

OIL-MIST-DETECTOR

VISATRON

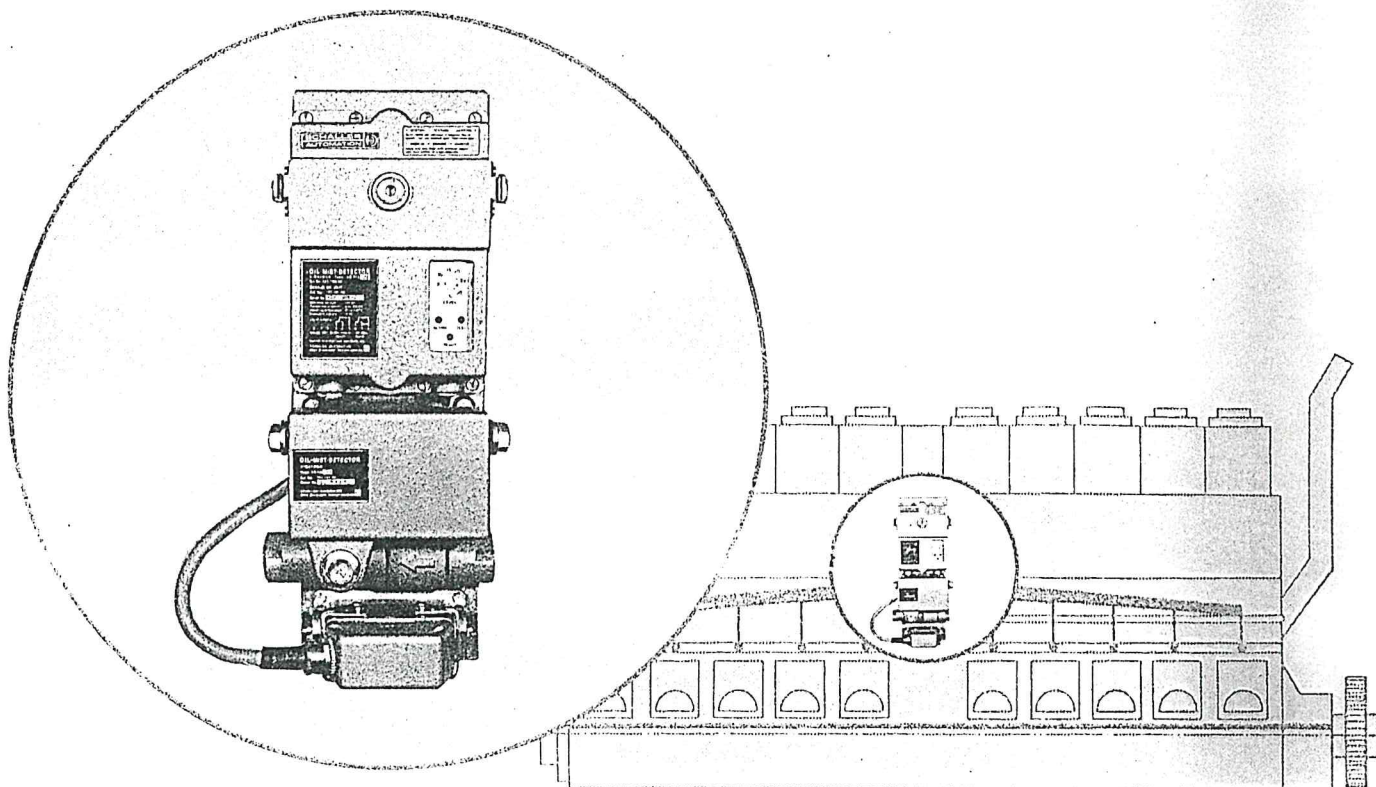
SYSTEM VN 115

**Crankcase
supervisory device
for diesel engines**

MANUAL

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1. INTRODUCTION

The tendency of building ships with complete or partial watch-free operation as well as the increase in designing unmanned resp. remote controlled stationary diesel engine plants requires the use of suitable safety- and monitoring equipments. Such a monitoring equipment is the oil mist detector which checks the unallowed oil mist concentration in the crankcase atmosphere continuously.

The self monitoring crankcase surveillance system VN 115 described here is used to monitor the crankcases of trunk piston engines. The unit triggers an alarm reliably when exceeding a pre-determined oil mist concentration and stops resp. reduces the power output or the speed of the engine as far as a corresponding system is connected.

2. REQUIREMENTS AND THEIR FULFILLMENT

Every combustion engine has a basic oil mist concentration in its crankcase which is caused by mechanical influence. Origin points are the timing gear during operation, bearing points, roller chains as well as all further moveable parts which are breaking the flow of supply oil, that comes through the lubricating points, mechanically and which distributes it in smallest droplets in the crankcase.

The dangerous oil mist however, which can cause crankcase explosions, results in shortness of lubrication at overheated engine parts. This generated oil vapour re-condensates in the very much colder crankcase atmosphere to oil mist which can be sampled and measured.

To sample the oil mist continuously, to analyse and give alarm if necessary, an oil mist detector must fulfill following requirements:

a. Reliability

This is guaranteed because a free of maintenance operation is performed for a longer period, pollution is controlled up to a fixed value. Besides that the VN 115 has an integrated self monitoring and an electronic unit suspended free of vibrations.

b. High sensitivity without false alarm

Is fulfilled due to the fact that the VN 115 is tuning up to the changing engine conditions automatically.

c. Short time of reaction

Is obtained thereby that the sensitivity depends not only on the oil mist opacity value but also on the opacity rising speed.

d. No influence caused by variations of pressure in the crankcase

Is obtained by integrated air draft pump with a constant sampling underpressure and inserted pressure blow throttle that a constant sampling and therewith the measuring is guaranteed by external negative or positive variations of pressure.

e. Compact construction type

The VN 115 is constructed compactly with a free of vibrations suspended electronic unit and is mounted to the engine directly. Thereby no different lengths of suction lines, hose connections and installation far from the engine are avoided.

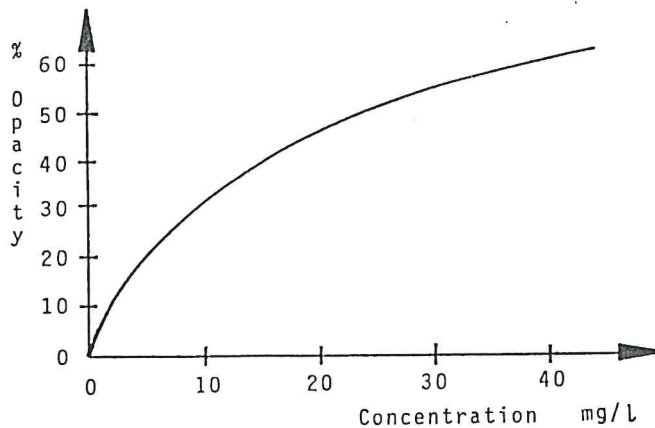
f. Easy handling

If required an exchange of the assembly groups can be performed by untrained personnel due to a plugable electronic unit and the arrangement in measuring unit and base plate with tube connection box.

g. Simple, space saving sampling system

Can be fulfilled by using syphon mounting units with horizontal tubing. If there is sufficient space a normal, screwed tubeline which needs less space can be used as well due to the smaller tube diameters.

3. EXPLANATION OF THE RELATIONSHIP BETWEEN OIL MIST CONCENTRATION AND OPACITY



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At a concentration of 50 mg/l and a simultaneous high temperature ($\geq 500^{\circ}$) danger of explosion is in force.

4. FUNCTIONAL DESCRIPTION (Block diagram see drawing annex as swing out sheet)

A. Suction System for Sampling of Crankcase Atmosphere to be Monitored

For sampling the suction tubes (2) are mounted at the single crankcase compartments of the engine (1) to be monitored. The suction tubes are mounted so that when oil mist develops caused by shortness of lubrication the oil mist will be sampled by at least one suction tube and fed to the unit via the collecting tubes (62). A maximum of 10 suction tubes (2 x 5) must have to be connected to the collecting tubes. In the unit (4) the collecting tubes lead to the tube connection box (3) and end in the collecting chamber (40).

In the following separator (5) large oil particles are separated by the centrifugal force. Oil separated in the collecting chamber (40) and separator is discharged from the unit through the oil outlet tubes (6) to the air draft pump (7) directly. Thus a clogging with oil is avoided. The sampled atmosphere is fed from the separator (5) via the channel (8) to the optical measuring channel (9) in the measuring unit VN 116. To prevent soiling of the infrared filters (10) of the light channel by the crankcase atmosphere, a fixed amount of fresh air is sucked via the air filters (12) into both chambers (11). A soiling of the infrared filters by the crankcase atmosphere is avoided due to the fact that the gas flow of the crankcase atmosphere is stabilized by the parallel sampled fresh air so that a contact of the gas flow with the infrared filters is nearly impossible. The crankcase atmosphere flows through the channel (13) to the air draft pump (7). The expanded air (15), exhausted from the air draft pump, consists of crankcase atmosphere and leak oil coming from the separator and will be fed into the bilge.

B. Measuring the Oil Mist Concentration of the Crankcase Atmosphere and Oil Mist Alarm Actuation

An infrared light emitting diode (LED) (18) belongs to the optical measuring channel (9), which produces a certain light intensity at the photodiode (19). The photodiode converts the light intensity to an electrical signal which is fed to the amplifier (20).

A part of the light is absorbed by the crankcase atmosphere passing through the measuring channel (9) achieving a smaller electrical signal. The comparator (48) compares the measuring signal provided from the amplifier (20) with the reference voltage set at the potentiometer (22) and, if the alarm logic (21) reports operational readiness, operates the alarm output stage (23) as soon the measuring signal falls below the reference voltage. The oil mist alarm-LED lights and the oil mist alarm contact changes, which happens in case of a higher oil mist opacity of the crankcase atmosphere in the measuring channel or at a damage within the crankcase. The signal outputs both of the amplifier (20) differs by their dynamical behaviour. The output leading to the control circuit comparator (24) generates a signal proportional to the input signal of the amplifier. The output to the alarm comparator (48) generates a signal recognizable by a proportional and differential part of the input signal. The differential part will be generated at a fast increasing of the opacity in case of a damage within the crankcase, which achieves a gain of the signal up to the factor 3 at a rising concentration of more than 10 % within 10 seconds. Thereby a quicker alarm release is provided already during increasing opacity. However this differential value becomes effective only if the flow monitor (30) reports that the air supply to the system is in proper condition.

C Automatic Sensitivity Control

Requiring a defined brightness value of the light source (18) the system described under B enables a releasing of an alarm. In practice, however, there are influences diminishing the accuracy of the alarm release inadmissibly. These influences are: Ageing and temperature deviation of components and a pollution of the infrared filters (10) which cannot be excluded totally.

In order to keep these influences as small as possible the brightness of the light source (18) is not hold constant as usual, but influenced by a control system, consisting of the components (24), (25), (26) and (27), in a way that the light intensity generated at the receiver (19) remains constant. The control procedure itself is acting as slow that a fast increasing of the opacity will be not compared by a higher brightness of the light source (18) during damaged condition. The brightness of the light source (18) is determined by the current generated from the amplifier (27). The amplifier input signal is fed from an electronical step-by-step system (26) and can be increased or decreased by steps of approx. 0,5 %. The step-by-step system is controlled via a clock generator (25) with a very low frequency for increasing of the brightness at rising pollution. A second high frequency achieves the decreasing of the brightness required e.g. after a cleaning procedure. Thus it will be guaranteed that a too high brightness effecting a sensitivity decrease of the system is corrected within a very short time. Generally the maximum brightness is set after switching on the operational voltage whereafter the brightness has to be reduced to the correct value by the control system which results in a starting period up to 30 seconds while the unit is working with a reduced sensitivity. However an unlimited follow-up is not possible whereby the alarm "Oil Mist Detector Failed" fed, at a determined value, from the step-by-step system (26) to the ready output stage (28) is released and a cleaning of the infrared filters must be performed. Now the "Ready LED" goes out and the "Ready Contact" changes.

clockwisely by hand until an evident resistance can be recognized. Then apply compressed air with a prepressure of 2-12 bar. No deflection should occur at the U-manometer. Turn setscrew 7 anti-clockwisely until vacuum of approx. 120 mm w.c. is indicated at the U-manometer. Turn setscrew 7 by a slight rotation so that locking plate 5 may be closed. Afterwards turn setscrew 4 anti-clockwisely until the vacuum drops to a value of approx. 60 mm W.C. Fasten setscrew 4 by tightening the counter nut 2. For testing open locking screw 8 at the pressure reducer and remove the spring 9. The pressure reducer becomes ineffective. After closing the locking screw 8 - without spring - the vacuum in the measuring chamber must increase up to approx. 120 mm W.C. again. A correction with setscrew 7 has to be made eventually. At last insert the spring 9 and safe the locking plate 5 by a safety wire using the bores 10 against unallowed opening. The pressure reducer will be ensured by an adjustable locking (13) which has to be sealed then.

Measure vacuum as follows:

- Open cover and hinge aside.
- Take out the measuring cover unit from the service box and fix it (for new units bore hole in the cover standard).
- Fill U-type manometer with water out of the service box and fit on.
- The pressure must amount approx. 50 mm W.C.

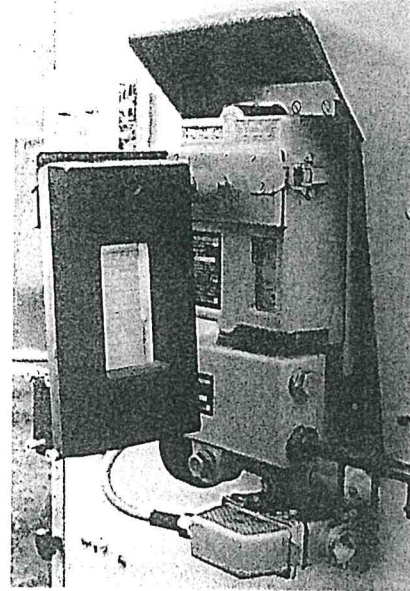
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E. Exhaust Air Connection

The mixture emerging from the exhaust side of the air draft pump (connection of the exhaust line via tube connection R 3/4") may be expelled into the atmosphere resp. bilge directly or connected to the crankcase ventilation (17) via a tube (16) with an inside diameter of at least 24 mm (depending on installation). However, the exhaust air has to escape without any counterpressure. In any case avoid oil bags in the tube (16).

F. Self Monitoring

In case of malfunctions of the power supply (29) or the air supply which are monitored with the flow control (30), the temperature compensation amplifier (31) and the Schmitt Trigger (32), the alarm "Oil Mist Detector Failed" is actuated, i.e. the READY LED of the indication extinguishes and the READY-relay contact deenergizes. The test LED (33) indicates simultaneously an actuated oil mist alarm from the comparator (48), but it is not transferred to outside. If the pollution limit of the optical measuring channel is obtained, and the alarm "Oil Mist Detector Failed" (READY LED out) is actuated, an oil mist alarm from the comparator (48) generated by the alarm logic (21) is transferred to the oil mist alarm output (23).

At complete interruption of the optical measuring channel the oil mist alarm is activated at (23), the extern opacity indication (44) remains at the left end of the indication scale and the LED's test (33) and READY (28) are out (see also function tests 7).

G. Remote Indication, Optional, only when Ordered Explicitely

The signals "Oil Mist Alarm Threshold" (22) and oil mist opacity at the output of amplifier (20) are converted by the voltage-current transformer (60) into an analogous current signal and indicated, if required, on an external analogous opacity indication (44) in the engine control station. During normal operation the pointer shows the value of the set oil mist alarm threshold (22) (3 - 30 %). A deflection into the negative area (≤ 0 %) means an oil mist alarm. The remote indication shows 0%-opacity in case of an unconnected plug of the VN 115 or missing operating voltage.

5. INITIAL OPERATION

For setting into operation open the driving air connection from of the supply air system and switch on the operating voltage.

Attention: The operation readiness is given first when the "Ready"-lamp lights. This can take up to 80 s.

Maintenance is not necessary during operation. Regularly checks are not necessary due to the construction of the apparatus and the automatic luminance control. The "Ready"-lamp goes out in case of malfunction that causes the deenergizing of the relay and the indication "Malfunction Oil Mist Detector" is actuated in the shipborne alarm system, depending on the kind of installation, acoustical too.

6. FUNCTION TESTS

A. Before starting the engine resp. before starting for sea

- Interrupt the operating voltage for a short time (for example, pull out the male connector and re-insert it.

Results: "Ready" lamp goes out and lights up after approx. 80 seconds again. The test- and alarm lamps should not.

- Open the cover of the measuring unit (quick closers).

Results: The "ready" lamp goes out after approx. 10 seconds. The "test" and "alarm" lamps may not light up.

- Close the cover of the measuring unit.

Results: The "ready" lamp will light up after approx. 80 seconds again. The "test" and "alarm" lamps may not light up.

A t t e n t i o n

The following test could result in an engine stop.

- Open the cover again and interrupt the optical measuring track with a non-transparent object or with a cloth so that the cover could be closed again but the optical measuring track remains interrupted completely.
- Close the cover
Result: After approx. 1 sec., Test LED lights up. If present the analogous opacity indication moves to left in the alarm area against the stop and remains there.
Result: Alarm LED lights up after approx. 30 sec. (attention engine stop).
Ready LED remains out. Test LED out. External analogous indication at left stop.
- Open the cover.
Result: Alarm LED goes out after max. 10 s, test LED lights up.
- Optical measuring track has been released.
Result: Indication moves via 0 % to the set threshold value.
Test LED goes out after approx. 20 sec.
- Close the cover.
Result: After max. 30 s READY LED on.

- B. Function Test with Testing Smoke (during stopped engine only) e.g. steam distillate or cigarette smoke (Attention: Observe sticker on the measuring unit)

Open one crankcase cover to reach a suction line. Fill the plastic bag which is in the service box with the smoke. Connect the filled plastic bag to the suction union and let the unit sample out of the bag for at least 15 sec.

It depends on the smoke intensity, concentration increase time and set threshold value whether an oil mist alarm is actuated.

7. PUTTING OUT OF OPERATION

Stopping the driving air supply by closing the air supply valve. The unit shall remain electrically switched on to avoid a penetration of humidity into the electronic components. Furthermore proceed working sequence acc. to point 8 d.

8. FAILURES

An appearing failure causes the going out of the lamp "Ready" and the alarm indication "Failure Oil Mist Detector" in the engine control room is actuated. Activated by:

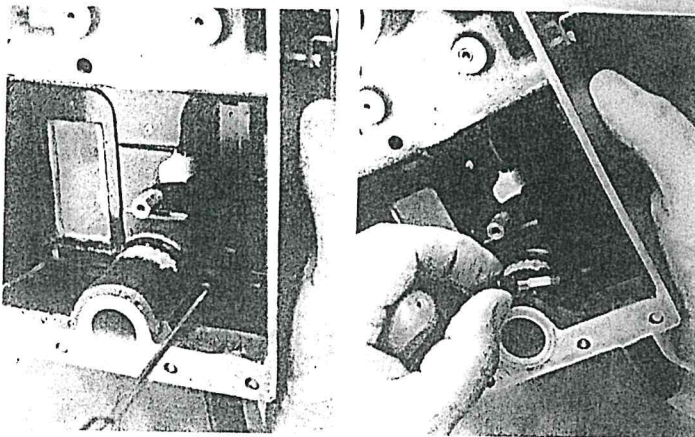
- a. Voltage failure
- b. Short-time interruptions of the supply voltage > 5 msec
- c. Luminance control has compensated approx. 55 % pollution (cloudiness)
- d. Failure of the driving air supply
- e. Soiled air filter in the pressure reducer
- f. Opened cover at the measuring unit
- g. Soiled air filter in the measuring unit
- h. Untightnesses at the unit, (cover measuring unit sealing between ground plate and measuring unit, defective bellows)
- i. Damaged flow control or defective electronic module
- j. Defective electronic module resp. defective valve box
- k. Failure of external and internal fuses
- l. Damages to the measuring unit (connection cable damaged a.s.o.)
- m. False alarm at fire with smoke within the engine room
- n. Furthermore failures

9. FAILURE ELIMINATION

a. Voltage Failure

- Reconnection of the supply voltage
- Replacing of the external fuse if necessary
- Replacing of the internal fuse by screwing out (bayonet) the cap of the fuse mount 90° (see photo) and inserting a new fuse (out of the service box).

Attention: The E-module needs not to be taken out to replace the fuse. It has been done in the illustration to make an easy presentation possible.



b. Short-Time Interruptions of the Supply Voltage

- Stabilize supply voltage, eventual with a stabilizing module.
See technical data page 13.

c. Luminance Readjusting has compensated approx. 55 % Pollution (Cloudiness) of the Infrared Filters

- Open cover measuring unit
- Soak wad tip in alcohol
- Clean the infrared filters with wad tip several times
- Polish with dry wad tip
- Close the cover again

Attention: Perform cleaning procedure acc. to point c. always together with air filter change, point g.

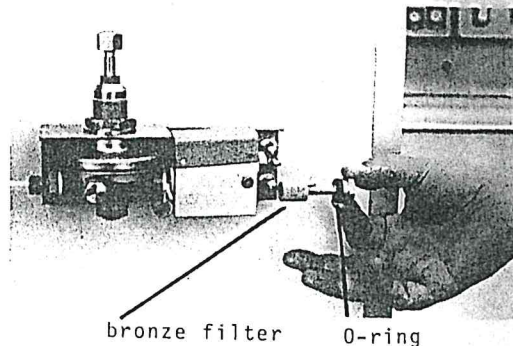


d. Failure of the Driving Air Supply

- Re-establish supply in the ship's network, drain the air lines if necessary and clean the eventual installed pre-filter.

e. Soiled Filter in the Pressure Reducer

- Renew the bronze filter in the pressure reducer
- Close the driving air supply
- Slacken screw (WO 19 mm), remove O-ring
- Take out the filter
- Insert filter, fit O-ring
- Fasten screw



f. Opened Cover at the Measuring Unit

- Close the cover, but before check the cover sealing on unobjectional condition.

g. Soiled Air Filter in the Measuring Unit (valid for VN 115, VN 116 and VN 215)

- Remove securing ring

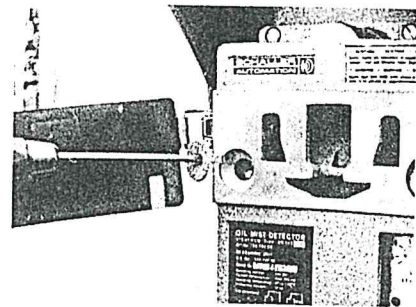
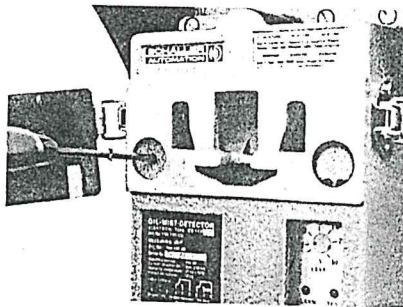
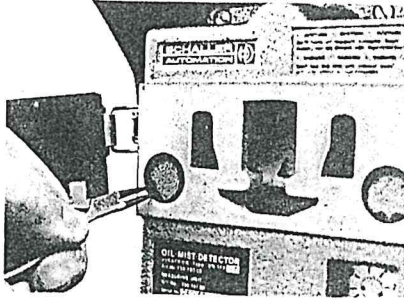
- Push out filter

- Take out filter

- Mount new filter
(both sides) (rough
side to outside)

- Insert securing rings

- Close cover

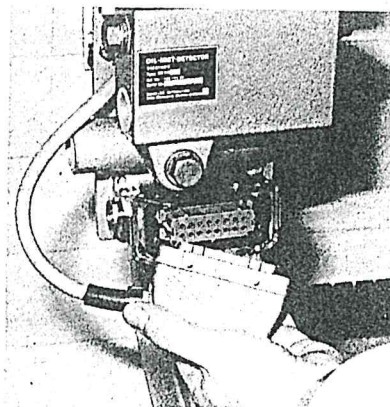
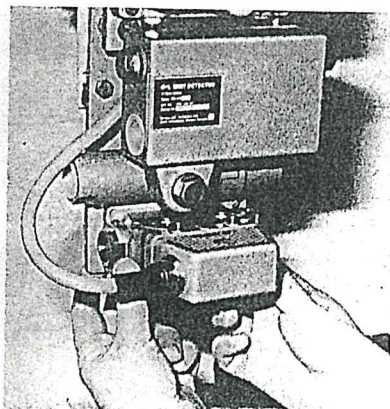


h. Untightnesses at the Unit

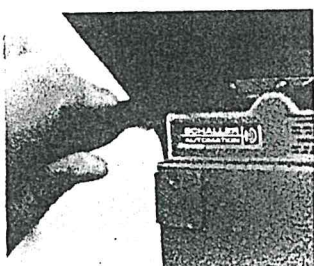
- Check connected tube lines and all sealings on untightnesses, renew damaged sealings, reseal untight tube lines.

i. Damaged Flow Control or Defective Electronic Module

- Replace faulty flow control by a spare module.
Send faulty flow control for repair to Messrs. Schaller immediately.
- Dismounting and mounting of the new modul.
- Take out plug 1, bend securing bow away.



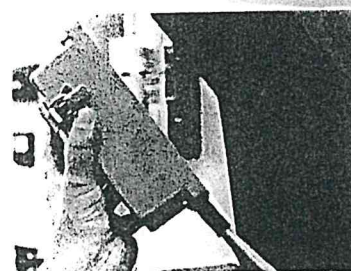
- Screw loose the screws (4 pieces above and 4 pieces below) at the measuring unit and take off measuring unit



upper screws: (4)

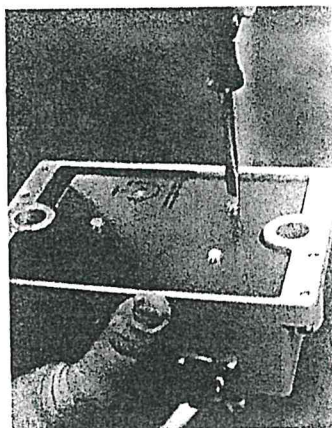


lower screws (4)

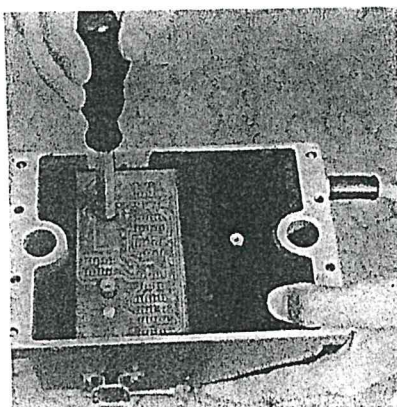


take off measuring unit

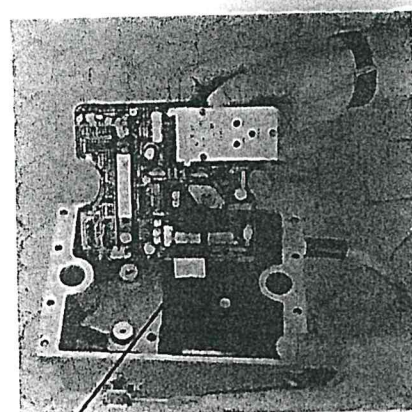
- Take out electronic module, for that loosen screw (3 pieces), remove cover plate, remove fixing screws at the module (WO 8 mm) (3 pieces) shake out module, draw off plug 1



remove cover plate
(3 screws)

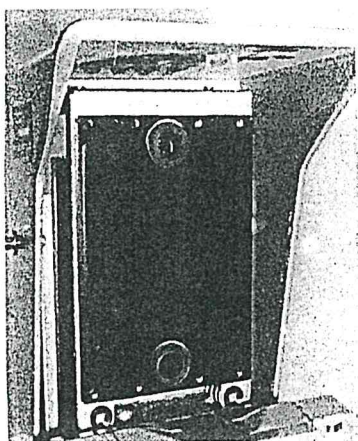


remove fixing screws

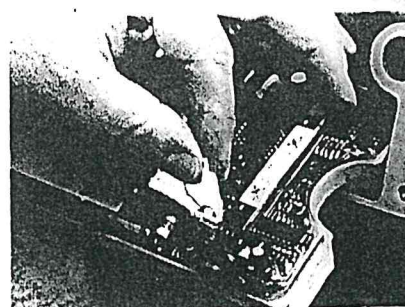


plug 1

- Before mounting clean spare module with tissue handkerchief, clean the infrared filters
- Plug in spare module VN 115, mount cover plate and measuring unit again and tighten crosswisely, keep care on unobjectionable sealing, check the bellows on unobjectionable seat (above and below).



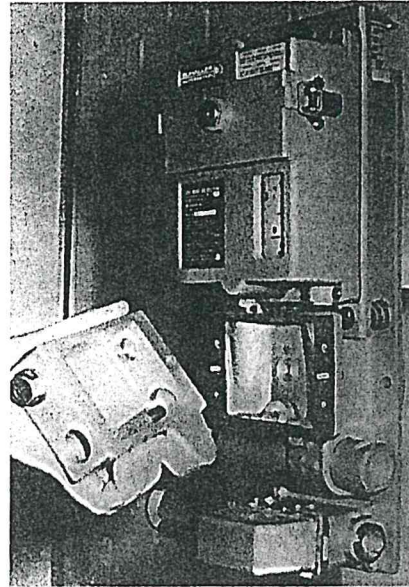
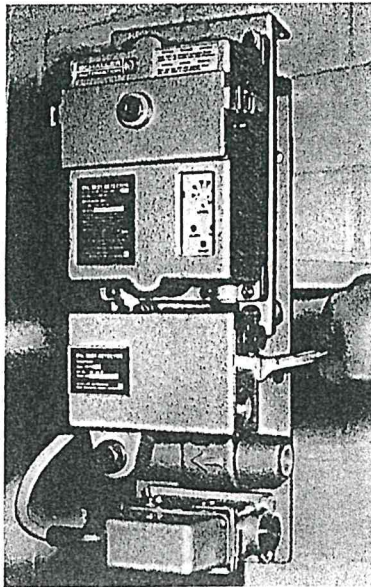
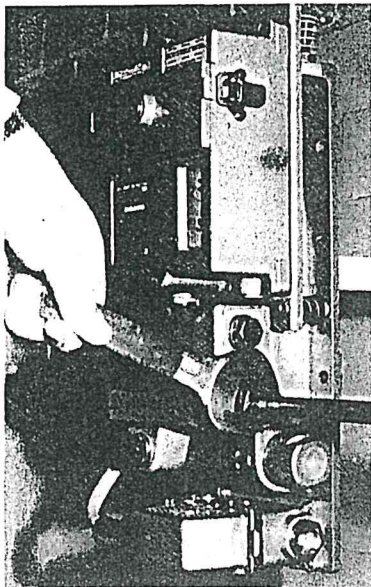
gasket with bellows



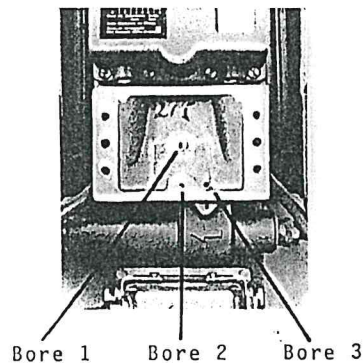
leans cleaning

j. Untightness of Tube Connection Box

- Check screw connections for untightness (illustr. 1).
- Remove valve box cover (illustr. 2)



- Clean bore holes 1, 2 and 3 by working air (blow-through), remove sealing residuals.
- Use new sealing when fitting the cover.



k. Failure of the Internal and External Fuses

Replacing of fuses, external fuses acc. to the position in the ship's network, internal fuses acc. to item a. of this failure elimination list.

Attention: The electronic module needs not to be taken out. It has been done in the illustration to make an easy presentation possible.

l. Replacing the Complete Measuring Unit (at Damaged Connection Cable, a.s.o.)

- For the measuring unit proceed acc. to item i; but after taking off the defective measuring unit stop repair works and fit new unit.

Attention: Send defective parts for repair to Company Schaller immediately

m. False Alarm at Fire with Smoke within the Engine Room

In case of a fire with smoke within the engine room a false alarm cannot be avoided. The smoke will penetrate via the scavenge air filter into the measuring track simulating an opacity which will release the oil mist alarm.

n. Further Failure Possibilities:

- By suddenly appearing misalarms in very warm or extremely cold areas, water can fall out due to remaining below the dewpoint and that can cause misalarms.

Elimination:

- Adjust the suction vacuum to minimum value
- If there are fans which are directed at the unit and its suction lines turn them away resp. install shields to hold the detector and its lines outside the airflow
- Clogging of Siphons at Siphon Fitting Works
Blow through the siphons with working air of max. 2 bar all 6 - 8 weeks to avoid a clogging.
- In case of misalarms after longer operation period, perform absolutely the works acc. to c) and g) because the sensitivity increases due to clogged air filters.

J. Changing of the Set Oil Mist Alarm Threshold:

At own risk! Before changing request the manufacturer.

The adjustment of the alarm threshold is done acc. to the following instruction:

- a) Working procedure acc. to "Failures, Point i)" for removing the measuring unit.
- b) Put screw driver into bore 4 at rear side of the measuring unit and set potentiometer to position required (observe indication in the sight glass at the front side) (illustr. 2).
- c) Install measuring unit on the base plate again. Observe exact position of bellows due to unobjectional sealing, insert plug again.

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10. TECHNICAL DATA

Construction:	Compact instrument consisting of assembly connection plate with air draft pump for all pneumatic and electrical connections; for mounting directly onto the engine; flexibly mounted platform for the measuring unit.
Operating voltage:	18-30 V DC (suitable to be supplied by the 24 V battery) or transformer supply voltage/ 24 V AC - 50/60Hz, with rectifier and smoothing capacitor 4700 uF/50V.
Permissible rest ripple:	The supply voltage may not decrease 18 V and not increase 30 V.
Overvoltage protection:	Incorporated and effective up to 60 V for 1 second, up to 250 V for 5 ms, Thermo-switch actuates fuse at a slow over-voltage for values above 36 V.
Reverse polarity protection:	By means of an incorporated diode up to 400 V.
Current consumption:	Max. 0,25 A
Excess current protection:	By means of an external 1,6 Amp quick-action fuse located at the outlet of the current supply or distribution. Additional protection is provided by an internal 2,0 Amp medium-acting fuse installed in the unit.
Suction system:	2 Collecting tubes (connection ability of R 1/2" and R 3/4" to the unit) with max. 10 branches. This permits monitoring of engines with up to 10 crankcase sections by 1 unit.
Depression for suction:	60-80 mm water column in the measuring chamber measured against atmosphere; generated by an air draft pump.
Supply air for the air draft pump:	Required air pressure approx. 0,3 to 0,5 bar gage pressure, pressure reducing valve at an air regulator set Pabs from 2 to 12 bar. Air draft pump consumption approx. 0,5 Nm ³ /h.

Sensitivity:

Adjustable to absorption values between 3 and 30 % which corresponds to a oil mist concentration of approx. 0,7 up to 8,6 mg/l (lower limit of an explosive mixture: approx. 50 mg oil concentration per liter air at simultaneous high temperature of 500⁰ C.

Signal outputs:

Oil mist alarm for automatic engine stop resp. automatic power or speed reducing (acc. to system):

1 potential-free relay change-over contact; make contact bridged with 33 kOhm resistor for detecting external line break. Mode of operation: relay is energized for oil mist alarm condition.

Oil mist detector ready for operation (Ready):

1 potential-free relay change-over contact. Mode of operation: relay is deenergized when the oil mist detector is not more ready for operation. (The relay reports an operation voltage failure at the unit, too, important for the monitoring unit: Action delay, max. 30 s, for that must be considered the automatic adjustment.

Contact load:

Voltage : max. 60V AC/DC
Current : max. 1A AC/DC
(with inductive load L/R max. 40 ms)
Power : max. 30 W / 60 VA (sufficient for auxiliary contactors up to approx. 8 VA holding power)

Permissible operating temperature: 0 to + 70⁰C

Permissible temperature of aspirated oil mist:

Max. + 70⁰C at instrument inlet.
(The temperature of the crankcase atmosphere lies normally around 70⁰C. Additional cooling takes place in the suction lines).

Permissible storage temperature: - 25 to 85⁰C

Humidity: Tested up to 90 % relative humidity, no condensation. (At 100 % R.H., the detector should always be on).

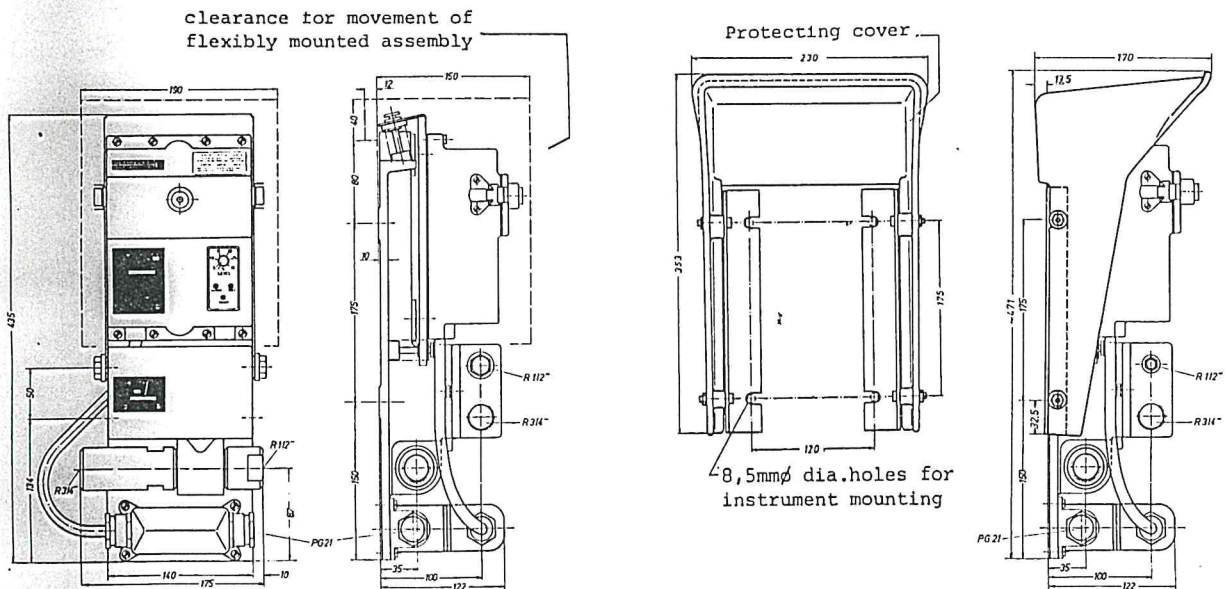
Protective system: IP 54 according to IEC 144 (dust-and splash proof)

Materials: Mounting/connection part and measuring unit housing: cast aluminium; vibration damped: mounting plate zinc- and chrom-plated sheet steel.

Surface: Hammertone enamel; color : aluminium

Netweight: 7,5 kg

Maximum: Width 175 mm, Height 435 mm, Depth 122 mm without cover
Width 230 mm, Height 471 mm, Depth 170 mm with cover



Elektronisches Blockdiagramm

Electronic Blockdiagramm

schéma de bloc modulaire

