes the version shown on this drawing is a Uni-directional Flame Arrester with no pressure monitoring port, which is the most common version for this type of Flame Arrester.

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## 6. Spare Parts List

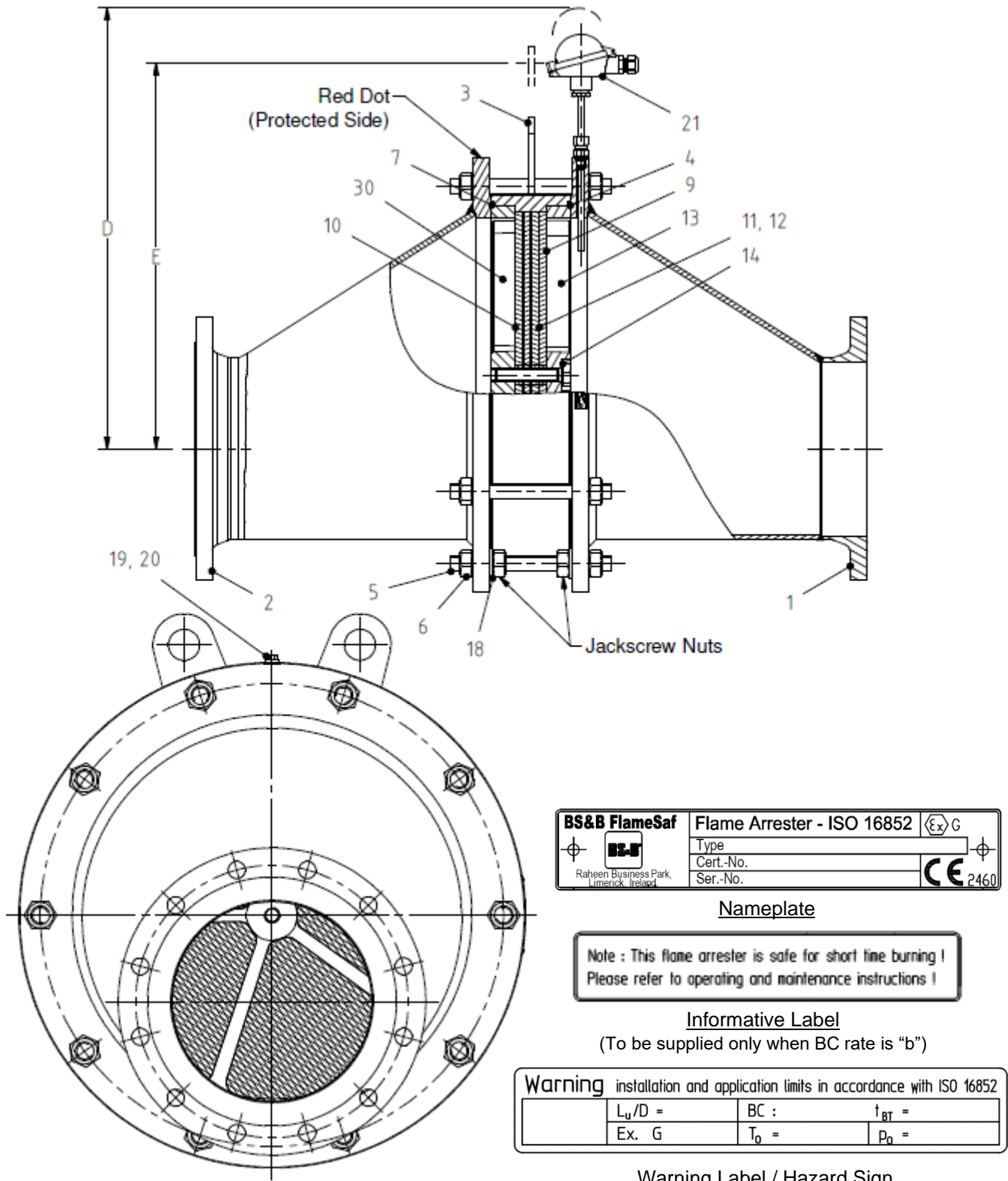
Item No	Designation	Qty	Material	Order Number
				DN400 (16")
3 *	Element Bank with FPM O-rings	1	SS	FET15546640
3 *	Element Bank with NBR O-rings	1	SS	FET15546640N
3 *	Element Bank with FEP encap. O-rings	1	SS	FET15546640VF
4 *	O-ring	2	NBR	780019100
			FPM	780019200
			FEP Encap.	780019300
5	Cover Bolts	18	SS	222026127
			CS	222026126
6	Hex Nut	44	SS	201542823
			CS	201521840
18	Washer	8	SS	52098300
			CS	940131000
19	Screw Plug	2	SS	212097500
			CS	215031200
20	Screw Plug Sealing Ring	2	Aluminium	504650200
			Copper	500009800
21 *	Temperature Sensor RTD - VÜ 48i – 3 Wire Circuit	1	SS	662037420
	Temperature Sensor RTD - VÜ 48i with Head Transmitter	1	SS	662071923
	Temperature Sensor RTD - Endress & Hauser TR24 with Head Transmitter	1	SS	652282970

**Table 6: Spare parts List**

### Notes:

- \* Essential parts for periodic preventive maintenance
- SS = Stainless Steel
- CS = Carbon Steel

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**Figure 2 – Identification of Parts**

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