

Electronic Water Sensor (EWS) for the measurement of free water in Jet Fuel

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1 Safety instructions



This manual provides installation, operation and routine maintenance instructions for the FAUDI Aviation AFGUARD® electronic water sensor.
Read this manual and ensure that you fully understand its content before you attempt to install, use or maintain the AFGUARD® electronic water sensor.
Important safety information is highlighted in this manual as WARNINGs and CAUTIONs.
The AFGUARD® is an intrinsically safe Sensor, suitable for the needs of field and laboratory analysis of the content of free water in Jet Fuel.
Work on electrical equipment is only to be carried out by trained specialists as per the regulations currently in force.
Attention must be paid to the requirements of VDE 0100 when setting high-power electrical units with nominal voltages of up to 1000V, together with the associated standards and stipulations.
Check the details on the housing to ensure that the equipment is connected to the correct mains voltage.
Protect against touching dangerously high electrical voltages.
The equipment is only to be set within the permitted range of temperatures and pressures.



AFGUARD® is subject to the standards of electrical equipment in accordance to safety regulations:

- EN 60079-0 (General Requirements);
- EN 60079-11 (Equipment protection by intrinsic safety "i");
- EN 60079-18 (Equipment protection by encapsulation "m");
- EN 60079-26 (Equipment protection for Group II Category 1 G);
- EN 60079-28 (Protection of equipment and transmission systems using optical radiation).

For operation of equipment in hazardous areas group II category 2, Explosion group “IIB”, Temperature class T4 with ambient temperature range – 30 °C ≤ T_a ≤ +60 °C.
For use in hazardous areas, observe the relevant national and international instructions and regulations.
Check that the location is weather-protected. It is recommended that the AFGUARD® sensor is not subjected to either direct rain or sunshine.
Installation, maintenance and monitoring may only be carried out by authorised personnel with respect to the relevant stipulations. Repairs should only be carried out by the supplier.
All part replacements which are not specified or approved by FAUDI Aviation GmbH, as well as any repair and service with the use of unauthorized parts shall invalidate the Ex-Certificate.
In case of any doubts, please directly contact FAUDI Aviation GmbH or the authorized FAUDI Aviation Distributor or Service organisation.
The AFGUARD® sensor is certified by **DEKRA Exam in Bochum**, an authorized company for official approval of electric equipment in Germany.
Detailed information and a copy of the certificate are attached to this operating manual.
Installation and operation of the analyser has to be carried out in accordance to the conditions in the Ex-Certificate (see appendix). Only if such conditions are followed, can the reliability of operation in hazardous areas be guaranteed.

1.1 Designated use



The AFGUARD® is suitable for continuous measurement of free water in Jet Fuel.
Typical applications of the AFGUARD® are:
Measuring the content of free water at the inlet of refuelling units and filter water separators.
Measuring the free water content at the outlet of FWS Filter Water Separators.
Measuring the content of free water at the inlet and outlet of filter vessels, especially at the outlet of Dirt Defence Filters according to JIG bulletin 130.
The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, Commissioning and Operation



Please note:
Installation, electrical connection, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
The technical personnel must be authorised for the specified activities by the system operator.
Technical personnel must have read and understood these Operating Instructions and must adhere to them.
Before commissioning the entire measuring point, check that all connections are correct.
Ensure that electrical cables and hose connections are not damaged.
Do not operate damaged products and secure them against unintentional commissioning.
Mark any damaged product as being defective.
Measuring point faults may only be rectified by authorised and specially trained personnel.
If faults cannot be rectified, products must be taken out of service and secured against unintentional commissioning.
Repairs not described in these Operating Instructions may only be carried out at the manufacturer or by a designated service organisation.

1.3 Operational safety



The sensor has been designed and tested according to the highest standards and it left the factory in perfect functioning order.
Relevant regulations and European standards have been met.
As the user, you are responsible for complying with the following safety conditions:
Installation instructions
Local prevailing standards and regulations

1.4 Return

If the device requires repair, please send it in cleaned condition to the appropriate sales centre. Please use the original packaging.
Please enclose the completed "Declaration of Decontamination" (available for download on our homepage) with the packaging and in addition, the shipping documents.
No repair is possible without the completed "Declaration of Decontamination"!
For optimized shipment, please contact FAUDI-Aviation Shipping department ahead of shipment, e.g. to get a proforma invoice.

1.5 Degree of protection (IP-Code)

For safety reasons, connectors must be protected from outside influences like dust, foreign objects, direct contact, and heavy rain. This protection is provided on industrial connectors by their housings with their latching devices and sealed cable entries.

To ensure IP67 protection, AFGUARD must always be connected to the dedicated cable with its proper cable connector. Without connection, IP67 protection cannot be guaranteed!

High pressure cleaners (such as Kärcher) that use high pressure and/or high temperatures must not be used on the sensor. This can cause harmful effects and the sensor can react with a failure signal or can be destroyed.



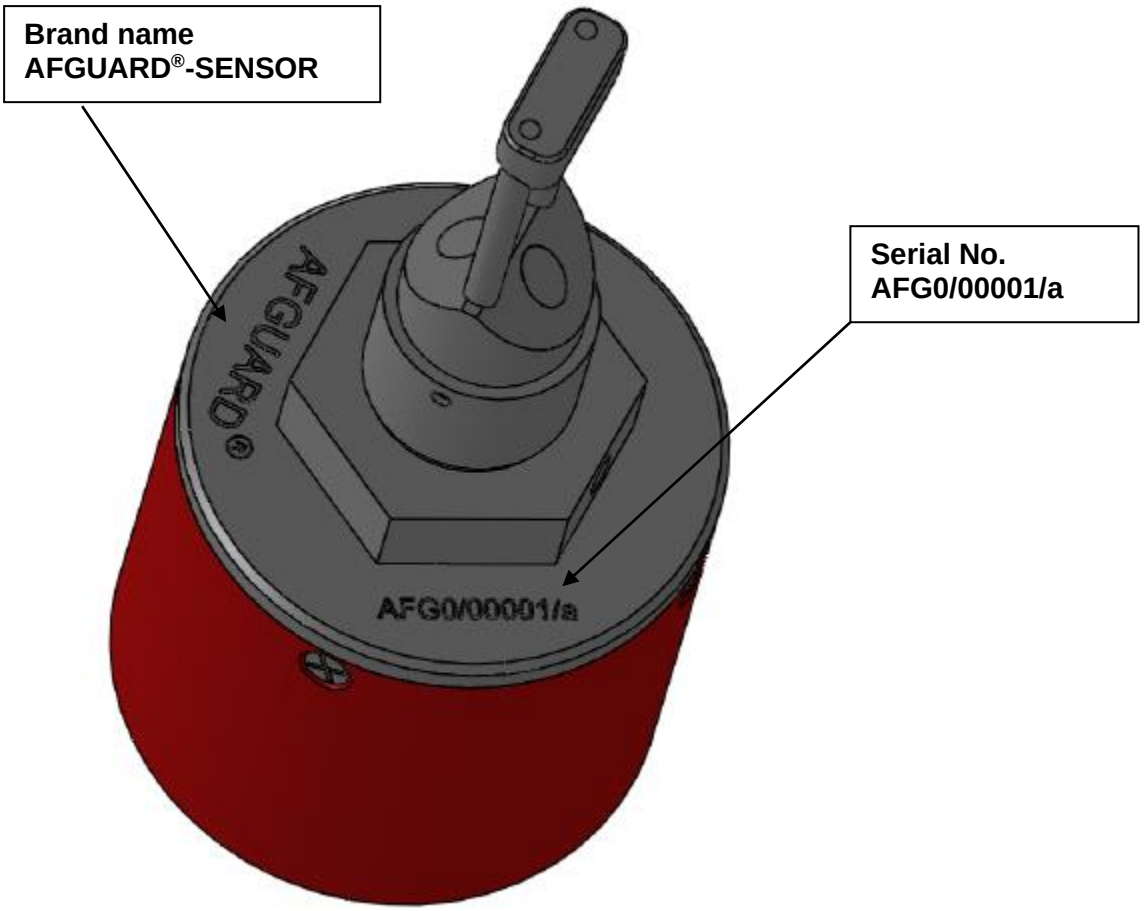
Notes on safety icons and symbols

	Warning! This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.
	Caution! This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.
	Note! This symbol indicates important items of information.
	Warning! This symbol alerts you to possible faults which can end in explosion. They can cause serious damage to the instrument or to persons if ignored.

2 Identification

2.1 Product structure

The AFGUARD® is marked with the following, permanently identification markings.
At the head of the Sensor, you will find the engraved name AFGUARD® and serial No. – see attached picture.

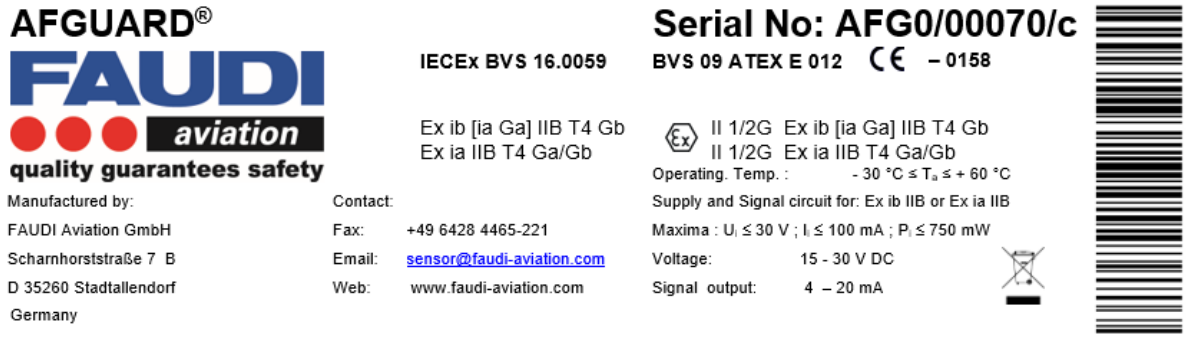


The Series No. is the distinctive feature that distinguishes the AFGUARD® from one other. It is born according the following attributes:

Engraved Serial No.: AFGX/XXXXX/a

- **Year of construction**
- **Serial number (5 digits)**
- **0 = Ex-Version zone 0/1**
- **Name**

In addition to the markings of name and serial No., there is an engraved nameplate on the housing of the AFGUARD® with additional information:



Picture: Nameplate of a Hazardous Area approved Version of the AFGUARD® for hazardous Area Zone 0/1

2.1.1 Nameplate

It is prohibited to commission the equipment if the nameplate is no longer legible or is completely missing.
Take organizational measures to ensure:
That the nameplate and possible affixed prohibition, or instruction labels on the equipment are kept legible!

If the nameplate is painted on or destroyed, the sensor is damaged and may no longer be used.
Solution: Remove the paint or buy a new sensor!
Make sure the sensor is not damaged by using chemical products when removing the paint.

2.2 Scope of delivery

The following items are included in the delivery:



Transport case – Hard-Top Case with foam
AFGUARD® with protective screw pipe to protect the mirror and optical path of the sensor
Set of accessories with the following content:

- 2 mm and 1.5 mm sealings,
- Aluminium and SS thread,
- Blue 15 m cable with Sensor plug connector,
- Operating Instructions – underneath the foam cover
- Calibration protocol

If you have any questions, please ask your local supplier or distributor.

3 Installation and dismantling

3.1 Incoming acceptance, transport, and storage

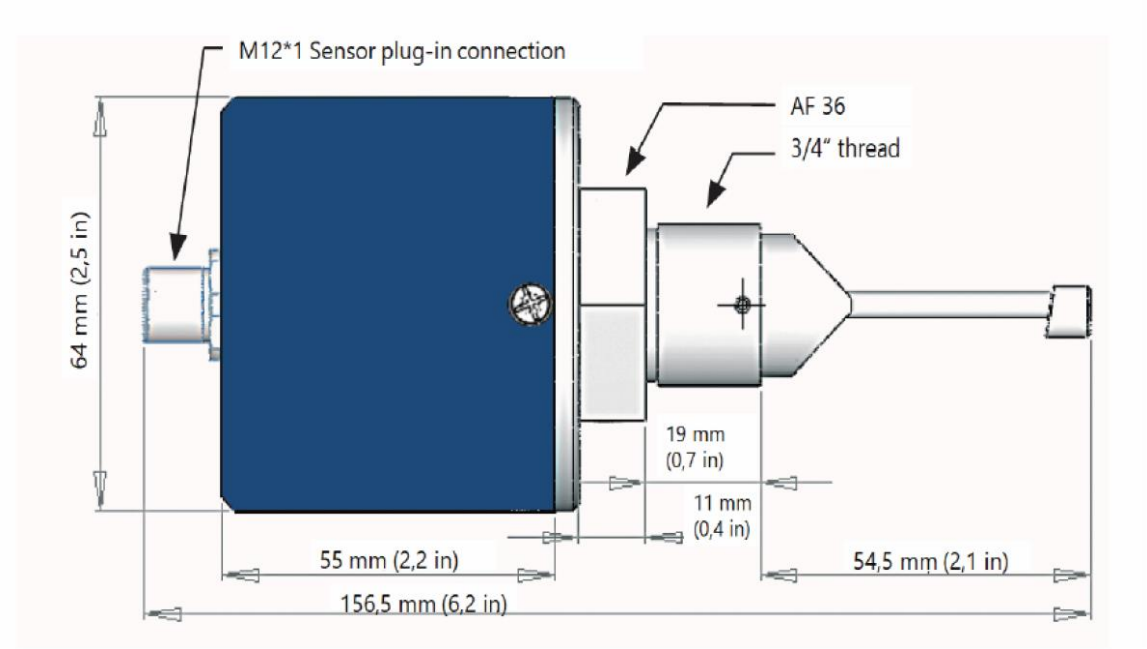
You should have received a delivery as shown in the picture below.



Make sure the packaging is undamaged!
Inform the supplier about any damage to the packaging.
Keep the damaged packaging until the matter has been settled.
Make sure the contents are undamaged!
Inform the supplier about any damage to the delivery contents. Keep all damaged products until the matter has been settled.
Check that the scope of delivery is complete and agrees with your order and the shipping.
The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
If you have any questions, please contact your supplier or your assigned sales centre.

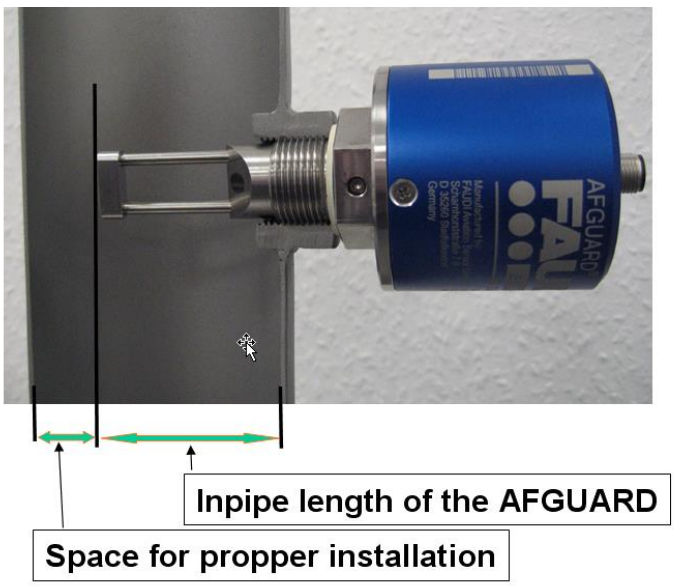
3.2 Installation conditions

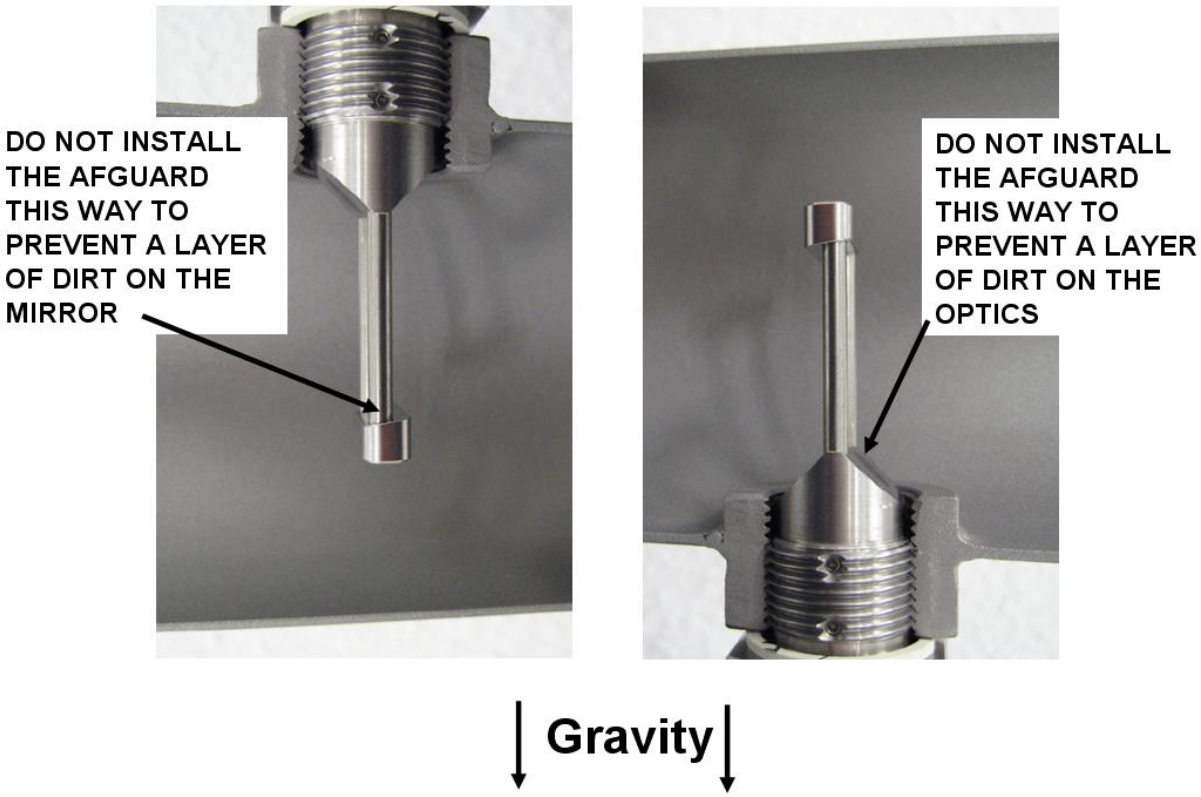
3.2.1 Dimensions



3.2.2 Mounting Position

The AFGUARD® must be mounted **horizontally**. Also check the drawing on page 13. Do not mount the AFGUARD® upside down. Make sure that there is enough space inside the pipe to prevent contact between the rear wall and the mirror during assembly – space for proper installation.





Do not touch the optics or mirror to avoid damaging it.

3.3 Thread for AFGUARD® installation

The AFGUARD® uses special threads to be weld into the pipe section. Threads are available in Stainless steel and Aluminium.
Ensure to only use FAUDI-Aviation threads as they have been specially designed for that purpose. Standard threads do not work with the AFGUARD®.

Welding instructions are part of each socket delivery.

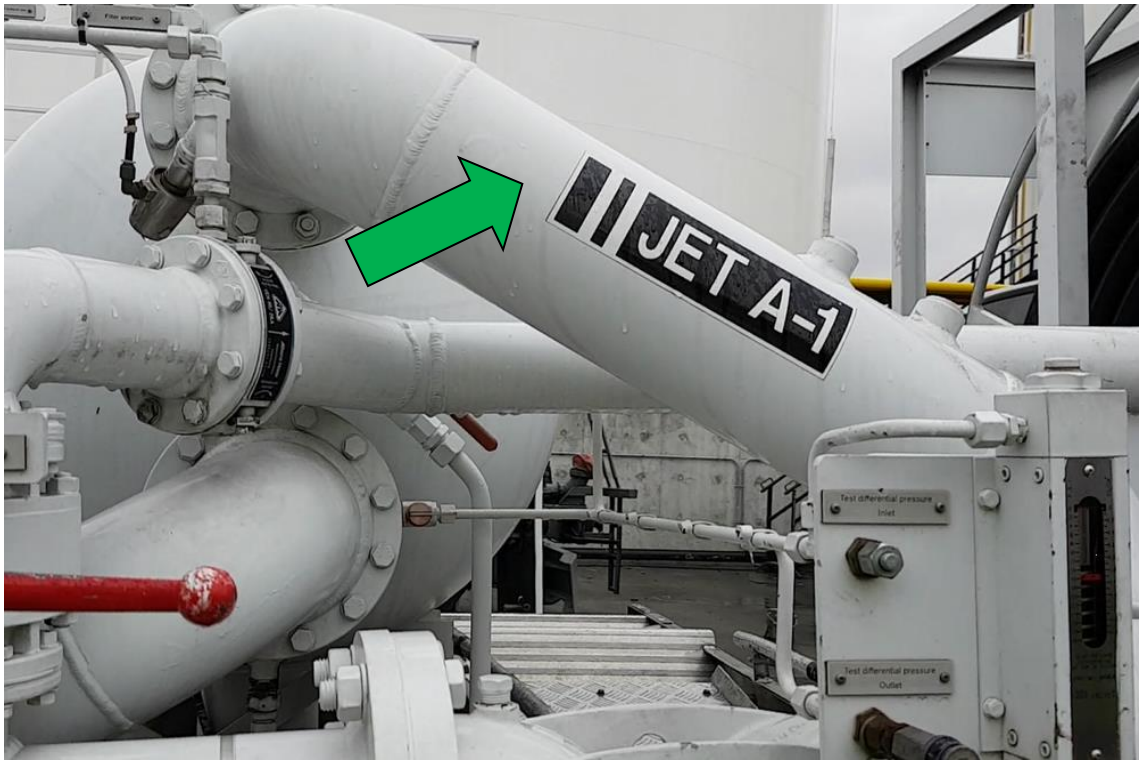
3.3.1 Installation location

Select the installation location so that there is easy access for future checks and service work.
Make sure that the AFGUARD® and related assemblies are secured safely and vibration-free. FAUDI Aviation would be happy to provide a good, picturized guideline on how to select a proper place for the installation of the AFGUARD®. Installation itself should be carried out by trained technicians, most probably by Trained Installers or Certified Installers.

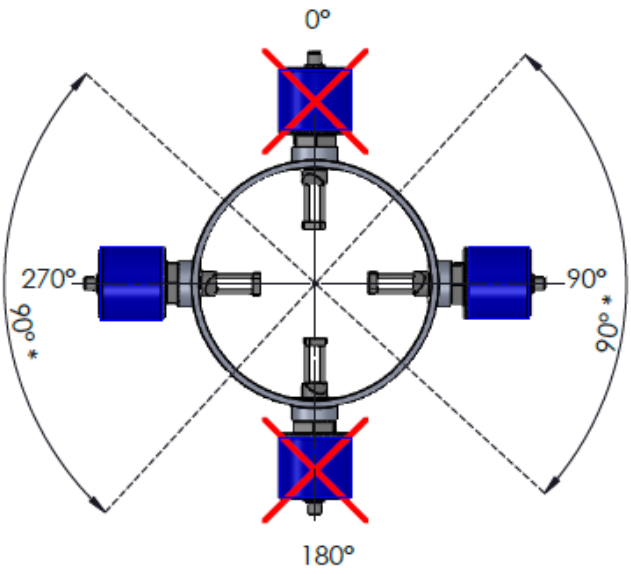
Procedure for proper AFGUARD® installation

Step 1:

Select the best place for installation in the effluent pipe section.



Have a look on the assembly area:



* Montagebereich
ASSEMBLY AREA

Step 2:

Drain the pipe section.

Step 3:

Disconnect the pipe section from the vessel and clean the pipe section from flammable fluids.

Step 4:

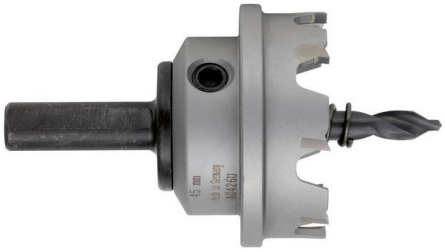
Drill the hole for the AFGUARD® socket.

Drilling tools:

HSS 45mm cylindrical saw for a hand drill

AFGUARD® stainless steel socket

FAUDI article number: 600355

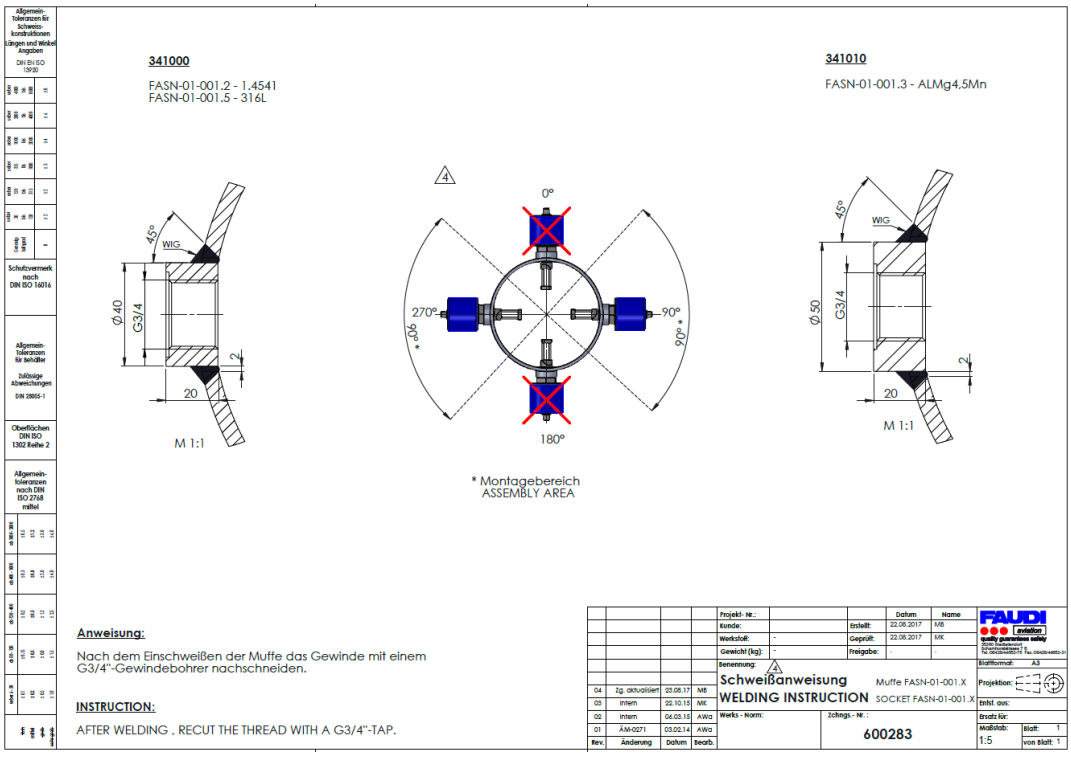


HSS 54mm cylindrical saw a hand drill

AFGUARD® aluminum socket

FAUDI article number: 600356

Please pay close attention to the welding instructions.



Step 5:

Weld the special AFGUARD® socket into the pipe section.





Step 6:

After welding, it is recommended to thread the socket with a G3/4”-thread cutter.



Step 7:

Proceed a pressure test to ensure the required PN rating of the pipe section.

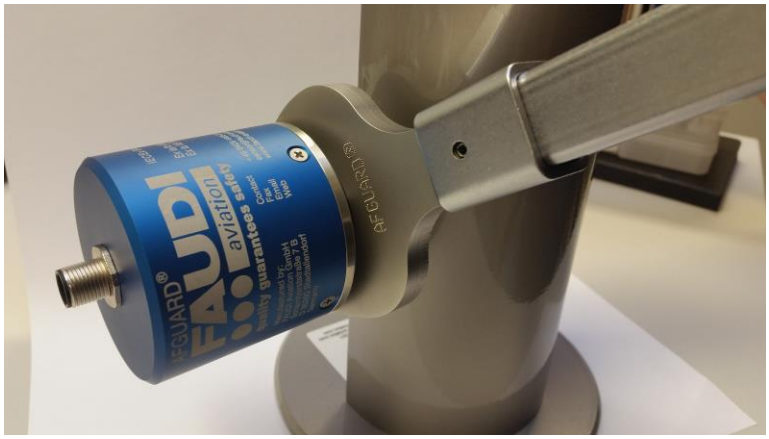
Step 8:

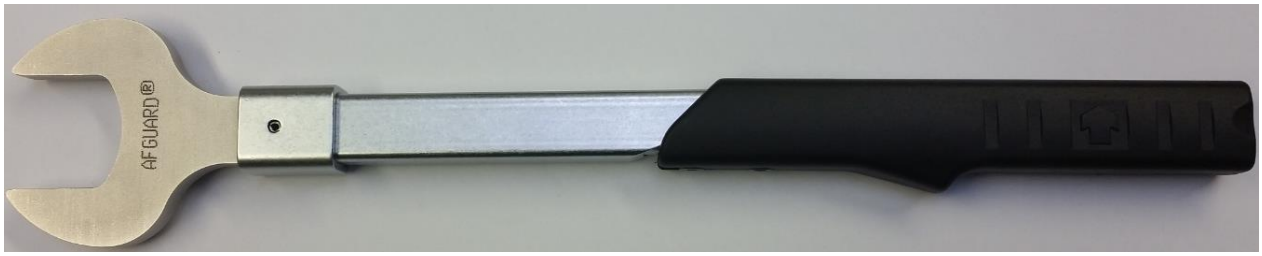
Reassemble the pipe section (ensure to use good working seals).

Step 9:

Install the AFGUARD® in the socket with one of the provided special KLINGERSIL-sealings. Start with the 2 mm one and check the AFGUARD orientation in the pipe section. If not adequate – replace it with the 1.5mm one.

Use the special AFGUARD® torque spanner to achieve the recommended torque of 50Nm.





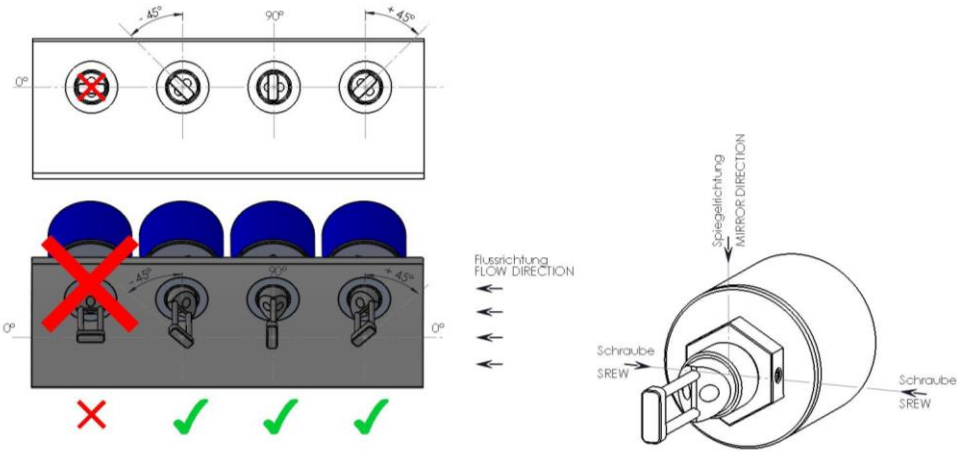
Step 10: AFGUARD spanner - FAUDI article no 600513

Connect the AFGUARD® to the control system of the truck / tank farm by using the blue two wire cable.

For hazardous area use, please ensure to only use the AFGUARD® together with a suitable barrier with power supply.

3.3.2 AFGUARD orientation in the pipe section

AFGUARD® is capable of detecting different droplet size distributions. Especially for bigger droplets, AFGUARD® orientation in the pipe section is of major importance.
Therefore, we recommend installing the AFGUARD according the following image:



Orientation of AFGUARD® could be achieved using one of the supplied sealings. Start with the 2 mm sealing to get an idea about the AFGUARD orientation (using the AFGUARD® spanner). If insufficient, replace with the 1.5 mm sealing.

3.3.3 Measuring system

- A complete measuring system comprises at least:
- The AFGUARD® sensor
- Sealing (select the 1,5 mm **or** the 2 mm seal which is provided together with the AFGUARD)
- Two-wire cable connection with plug connector. Only the cable delivered together with the AFGUARD® should be used.
- Isolating converter with transmitter supply.

3.3.3.1 Isolating converter with transmitter supply for signal output 4 to 20 mA (inherent safe)

Manufacturer	Type	Rating. EGB for Explosion group „IIB“				
		Uo	Io	Po	Co	Lo
Endress + Hauser	RMA42	27,3 V	96,5 mA	659 mW	352 nF	100 mH
	RN221N (PTB 00 ATEX 2018)	27,3 V	87, 6 mA	597 mW	683 nF	18,9 mH
Phoenix Contact	**MACX MCR-EX-SL-RPSS-I**	**25,2 V**	**93 mA**	**587 mW**	**820 nF**	**4 mH**

FAUDI Aviation highly recommends the use of isolating converters with transmitter supply. Especially for use in hazardous areas, the use of inherent safe isolating converters is mandatory. Protection class can be "ia" or "ib".

3.3.3.2 Proof of intrinsic safety for the interconnection of simple electrical circuitry Ex i

When using AFGUARD® in combination with an isolating converter with transmitter supply (sometimes together with other equipment like displays), it is evident to make sure that such equipment may be used together. This should be done before installation. If you are not sure on how to proceed, please contact FAUDI Aviation GmbH.

Example: Combination of AFGUARD (Ex ia IIB) together with RN 221N (E+H)

Intrinsic safe AFGUARD		Proof of intrinsic safety	Isolating converter with power suply		
AFGUARD Zone 0/1 Ex ia IIB			RN221N (E+H) Ex ia IIB		
	Data			Data	Remarks
U_i	30 V	≥	U_0	27,3 V	comply
I_i	100 mA	≥	I_0	87,6 mA	comply
P_i	750 mW	≥	P_0	597 mW	comply
L_i+L_c		≤	L_0	18,9 mH	L_i negligible
C_i+C_c		≤	C_0	683 nF	C_i negligible

cable data according to EN 60079-14, 12.2.2.2					
L_C	1 µH/m	results in	18900	m	length of cable
C_C	200 pF/m	results in	3415	m	length of cable

Use the result with shorter cable length

max. cable length	**3415**	**m**	*acc. EN 60079-14*

The calculation delivers the maximum length of cable (please use specific cable data) to be used for the specific combination of AFGUARD, optional Display, and isolating converter with power supply.

3.3.4 Installing a measuring point

The AFGUARD® is an optical working measuring device that is designed for use in field applications under rough conditions. Regarding these circumstances, some minimum directives must be considered:
The optical path of the AFGUARD® (Glass rod, Mirror) is specially adjusted to the application.
Avoid direct contact with hard or sharp edges. Do not touch with unprotected hands.
During installation of the AFGUARD®, be careful when applying force.
The recommended fastening force is 50 Nm – the AFGUARD spanner should be used.
Handle the connection cable with care. Do not lay the cable under stress. Try to avoid sharp angles.
Protect the cable against "getting caught".



Please take care of possible electrostatic charges on the outer surface of the cable. The cable may only be cleaned by using a damp cloth.

FAUDI Aviation highly recommends the use of isolating converters with transmitter supply. Especially for use in hazardous areas, the use of inherent safe isolating converters is mandatory. Protection classes "ia" or "ib" are allowed.

3.4 Installation examples

Try to only touch the AFGUARD® on the housing when taking it out of the box.
Remove the protection device from the optics.
Put the sealing over the thread in front of the Sensor. Only use one seal – the 1.5 mm or the 2 mm seal, which were delivered together with the AFGUARD®. Do not use other sealing than the ones recommended by FAUDI Aviation GmbH.
Screw the sensor into the fitting.
Manually secure it and apply the recommended torque setting of approx. 50 Nm.
Check the sealing.
Adjust the cable. Make sure no stress is applied to the cable.

Connect the cable to the responding connecting terminals using one of the recommended isolating converters with transmitter supply.
Finally, connect the plug with the responding plug socket at the rear end of the AFGUARD®

3.5 Check of Correct Assembly

Check the mounting position.
Check the recommended torque setting of 50 Nm by using of the AFGUARD® spanner.
Check against any leakages. Make sure the AFGUARD® sensor is correctly positioned.
Check the signal cable. Try to position it in a way as to prevent water from going straight to the plug. The direction of the cable should be downwards or horizontal.
Avoid applying any stress to the cable.

3.6 Dismantling

The dismantling of the Sensor is made by reversing the steps used to install the AFGUARD®.
Make sure that the power is off and the pipe work is free of pressure and empty (medium free).
Remove the sensor plug connection.
Screw the Sensor out.
Remove the sealing,
Screw in a blind plug instead of the Sensor (do not forget the sealing).
Clean the Sensor and check it carefully.

To send the Sensor back for service purposes, please fill out the declaration of decontamination (chapter 12), which is available for download on our Homepage.
Use the original transport box for storage and/or transport.

4 Cabling



WARNING!
The electrical connection must only be carried out by authorised technical personnel.
Technical personnel must have read and understood the instructions in this manual and must adhere to them.
Ensure that there is no voltage at the power cable before beginning connection.



It is only permitted to use the cable specified by FAUDI Aviation GmbH.
For direct connection between the AFGUARD® and the recommended isolated converter with transmitter supply, FAUDI Aviation delivers 15 m of two-wired cable with isolated plug adapter M12*1. The cable can only be shortened by authorized technical personnel.
The following connection is recommended:

Colour of cable	Function
blue	Signal output
brown	Power supply



It is only allowed to clean the cable using a damp cloth to prevent electrostatic charges.

4.1 Direct connection to isolated converter with power supply



The AFGUARD® must be connected via specified sensor cable with plug adaptor with the terminal clamps of an inherent safety isolated converter with power supply.
The marking "II 1/2G Ex ib [ia] IIB T4" applies to the transmitter in case of being supplied by means of an IS 2-wire supply, and signal circuit providing level of protection "Ex ib IIB."
The marking "II 1/2G Ex ia IIB T4" applies to the transmitter in case of being supplied by means of an IS 2-wire supply, and signal circuit providing level of protection "Ex ia IIB."

The power circuit parameters should comply with:

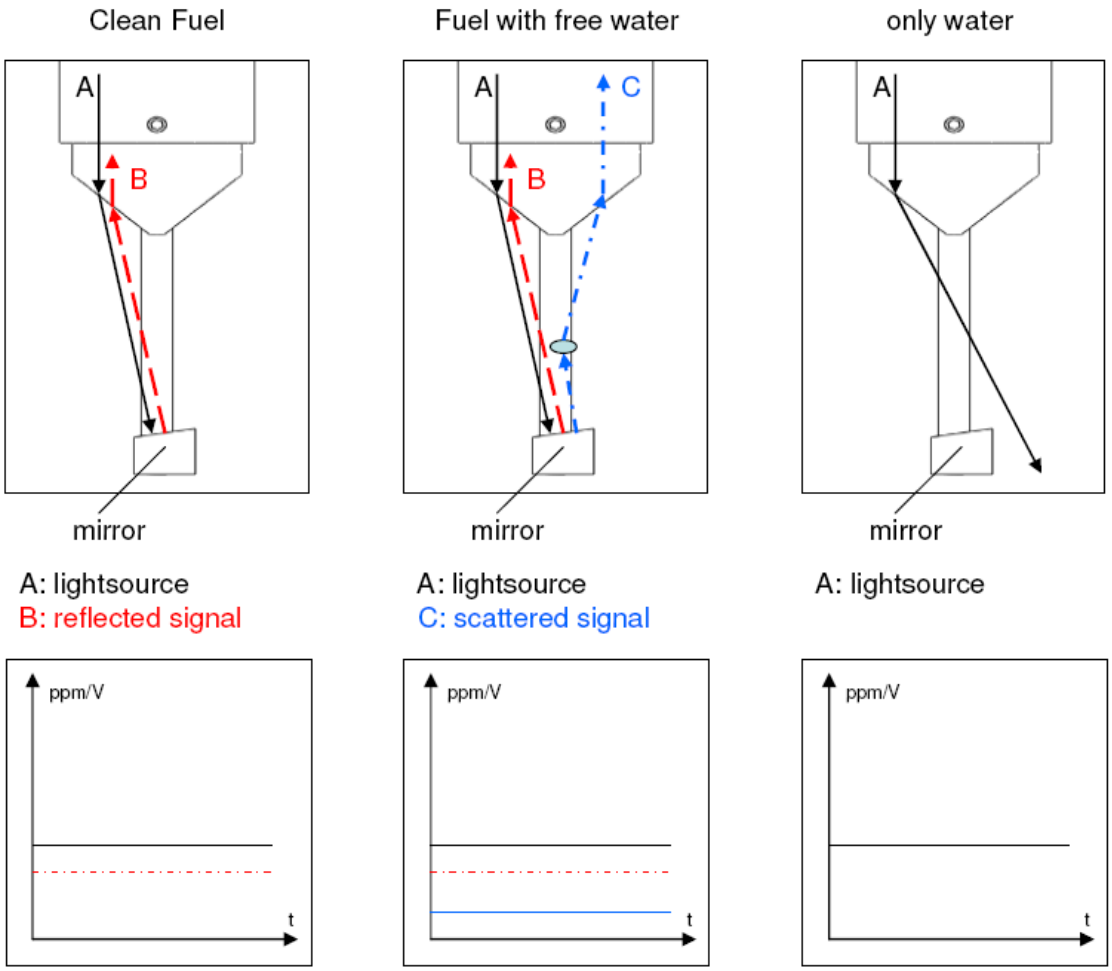
Supply and signal circuit intended for connection to an intrinsically safe 4 to 20 mA current loop

Voltage	U_i	DC	30	V
Current	I_i		100	mA
Power	P_i		750	mW
Effective internal capacitance	C_i		negligible	
Effective internal inductance	L_i		negligible	

Make sure to follow the manufacturer's instructions of the operating manual that will be provided with your isolating converter with power supply. For hazardous areas, make sure to use correct intrinsically safe power supply.

5 Operation

5.1 Mode of Operation



The AFGUARD® is an inline Sensor to detect the content of free water phases in Jet Fuel. The principle of measuring can be described as refraction index bases IR scattered light effect.

Operation:

Clean Fuel: Pulsed IR light – (Transmitter A) leaves the optics under defined refraction index, passing through the Jet Fuel until the mirror is reached, being reflected, and going back to the optics where the signal intensity is being measured. The difference between transmitted and received light intensity will be handled for:
Internal adjustment, for example if there is some debris on the optics or the mirror caused by dirt in the Jet Fuel.
Self Check of electronics.
As long as there is no free water in the measuring zone, there will be no scattered light.

Fuel with free water: Free water in Jet Fuel as fine dispersed second phase will be detected as scattered light by receiver C. During the whole process, the self-checking functionality of the electronics is ongoing.

Only water (water slug): If there is a water slug phase, the refraction index will change. This results in another angle of light beam leaving the optics (A). Under this principle, it is easy to differentiate between Jet Fuel and water. Additionally, AVGAS and Gas phases could be determined.

Optional measuring of gas phases:
The AFGUARD® can detect gas phases. This can irritate the measurement signal as it interferes with the free water content.

5.2 Signal output

The signal output of the AFGUARD® is 4 to 20 mA as according to worldwide standards. Additionally, the AFGUARD® gives out a lower and upper signal:

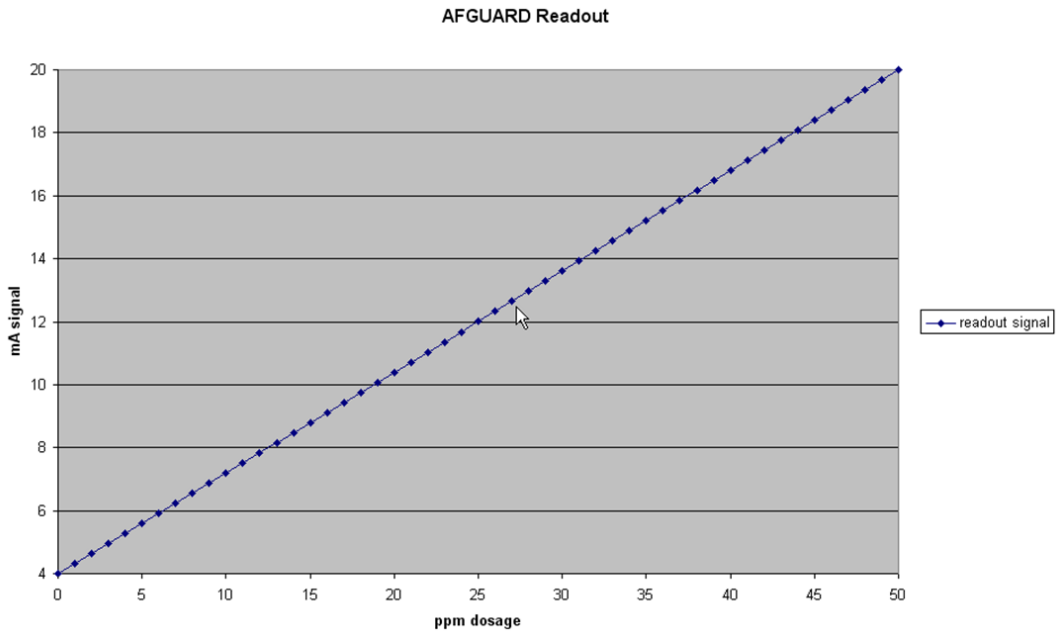
Signal output:	< 3.8 mA:	Self Check (Electronics)
Signal output:	4 to 20 mA:	Measuring range 0 to 50 ppm
Signal output:	> 20.2 mA:	Water slug, Gas phases

5.3 Calibration

The AFGUARD® leaves the factory calibrated to Jet A/Jet A1. FAUDI recommends checking the AFGUARD® on a yearly basis (2 years after initial calibration).

In case there are no special requirements made for designated use of the AFGUARD®, the AFGUARD® leaves the factory calibrated for 0 to 50 ppm Jet A1.
Other calibration curves could be asked for if needed.

Signal output (AFGUARD® readout curve depending on calibration status)**:**



6 Commissioning

Before first commissioning, check if:

- the sensor is correctly installed.
- the electrical connection is correct and was carried out by trained specialists as per the regulations currently in force.

6.1 Check of Installation and function

Warning!
Before applying pressure to the system, make sure the connections are correctly fitted.
Check the cabling and electrical installation.
Do not paint or stick anything to the housing of the sensor. Especially when using the Hazardous Area approved AFGUARD®.
Make sure that the AFGUARD® is connected to an isolating converter with transmitter supply.



Picture for Installation and functioning check

The following procedure is recommended to check the functionality of the AFGUARD® if there is no response during installation and start up.
Keep a digital current meter ready for use.

1. Connect the AFGUARD with supply voltage in the range between 16 VDC and 30VDC
brown = +Ub
blue = –Ub

2. Connect the digital current meter at the 4 to 20 mA outlet (blue cable) against –Ub.

3. Check the output signal (electrical current):

No signal:	Cable / Connector damaged – check if the cable is broken
< 3,8 mA:	Self check / Sensor damaged
Between 4..20 mA:	AFGUARD® submerged in Jet Fuel
> 20,2 mA:	AFGUARD® in Air or submerged in Water

7 Loop check

FAUDI developed a special device to check the loop behind the AFGUARD to ensure that critical signals from the AFGUARD will be handled as required.

A loop test protocol for the periodic check of the loop behind the EWS can be provided on request.

Loop test protocol using the AFGUARD loop tester

- FAUDI part no: 600514 reflecting JIG requirements
- FAUDI part no: 600754 reflecting A4A requirements

Test protocol for AFGUARD® installation with ……..

ok

Requirements: System must be powered on, loop tester installed instead of AFGUARD®

Pre test (no button pressed)

Function test for 4 mA base signal of AFGUARD® sensor
➡ No further interaction (do not press any function button)
Output 4 mA or 0 ppm ☐

Test 1: Fail safe test AFGUARD -> signal output << 4 mA – blue lamp off
Function test for NAMUR 1
Press F1:
Output: Immediate reply (LED F1 constantly on) – blue lamp should be off (no blinking) ☐

Test 2: Warning level -> signal output representing > 15 ppm – slow blinking blue lamp
Function test for warning level
Press F2 for warning level (15 ppm < water level < 30 ppm)
Output: LED blinking -> after _10__ seconds LED constantly on - blue lamp slowly blinking ☐

Test 3: Alarm level -> signal output representing > 30 ppm – fast blinking blue lamp
Function test for alarm level
Press F3 for alarm level (water level > 30 ppm)
Output: LED blinking -> after _10__ seconds LED constantly on ☐

Test 4: Water slug indication -> signal output >> 20 mA – fast blinking blue lamp
Function test for water slug indication
Press F4 for water slug (water level >> 50 ppm)
Output: LED blinking -> after _5__ seconds LED constantly on ☐

Test 5: AFGUARD broken wire -> no mA signal – blue lamp off
Disconnect the AFGUARD cable – blue lamp should be off (no blinking) ☐

Remarks:

Part of the loop test protocol

8 Maintenance

8.1 Cleaning of the AFGUARD®

The sensor has a functional coating that makes it very unlikely that optical surfaces are contaminated. Caution is advised when touching the functional layer.

The sensor intelligence will detect and compensate minor deviations.
Should severe measuring deviations occur during operation, we recommend dismounting the sensor and cleaning the optical path:

- Surfaces of glass elements of the sender and receiver, as well as the mirror.
- Please use only soft, fuzz-free cloths, to avoid any damage to the optical path, such as scratches or brush marks.

9 Recertification and recalibration of AFGUARD®

AFGUARD® will be delivered calibrated to the customer's requirements. Standard calibration range is 0 to 50 pm free water in Jet Fuel. Other calibrations ranges are possible, but must be especially requested.
After a certain period of use, AFGUARD® needs to be checked to assure actual measurement results are still in the expected measurement range. A so-called recertification needs to be done. If recertification fails (deviation of measurement result is out of scope) – the AFGUARD® must be recalibrated.

The following recertification intervals are to be followed and are mandatory:
AFGUARD® for first installation (brand new AFGUARD®):
Two years after initial calibration – see calibration report
AFGUARD® for second and following recertification intervals:
Every year after previous recertification / calibration

9.1 Firmware on AFGUARD®

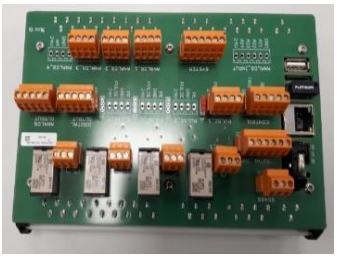
AFGUARD® runs a firmware which must be in line with the requirements defined in JIG statements. The actual firmware to be conformant to JIG 130 is firmware 1.19.
If you are not sure about your actual firmware status – please look at the latest calibration report of your AFGUARD® or contact your FAUDI-Aviation service organisation.

REMARKS	SOFTWARE 20_08_19 FIRMWARE 01.19 P2 Jet A-1

For further information regarding recertification / recalibration, please contact your local FAUDI Aviation sales contact.

10 Accessories

To make installation as easy as possible, FAUDI Aviation GmbH recommends the use of the below mentioned devices.

CCS (Contamination Control System) Order reference: 740000 Description: CCS Silver ***Or*** Order reference 730000 Description: CCS Gold Gold and silver are linked with: AFGUARD® (120500), Barrier 1 channel (600517), blue LED warning light (600361), SLUGGUARD® (600306), external key switch (600087) The CCS is developed to process, in combination with the AFGUARD, the actual free water contamination in fuel. It relays outputs to switch alarms and warnings according to the latest specifications. Logged data can be stored on memory sticks or be sent out to connected SCADA system.	 
Barrier 1 channel Order reference: 600517 Description: Barrier, 1-Channel, EX I, Zone 2 Linked with: AFGUARD® (120500) Quantity: 1 PHOENIX barrier - Ex i with power supply and input signal conditioner: -Transmits supplied or active 0/4 - 20mA signals from the hazardous area to a load (active or passive) in the safe area -Electrical isolation -SIL 2 according to IEC 61508 -With screw connection	

Blue LED warning light Order reference: 600361 Description: Blue LED warning light 24 V DC IP66 Linked with: Contamination Control System Silver (740000) Light indicator according to JIG bulletin 110 to indicate warning and or alarm situation in case of critical levels of free water.	
AFGUARD® loop tester Order reference: 600514 Description: AFGUARD® Loop Tester Linked with: AFGUARD® (120500) Loop tester to periodically test the loop of the AFGUARD installation according to JIG requirements.	
AFGUARD® torque spanner Order reference: 600513 Description: AFGUARD® Torque Spanner To install the AFGUARD sensor with the right torque setting of 50 Nm.	
External key switch Order reference: 600087 Description: External key switch External key switch to reset the warning and alarm levels of the Contamination Control System, non-Ex variant, IP66.	

10.1 Installation accessories

Optional torque wrench with spanner inserts SW36
Optional ¾" sleeve for welding into pipe lines (aluminium/stainless steel)
Spare gaskets for 3/4" sleeve connection.

11 Trouble-shooting

11.1 Trouble-shooting instructions

See chapter 14 issues and solutions.

11.2 Sensor checks



Caution!
Only authorised and trained personnel may test the AFGUARD®!

11.3 Spare parts

Sealing
Cable with Sensor plug
Hard case for storage and transport
Protection sleeve for the optics

11.4 Return



If the device requires repair, please send it cleaned to the sales centre responsible. Please use the original packaging, if possible.
Please enclose the completed "Declaration of Decontamination" (download or copy the page of chapter 15 of these Operating Instructions) with the packaging and the transportation documents.
No repair will be carried out without the completed "Declaration of Decontamination"!

11.5 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.
Please observe local regulations.

12 Technical Data

12.1 Input

Measured value	Free water [ppm] Water slug; Gas phases,
Measuring range	0 … 50 ppm Other ranges on request

12.2 Ambient conditions

Storage temperature	- 40 °C … + 75 °C
Operating temperature	- 30 °C … + 60 °C
Rel. humidity	10 % … 90 %
Ingress protection acc. EN 60529	IP 67

12.3 Performance and parameter

Supply and signal circuit intended for connection to an intrinsically safe 4 to 20 mA current loop:		
Voltage	U_i	DC 30 V
Current	I_i	100 mA
Power	P_i	750 mW
Optical radiation (Power output)		
Wave length		840 nm ≤ f ≤ 1050 nm
Optical power		≤ 12 mW
Irradiation intensity		≤ 1,025 mW/mm²
Light pulse-Energy		≤ 53 µJ
Ambient conditions and Explosion group and Temperature class		
Ambient temperature		-30 °C ≤ T_a ≤ 60 °C
Explosion group		IIB
Temperature class		T4

12.4 Process conditions

Operating pressure	Max. 10 / 16 bar, no vacuum
Process Temperature	- 30 °C … + 60 °C
Process medium	Kerosene, Jetfuel,

12.5 Layout

Design, Dimensions	See chapter 3.2.1	
Weight	Sensor hazardous approved:	ca. 1 kg
Materials (in contact with medium)	Sensor head: Glass rod: Sealing:	SS 1.4301 optical Glass Klingersiel FKM intern

Process connections:	Thread: Length of thread: Wrench size: Torque setting:	G3/4“ 25 mm AF 36 mm 50 Nm
Cable connection	Sensor plug	
Length of cable	Delivered length: specification:	15 m
Temperature compensation	internal	

12.6 Reliability prediction

Zuverlässigkeitsberechnung (Reliability Prediction)

Typenbezeichnung:	AFGUARD®
Material Nummer:	220500
Status:	Serie
Betriebstemperatur [°C]	40
Betriebsspannungsbereich [VDC]	16 - 30
Berechnungsgrundlage:	EN ISO 13849-1:2015
Berechnungsmethode	Part Count
MTTF(d)-Komponenten (Worst Case)	Faktor 10
50% gefahrbringende Fehler	Faktor 0.5
Umgebungstemperatur [°C]	40
Betriebsbedingungen	Nennbelastung
MTTF-Basiswerte (übrige Komponenten)	MIL-HDBK 217F, Notice 2 / RDF 2000
Umgebungsbedingungen	Ground mobile, 40°C
Bedingung	konstante Ausfallrate

Total:	**Worst Case**
Mean time to dangerous failure $MTTF_d$ [Jahre]	> 42 (without regular checks)
Mean time to dangerous failure $MTTF_d$ (based on yearly checks)	> 84 (yearly check)
Mean time to dangerous failure $MTTF_d$ [Stunden, h]	> 736134
Wahrscheinlichkeit eines gefährlichen Ausfalles je Stunde [1/h]	< 1.36E-06

Hinweise:
- Die Werte der angewendeten EN-ISO-Berechnungsmethode beziehen sich auf Worst Case Betrachtungen, sind jedoch um ca. Faktor 2 besser als nach Berechnung gemäß MIL-HDBK-217.
- Typische Werte können unter Berücksichtigung des effektiven Einsatzes deutlich besser sein.
- Der resultierende MTTF(d)-Wert beurteilt nicht die Sicherheit des Produktes, sondern ist lediglich eine Berechnung resp. Abschätzung der zufälligen Fehler, welche sich auf Grund von zufälligen Hardwareausfällen ergeben, als Ergebnis der begrenzten Zuverlässigkeit von Hardwarebauteilen.

12.7 FMEA

Final Report, Revision 1, Issue Date: February 1, 2021 -> download from JIG server available

13 EC-Type Examination Certificate (Original)

DEKRA

(1) **EG-Baumusterprüfbescheinigung**

(2) **- Richtlinie 94/9/EG -**
Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen

(3) **BVS 09 ATEX E 012**

(4) **Gerät:** **AFGUARD® Typ: AFG0/xxxxx/x**

(5) **Hersteller:** **FAUDI Aviation Sensor GmbH**

(6) **Anschrift:** **35260 Stadtallendorf**

(7) Die Bauart dieses Gerätes sowie die verschiedenen zulässigen Ausführungen sind in der Anlage zu dieser Baumusterprüfbescheinigung festgelegt.

(8) Die Zertifizierungsstelle der DEKRA EXAM GmbH, benannte Stelle Nr. 0158 gemäß Artikel 9 der Richtlinie 94/9/EG des Europäischen Parlaments und des Rates vom 23. März 1994, bescheinigt, dass das Gerät die grundlegenden Sicherheits- und Gesundheitsanforderungen für die Konzeption und den Bau von Geräten und Schutzsystemen zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen gemäß Anhang II der Richtlinie erfüllt.
Die Ergebnisse der Prüfung sind in dem Prüfprotokoll BVS PP 09.2120 EG niedergelegt.

(9) Die grundlegenden Sicherheits- und Gesundheitsanforderungen werden erfüllt durch Übereinstimmung mit:

EN 60079-0:2006	Allgemeine Anforderungen
EN 60079-11:2007	Eigensicherheit 'i'
EN 60079-26:2004	Gerätegruppe II Kategorie 1G

(10) Falls das Zeichen „X" hinter der Bescheinigungsnummer steht, wird in der Anlage zu dieser Bescheinigung auf besondere Bedingungen für die sichere Anwendung des Gerätes hingewiesen.

(11) Diese EG-Baumusterprüfbescheinigung bezieht sich nur auf die Konzeption und die Baumusterprüfung des beschriebenen Gerätes in Übereinstimmung mit der Richtlinie 94/9/EG.
Für Herstellung und Inverkehrbringen des Gerätes sind weitere Anforderungen der Richtlinie zu erfüllen, die nicht durch diese Bescheinigung abgedeckt sind.

(12) Die Kennzeichnung des Gerätes muss die folgenden Angaben enthalten:

II 1/2G Ex ib [ia] IIB T4
II 1/2G Ex ia IIB T4

DEKRA EXAM GmbH
Bochum, den 04. August 2009

Zertifizierungsstelle Fachbereich

Seite 1 von 3 zu BVS 09 ATEX E 012
Dieses Zertifikat darf nur vollständig und unverändert weiterverbreitet werden.
DEKRA EXAM GmbH Dinnendahlstraße 9 44809 Bochum Telefon 0234/3696-105 Telefax 0234/3696-110 E-mail zs-exam@dekra.com

DEKRA

(13) Anlage zur

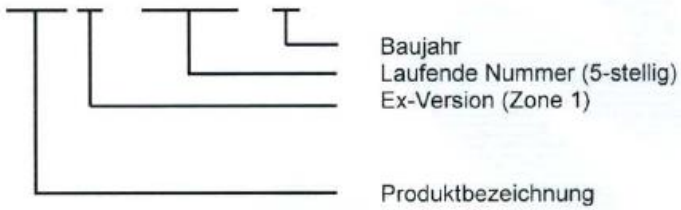
(14) # EG-Baumusterprüfbescheinigung

BVS 09 ATEX E 012

(15) 15.1 Gegenstand und Typ

AFGUARD® Typ: AFG0/xxxxx/x

Eingelaserte Seriennummer:
AFG 0 / XXXXX / X



15.2 Beschreibung

Der AFGUARD® Typ: AFG0/xxxxx/x dient zur Messung der Partikel-Verunreinigung in Kraftstoffleitungen.

Der Messumformer des Typs: AFGUARD® besteht aus einem Elektronik-Gehäuse aus Leichtmetall, Edelstahl oder leitfähigem Kunststoff (Oberflächenwiderstand ≤ 10^9 Ω) und einem integrierten optischen Sensor.

Das Elektronik-Gehäuse enthält teilweise in Vergussmasse eingebettete Leiterplatten mit elektronischen Bauteilen.

Der eigensichere Speise- und Signalstromkreis ist auf einen Steckverbinder aufgelegt.

Das Befestigungselement des integrierten optischen Sensorkopfes besteht, unabhängig vom Material des Elektronikgehäuses, aus Edelstahl und ist für den Einbau in die Trennwand zwischen Bereichen mit 1G bzw. 2G Anforderungen bestimmt.

Die Kennzeichnung 'II 1/2G Ex ib [ia] IIB T4' gilt bei Betrieb des AFGUARD® mit einem eigensicheren Zweidraht-Speise- und Signalstromkreis mit Schutzniveau 'Ex ib IIB'.

Die Kennzeichnung 'II 1/2G Ex ia IIB T4' gilt bei Betrieb des AFGUARD® mit einem eigensicheren Zweidraht-Speise- und Signalstromkreis mit Schutzniveau 'Ex ia IIB'.

Dieses Zertifikat darf nur vollständig und unverändert weiterverbreitet werden.
DEKRA EXAM GmbH Dinnendahlstraße 9 44809 Bochum Telefon 0234/3696-105 Telefax 0234/3696-110 E-mail zs-exam@dekra.com

DEKRA

15.3 Kenngrößen

15.3.1 Speise- und Signalstromkreis
zum Anschluss an eine eigensichere 4 bis 20 mA Stromschleife

Spannung	U_i	DC	30	V
Stromstärke	I_i		100	mA
Leistung	P_i		750	mW
innere wirksame Kapazität	C_i	vernachlässigbar		
innere wirksame Induktivität	L_i	vernachlässigbar		

15.3.2 Optische Strahlung

Wellenlänge	840 nm ≤ f ≤ 920		nm
Optische Dauerleistung	≤	12	mW
Bestrahlungsstärke	≤	1,025	mW/mm^2
Lichtimpuls-Energie	≤	53	µJ
Lichtimpuls-Dauer	≤	10	µs
Impulsabstand	≤	1	ms

15.3.3 Umgebungstemperaturbereich :

$-30\ °C \leq T_a \leq 60\ °C$

(16) Prüfprotokoll

BVS PP 09.2120 EG, Stand 04.08.2009

(17) Besondere Bedingungen für die sichere Anwendung

Entfällt

13.1 EC-Type Examination Certificate (Translation)

DEKRA

Translation

(1) **EC-Type Examination Certificate**

(2) **- Directive 94/9/EC -**
Equipment and protective systems intended for use in potentially explosive atmospheres

(3) **BVS 09 ATEX E 012**

(4) **Equipment:** **AFGUARD® type: AFG0/xxxxx/x**

(5) **Manufacturer:** **FAUDI Aviation Sensor GmbH**

(6) **Address:** **35260 Stadtallendorf, Germany**

(7) The design and construction of this equipment and any acceptable variation thereto are specified in the appendix to this type examination certificate.

(8) The certification body of DEKRA EXAM GmbH, notified body no. 0158 in accordance with Article 9 of the Directive 94/9/EC of the European Parliament and the Council of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.
The examination and test results are recorded in the test and assessment report BVS PP 09.2120 EG.

(9) The Essential Health and Safety Requirements are assured by compliance with:

EN 60079-0:2006 General requirements
EN 60079-11:2007 Intrinsic safety 'i'
EN 60079-26:2004 Equipment Group II Category 1G

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the appendix to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to Directive 94/9/EC.
Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate

(12) The marking of the equipment shall include the following:

II 1/2G Ex ib [ia] IIB T4
II 1/2G Ex ia IIB T4

DEKRA EXAM GmbH
Bochum, dated 04. August 2009

Signed: Dr. Eickhoff
Certification body

Signed: Leiendecker
Special services unit

Page 1 of 3 to BVS 09 ATEX E 012
This certificate may only be reproduced in its entirety and without change
DEKRA EXAM GmbH Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 234/3696-105 Fax +49 234/3696-110 E-mail zs-exam@dekra.com

DEKRA

(13) Appendix to

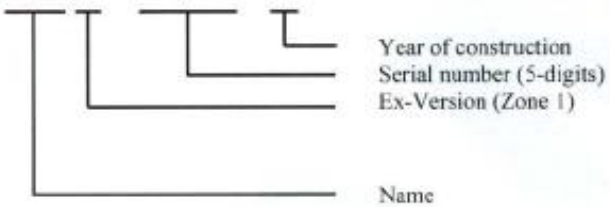
(14) **EC-Type Examination Certificate**

BVS 09 ATEX E 012

(15) 15.1 Subject and type

AFGUARD® type: AFG0/xxxxx/x

Engraved Serial No:
AFG 0 / XXXXX / X



15.2 Description

The AFGUARD® type AFG0/xxxxx/x is used for particle contamination measuring purposes in fuel pipes.

The transmitter of the type AFGUARD® comes with an electronics housing made of light alloy, stainless steel or conductive synthetic material (surface resistance $\leq 10^9\ \Omega$) and an integrated optical sensor.

The electronics enclosure contains PCB, partly embedded in casting compound.

The IS supply- and signal circuit is fitted with a connector.

The mounting assembly of the integrated optical sensor head is made of stainless steel independently of the material of the electronics enclosure and is designated for mounting in the boundary wall between areas requiring 1G or 2G apparatus.

The marking 'II 1/2G Ex ib [ia] IIB T4' applies to the transmitter of the type: AFGUARD® in case of being supplied by means of an IS 2-wire supply- and signal circuit providing level of protection 'Ex ib IIB'.

The marking 'II 1/2G Ex ia IIB T4' applies to the transmitter of the type: AFGUARD® in case of being supplied by means of an IS 2-wire supply- and signal circuit providing level of protection 'Ex ia IIB'.

This certificate may only be reproduced in its entirety and without change
DEKRA EXAM GmbH Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 234/3696-105 Fax +49 234/3696-110 E-mail zs-exam@dekra.com

DEKRA

15.3 Parameters

15.3.1 Supply and signal circuit
intended for connection to an intrinsically safe 4 to 20 mA current loop

Voltage	U_i	DC	30	V
Current	I_i		100	mA
Power	P_i		750	mW
Effective internal capacitance	C_i	negligible		
Effective internal inductance	L_i	negligible		

15.3.2 Optical radiation

Wave length	840 nm ≤ f ≤ 920 nm		
Permanent optical power	≤	12	mW
Radiation power	≤	1.025	mW/mm²
Light pulse energy	≤	53	µJ
Light pulse duration	≤	10	µs
Pulse rate	≤	1	ms

15.3.3 Ambient temperature range:

-30 °C ≤ T_a ≤ 60 °C

(16) Test and assessment report

BVS PP 09.2120 EG as of 04.08.2009

(17) Special conditions for safe use

None

We confirm the correctness of the translation from the German original.
In the case of arbitration only the German wording shall be valid and binding.

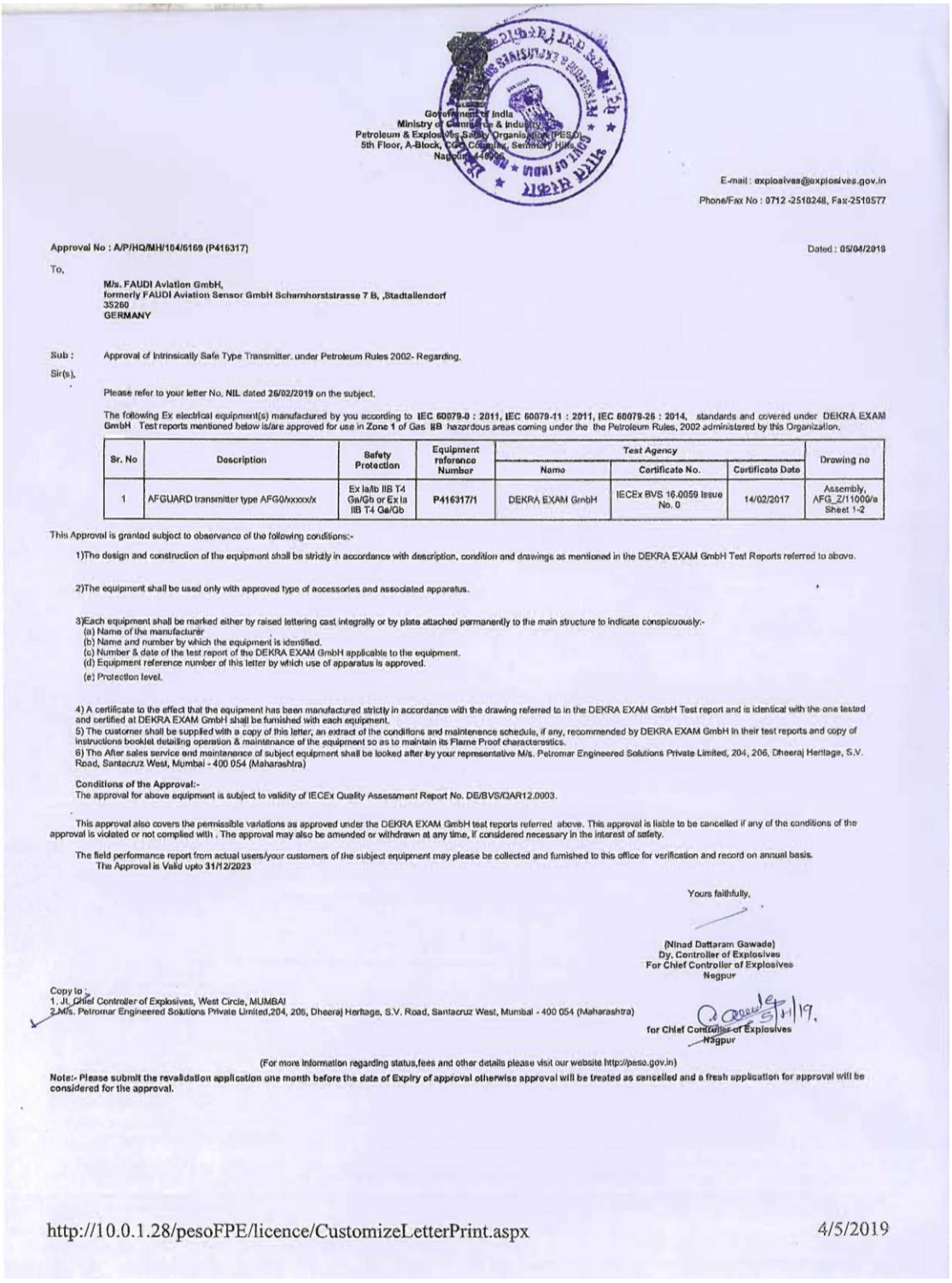
44809 Bochum, 04. August 2009
BVS-Scha / Her A 2080628

DEKRA EXAM GmbH

Certification body

Special services unit

13.2 PESO Certificate for India



Government of India
Ministry of Commerce & Industry
Petroleum & Explosives Safety Organisation (PESO)
5th Floor, A-Block, CGO Complex, Seminary Hills
Nagpur-440006

E-mail : explosives@explosives.gov.in
Phone/Fax No : 0712 -2510248, Fax-2510577

Approval No : A/P/HQ/MH/104/6169 (P416317) Dated : 05/04/2019

To,

M/s. FAUDI Aviation GmbH,
formerly FAUDI Aviation Sensor GmbH Scharnhorststrasse 7 B, ,Stadtallendorf
35260
GERMANY

Sub : Approval of Intrinsically Safe Type Transmitter, under Petroleum Rules 2002- Regarding.

Sir(s),

Please refer to your letter No. NIL dated 26/02/2019 on the subject.

The following Ex electrical equipment(s) manufactured by you according to IEC 60079-0 : 2011, IEC 60079-11 : 2011, IEC 60079-26 : 2014, standards and covered under DEKRA EXAM GmbH Test reports mentioned below is/are approved for use in Zone 1 of Gas IIB hazardous areas coming under the the Petroleum Rules, 2002 administered by this Organization.

Sr. No	Description	Safety Protection	Equipment reference Number	Test Agency			Drawing no
				Name	Certificate No.	Certificate Date	
1	AFGUARD transmitter type AFG0/xxxxx/x	Ex ia/ib IIB T4 Ga/Gb or Ex ia IIB T4 Ga/Gb	P416317/1	DEKRA EXAM GmbH	IECEx BVS 16.0059 Issue No. 0	14/02/2017	Assembly, AFG_Z/11000/a Sheet 1-2

This Approval is granted subject to observance of the following conditions:-

1)The design and construction of the equipment shall be strictly in accordance with description, condition and drawings as mentioned in the DEKRA EXAM GmbH Test Reports referred to above.

2)The equipment shall be used only with approved type of accessories and associated apparatus.

3)Each equipment shall be marked either by raised lettering cast integrally or by plate attached permanently to the main structure to indicate conspicuously:-
(a) Name of the manufacturer
(b) Name and number by which the equipment is identified.
(c) Number & date of the test report of the DEKRA EXAM GmbH applicable to the equipment.
(d) Equipment reference number of this letter by which use of apparatus is approved.
(e) Protection level.

4) A certificate to the effect that the equipment has been manufactured strictly in accordance with the drawing referred to in the DEKRA EXAM GmbH Test report and is identical with the one tested and certified at DEKRA EXAM GmbH shall be furnished with each equipment.
5) The customer shall be supplied with a copy of this letter, an extract of the conditions and maintenance schedule, if any, recommended by DEKRA EXAM GmbH in their test reports and copy of instructions booklet detailing operation & maintenance of the equipment so as to maintain its Flame Proof characteristics.
6) The After sales service and maintenance of subject equipment shall be looked after by your representative M/s. Petromar Engineered Solutions Private Limited, 204, 206, Dheeraj Heritage, S.V. Road, Santacruz West, Mumbai - 400 054 (Maharashtra)

Conditions of the Approval:-
The approval for above equipment is subject to validity of IECEx Quality Assessment Report No. DE/BVS/QAR12.0003.

This approval also covers the permissible variations as approved under the DEKRA EXAM GmbH test reports referred above. This approval is liable to be cancelled if any of the conditions of the approval is violated or not complied with . The approval may also be amended or withdrawn at any time, if considered necessary in the interest of safety.

The field performance report from actual users/your customers of the subject equipment may please be collected and furnished to this office for verification and record on annual basis.
The Approval is Valid upto 31/12/2023

Yours faithfully,

(Nihad Dattaram Gawade)
Dy. Controller of Explosives
For Chief Controller of Explosives
Nagpur

Copy to :
1. JL Chief Controller of Explosives, West Circle, MUMBAI
2.M/s. Petromar Engineered Solutions Private Limited,204, 206, Dheeraj Heritage, S.V. Road, Santacruz West, Mumbai - 400 054 (Maharashtra)

for Chief Controller of Explosives
Nagpur

(For more information regarding status,fees and other details please visit our website http://peso.gov.in)

Note:- Please submit the revalidation application one month before the date of Expiry of approval otherwise approval will be treated as cancelled and a fresh application for approval will be considered for the approval.

http://10.0.1.28/pesoFPE/licence/CustomizeLetterPrint.aspx 4/5/2019

13.3 EG-Konformitätserklärung – EC Declaration of conformity

To be provided on request

14 Issues and solutions

Question	Solution
Is the connector to be inserted compliant with explosion proof specifications?	Connectors for use with "Intrinsically safe" ("ia/ib") initiator types do not necessarily have to be Ex-certified, because the energy of the ex-i circuit is limited to a point avoiding any ignitive sparks. (Limitation of short circuit current and open-circuit voltage)
Is there no blue ex- i proof cable to be used with ex-proof intrinsically safe electric circuit?	For ignition protection type, an "intrinsically safe" ("ia/ib") cable, marked blue, is generally required. Since the entire market does not offer plastic coated cables with a surface resistance of $< 10^9\ \Omega$, the cable is to be wiped only with a damp cloth considering possible electrostatic charge.
Should a sensor cable for special use/requirements be used?	For connector M 12X1, a cable socket with a connection via user specific cable, 4 mm^2 to 8 mm^2 cross section, can be used.
Is the AFGUARD® sensitive to extraneous light?	Yes, the sensor optic should not be exposed to light (>10 Lux). Therefore, installation into a sight glass is not possible.
How does the sensor detect the difference between water and jet fuel?	The principle of the AFGUARD® is based on an optical process, relying on the refraction index of the medium to be examined. The refraction index of Jet Fuel and water strongly diverge from each other. Water results in an optical bypass of the mirror.
Can AFGUARD® differentiate between clean water and jet fuel?	Yes.
What is the output signal?	The output signal of the AFGUARD® is a so-called standard signal of 4 to 20 mA. As an example, for a measuring range of 0 to 50 ppm, this means having an output current of 4 mA = 0 ppm and 20 mA = 50 ppm. The signal measuring span of 16 mA is distributed linearly to the measuring range.
How can I assure that the AFGUARD® is properly installed/positioned?	The marking near the SW36 screw nut should be pointing to the direction of the flow.

Can the non-explosion proof AFGUARD® also be used in areas susceptible to explosions (Ex zones)?	This is the operator's decision. We, FAUDI Aviation GmbH, will only recommend the use of hazardous area approved equipment for use in hazardous zones.
Which explosive areas (ex-zones) do I have, and where are they?	The operator is responsible for allocating zones, as well as for deciding which sensor technology to be used (plant safety regulations). We, FAUDI Aviation GmbH, can only offer assistance in the decision process.
Which documents do I need for obtaining operation approval?	**-.-**
Who may install the AFGUARD®?	This is the operator's decision (plant safety regulations). We recommend installation only by authorized personnel with the proper certification regarding explosion proof installations.
How often does the AFGUARD® require calibration?	Our recommendation is: Once per year. The operator may, based on experience with the sensor, shorten the intervals.
Is FAUDI Aviation able to deliver electronic accessories like intrinsically safe barriers, hazardous area approved displays or data loggers?	Yes – FAUDI Aviation developed electronic bundles to make life and operation easier. Delivery conditions and pricing for electronic devices can be requested through your local sales contact.
Do you have the possibility to address alarms?	The AFGUARD® itself only gives out a linear signal readout that represents the amount of free water with regard to the calibration of the sensor. This readout signal could be used together with additional electronic devices to address alarms such as optical or acoustical signals, or relays to stop the process.
Where do I need to place the intrinsically safe barrier?	Intrinsically safe barriers should be installed in safe areas. Please refer to the manuals provided with each electronic device.
Is the AFGUARD able to see particulate matter?	Yes – but the AFGUARD® is not calibrated to give out correct values related to particulate matter. It is more or less a volume-based signal that should be multiplied with the density of particulate matter to have an idea of the mass.

15 Declaration of Decontamination

Declaration of Decontamination
Electronic Sensor

Due to legal regulations and for the safety of our employees and operating equipment, we require this "Declaration of Decontamination" with your signature before your order can be processed. Please enclose the fully completed declaration with the equipment and shipping documents in any case. If necessary, also enclose safety data sheets and / or special instructions for action.

Shipping Address: FAUDI Aviation GmbH
Scharnhorstraße 7B
35260 Stadtallendorf
Germany

Type of Device / Sensor:

Serial No.:

Medium / Concentration:

Chemical Notation:

Description:

Reason for Return:

Company Data:

Company:

Contact Person:

Street:

Address:

Telephone:

Fax:

E-Mail:

Your Order No.:

Place:

Date:

Signature:

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Rev. 1.0
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