SMOKE DENSITY INDICATOR
MODEL : BI-SM2004

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SMOKE DENSITY INDICATOR

Model No. BI-SM2004

The Unit has been designed to enable Industry to comply with the Clean Air Act and worldwide ships to comply with Canadian Shipping Air Pollution CRC, Vol. XV, C. 1404 and Alaska – 18 AAC 50.070, Marine Vessel Visible Emission Standards.

The product consists of Control Panel, Light Beam Projector, Photocell Receiver, Stack Adapter and the Intermediate Adaptor that clean air is supplied for Glass Cleaning.

There are two type of Control Panel, one is disclose type for the application of exposure area, the other type is for inside installation of Boiler Panel and any other Control Panel.

The Projector and Receiver connected to Intermediate Adaptor are mounted on opposite side of the chimney or flue preferably where a negative pressure exists thus reducing the necessity of frequent cleaning of the optical system.

The presence of smoke in the flue or chimney will cause changed electrical signal between the Projector and Photocell Receiver. The changed signal is analyzed by Control Panel and give the information on the Digital Display. The Preset Alarm, Low and High alarm, can be adjusted easily to meet the regulation required per country.

Key Features

- Digital Display: 0.1% Resolution
- Easy Installation: Easy Cleaning and Removing
- Low maintenance cost
### Technical Specification

#### Measuring Range
0.0% - 100% Smoke Density for Black & White Smoke

#### Power Supply
AC110 & AC 220 to 240 V, 50/60Hz

#### Dimension of Control Panel
290mm x 240mm x 120mm for Disclose Type

#### Weight of Control Panel
5.5kgs

#### Signal Output
4-20mA able to connect to ECR directly

#### Adjustable Time Delay
Adjustable between 0 - 60 Seconds, Factory Set 15 Seconds

#### Protection
Designed to IP65

#### Accuracy
+/− 2% full scale detection (FSD)

#### Resolution
0.1% Smoke Density.

#### Alarm Setting
Adjustable Low & High Alarm
Factory Low Setting: 40% Smoke Density.

#### Zero Stability
Manual zero by one push button

#### Relative Humidity
0 to 95% non condensing

#### Temperature Limits
-10 ~ 60 °C Ambient

### Optional
- Recorder, Digital/Analog Indicator
- Date Logger System to follow the measured smoke density
- Alarm Repeater

### Easy Cleaning Procedure
1. Remove Projector / Receiver from intermediate Adaptor
2. Fit Blind Flange to Intermediate adaptor (Because the leakage of Exhaust Gas)
3. Cleaned the Glass and Reassembled.

### Typical Installation

![Typical Installation Diagram]

**Smoke Stack**

**Control Panel**

**Boiler**

**Projector**

**Receiver**

**Buzzer**

**Signal Out 4-20mA**

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TEL : (82) 2 795-3077 (REP)    FAX : (82) 2 795-3076    Home page add. : http://www.b-i.co.kr

As an ISO 9001 approved company, B-I Industrial Co., Ltd’s quality assurance programmes demand the continuous assessment and improvement of all B-I products.
1- 2 INTRODUCTION

The environments is high on the political agenda at the moment and Pollution is still very much a live issue. Accordingly, we have developed this system to meet requirements for the Air Pollution Control Act, etc enable to measure and acknowledge the quantity of gas emitted in order for the prompt response against the status of smoke.

The regulations relevant Air Pollution from ships are as follows;

Canada Shipping Act : Air Pollution Regulations - CRC, Vol. XV, c.1404
SIP - ALASKA - 18AAC 50.700
ETC.

The main purpose of our smoke density indicator is to prevent Air Pollution by installation on smoke stack on vessels and Chimney on industries.

1- 3 GENERAL INFORMATION

Our System consists of Control Panel, Light Beam Projector, Photocell Receiver, Stack Adaptor and Intermediate Adaptor.

When Smoke is present in the Flue or Chimney, it will obscure the light beam and cause a change in the electrical signal on the receiver cell. This change is recognized by the control which displays the information on the panel meter and the control panel digitalize the electric signal and display the value of 0~100 on the monitor.

Project is used with High Brightness LED. The life time of this LED is semipermanent and light intensity is maintained regularly.

Receiver is equipped with CDS Cell which has characteristics of long life time and liner to detect light in comparison with other sensors.

The materials of Projector and Receiver is light- weight and anti- corrosion Aluminum so it is easy for users to replace spares and maintenance.

There are two Relays for high and high high on Main Panel. Accordingly, the efficency of compatibility with othe instruments is improved.

Operator can see the status of Smoke by observation of the value on the monitor. Our system is easily operated by beginner.
1- SPECIFICATIONS

1- 1 Control Unit

Power Requirement : 240 or 110Vac, 60 Hz
Obscuration Range : 0% to 100%
Analogue Output : 4 to 20 mA for 0% to 100% obscuration
Alarms : Two SPCO, each rated at 5A, 250V.A.C.
Keyboard : Touch membrane
Display : 5 FND DIGITAL
Calibration : Automatic zero and span
Temperature Limits : -10°C to 60°C Ambient
Panel Cut- Out : A Type 240mm x 290mm x 120mm
Dimensions(H x W x D) : B Type 97mm x 97mm x 140mm
Weight(A type/Btype): 4.9Kg/0.3Kg

1- 2 Projector/Receiver Units

Projector - Lamp : 5 V.D.C. HIGH BEAM LED
Receiver
Cell : CDS cell
Scanning Distance : 300 to 5000 mm (standard unit)
Flanges : 115 mm x 49 mm x 12Ø X 4 HOLE
Mounting Tube : Optional Extra
Inject air connection : 10mm BSP Standard Connection 0.5 BAR
Max. Temperature : 70°C
Weight : Projector 0.4Kg, Receiver 0.4Kg
Miniclean Adapter 2.3Kg, Stack Adapter 2.1Kg
CHAPTER 2

2-1 OPERATION AND SETTING

2-1-1 Preliminary Operation
a. Check the connection of terminal block, etc inside control panel
b. Check the power connection AC110/220V and PCB socket status according to the
   POWER AC110/220V
c. If all connection is setup properly, please power on and check the monitor
d. After booting completion, Indication will be displayed according to stack status

2-1-2 Operation

Power On
Switch the power on at the ac inlet. The FMD on the front panel illuminates, it remains
illuminated while the ac power is connected to the unit and switched on. The Smoke Density
Indicator enters its warm-up, this takes approximately 60 seconds to complete. During
warm-up the following screens appear on the display.

START WARM-UP

DISPLAY THE SOFTWARE VERSION

CHECKING SMOKE SENSOR

COMPLETED WARM-UP AND NORMAL OPERATING
DISPLAY
The instrument is operated via 4 button belows.

The explanation how to operate button and it’s functions is belows.

- Escape from manu selection
- Alarm reset, Zero setting (press for 5 seconds)
- Reading of AD value
- Selection main manu
- Adjust setting value
- Light Beam on/off
- Into main manu(Press for 5 seconds)
- Into setup & Input setting value

๓. AD VALUE
The value of signal comes from Projector to Receiver. The value is to be changed depending on distance between Projector and Receiver and the status of Smoek Stack.

After initial installation, you can detect the status of Receiver / Projector and damage of Glass, if you compare the reading of AD Value when Zero & Span is 100% to the value after long hours of operation.

AD - The signal of analog is digitalized

๓. When Setting 4- 20mA
if you push button simultaneously, the value is decreased.

2- 1- 2 Setting Value
You can configure below value by means of using above 4 buttons.

Factory default setting

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALARM</td>
<td>20%</td>
</tr>
<tr>
<td>HIGH LEVEL</td>
<td>20%</td>
</tr>
<tr>
<td>HIGH HIGH LEVEL</td>
<td>40%</td>
</tr>
</tbody>
</table>
**DELAY : 15 SECONDS**, Set by 0~60 sec. range and 5sec. 
(after detection of smoke, Delay when Aram, High & High High signal output)

**FILTER : 1**, Select proper value among 0~9. (Sensitivity of smoke sensor)

**ZERO :** Setting is configured when delivered but reconfiguration is recommended after installation.

**SPAN : 100% SPAN**, Setting is configured when delivered but reconfiguration is recommended after installation.

**4- 20mA :** Signal output to ECR. (It is not necessary to reconfigure after installation)

---

### 2-1-4 Setting

If you press  for 5 seconds, Setup Menu is displayed. By means of button, you can move to another menu. The sequence of Setup menu display is as follows:

1. **SETUP**
2. **ALARM**
3. **HIGH**
4. **FILTER**
5. **DELAY**
6. **HIGH I**
7. **SPAN**

*You can start to set up, if you press button*
**Alarm Setting**

Press \[ \text{ENT} \], Displayed ALARM value

\[ \text{ALAR}n \]

By Pressing \[ \text{△} \text{△} \] button, Adjust ALARM value(0~100%)

Completed Alarm setup

**High Level Setting**

Press \[ \text{ENT} \], Displayed HIGH value

\[ \text{HIGH} \]

By Pressing \[ \text{△} \text{△} \] button, Adjust HIGH value(0~100%)

Completed High level setup
**High High Level Setting**

Press **ENT**, Displayed HIGH HIGH value

By Pressing ▼ ▲ button, Adjust HIGH HIGH value (0~100%)

Completed High High level setup

**Delay Time Setting**

Press **ENT**, Displayed DELAY TIME

By Pressing ▼ ▲ button, Adjust DELAY TIME (0~60sec.)

Completed Delay Time setup
**Filter Setting**

Press \( \text{FILE} \) \( \text{ENT} \), Displayed FILTER LEVEL value

By Pressing \( \square \) \( \triangle \) button, Adjust FILTER LEVEL value (0~9)

Press \( \text{ENT} \), Displayed \( -5\text{A}\text{u}- \)

Completed Filter Level setup

**Span Setting : Zero**

Press \( \text{SPAN} \) \( \text{ENT} \), Displayed Zero & Reading AD value

\( -0- \) AND \( 3\text{1200} \)

AD Value become steady (about 2 min. Later), Press \( \text{ENT} \), Displayed \( -5\text{A}\text{u}- \)

Completed Zero Setup. And Light Beam will be switched off and converted to Span 100% Setting Mode.
**1. Span Setting : 100%**

Displayed 100% span & Reading AD value

\[
\begin{align*}
-100 & \quad \text{AND} \quad 56280
\end{align*}
\]

AD Value become steady (about 2 min. Later), Press \( \text{ENT} \), Displayed

\[
-5Au-
\]

Completed Span 100% Setup

**2. 4-20mA Setting : 4mA**

Connect ampere meter to terminal of Signal Output on Terminal Board inside Control Unit.

If you press \( \text{A} \) \( \text{A} \) button simultaneously, the value will be decreased.

\[
\begin{align*}
4-20\text{mA} & \quad \text{Press} \quad \text{ENT} \quad \text{, Displayed 4mA & Reading AD value} \\
4-\text{mA} & \quad \text{AND} \quad 633
\end{align*}
\]

By Press \( \text{A} \) \( \text{A} \) button, Adjust the AD value until Ampere Meter read out 4mA

\[
\text{Press} \quad \text{ENT} \quad \text{, Displayed} \quad -5Au-
\]

Completed 4mA Signal Output setup, and display converts to 20mA Setting Mode.
4. 4-20mA Setting : 20mA

Press 🔄 ENT, Displayed 20mA & Reading AD value

| 20-mA | AND | 3311 |

By Press 🔄 button, Adjust the AD value until Ampere Meter read out 20mA

Press 🔄 ENT, Displayed -5A-

Completed 20mA Signal Output setup

*** CAUTION ***

Please note that 4-20mA is factory default thus re-setting is not necessary and it should not be changed by users.

If the re-setting is to be indispensable, please contact our Technical Department.
## 2-1-5 Trouble Shooting

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<tr>
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<th>Cause</th>
<th>Action</th>
<th>Remarks</th>
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</thead>
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<td>Disconnection of electric cable</td>
<td>Check cable connection between control panel &amp; receiver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor fail</td>
<td>Zero resetting &amp; calibration</td>
<td></td>
</tr>
<tr>
<td>ouEr</td>
<td>Sensor fail</td>
<td>100% span resetting &amp; calibration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power fail</td>
<td>Check the power source</td>
<td></td>
</tr>
<tr>
<td>Display error</td>
<td>Break down fuse</td>
<td>Replace fuse with new one</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program damaged</td>
<td>System reset(power off &amp; on)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Display board damaged</td>
<td>Replace display board with new one</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Main board damaged</td>
<td>Replace main board with new one</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20p cable damaged</td>
<td>Replace 20p cable with new one</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor fail</td>
<td>Zero resetting &amp; calibration</td>
<td></td>
</tr>
<tr>
<td>Abnormal indication</td>
<td>Glass was dirty</td>
<td>100% span resetting &amp; calibration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stack adaptor is Clogged</td>
<td>Cleaned stack adaptor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check sealing air line</td>
<td></td>
</tr>
</tbody>
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CHAPTER 3

3- 1 Preliminary Instructions

A. This equipment comprised:

A.1 Light Beam Projector

This consists of two parts, a tube housing a solid state light source and optical system and a flange casting which is mounted onto the flue or stack. The flanged casting should be insulated against the flue or ducting by an asbestos gasket to reduce conduction of heat into the projector and receiver units.

A.2 CDS cell Receiver

This has a casting for mounting on the flue or stack similar to the projector unit. A second tube houses a photocell, and optical system which should be cleaned at regular intervals in order to prevent soot deposits causing incorrect operation. The cell should not be subjected to an ambient temperature in excess of 70 deg Centigrade.

A.3 Control Unit

This is contained in a robust housing suitable for panel or wall mounting. Wiring should be carried out in accordance with the diagram.

B. The following points should be carefully observed before installation:

B.1 Optical units must be rigidly mounted and properly aligned.

B.2 Avoid temperature extremes at the projector, receiver and cable junctions i.e. direct sunlight, hot stack etc. Max. temperature 70°C.

B.3 Prevent external light sources affecting the optics i.e. install away from duct or flue exit.

B.4 The optical units should be installed after possible pipe connection to an inert gas system.
3-2 Installation - Projector and Receiver Units

3-2-1 General

To avoid possible errors in obscuration readings due to infiltration of air the optical units should be located away from the flame area and downstream of any flue gas sampling points.

Typical Installation

3-2-2 Location

These units must be rigidly mounted in the horizontal plane on opposite sides of the stack or duct so that the projector light beam is at right angles to the flow of flue gases and gives unrestricted illumination of the receiver CDS cell. The following considerations should be taken into account when choosing a suitable location.

3-2-3 Temperature

Radiated heat, which has the greater effect on the units, can be effectively reduced by suitable lagging of adjacent hot surfaces. Normally sufficient cooling effect is provided by air purging. The temperature of the Projector / Receiver units should not exceed 70°C.

3-2-4 Accessibility

Optical units must be located such that they are readily accessible for lens cleaning, routine maintenance and servicing.
Whilst the optical units will function correctly at temperatures up to 70°C, locations of high ambient temperature should be avoided as far as possible so that routine maintenance and service can be carried out whilst the plant is in operation.

3- 2- 5 Scanning Distance

It is recommended that the scanning distance be kept within the limits 300 mm to 5000 mm. Where the distance between the duct walls is greater the mounting tubes may be extended into the duct to reduce the scanning distance, Scanning distances less than 300 mm should be avoided if possible.

3- 2- 6 Stratification

To ensure that the smoke or dust measured by the instrument is representative of that emitted, the influence of dampers, bends, tees, obstructions and draught balance doors should be considered when selecting a suitable position. Location of the units close to bends in the flue should also be avoided as the momentum of the flue gases may deposit dust on the lenses.

3- 2- 7 Sunlight

The optical units should not be installed at the flue opening to atmosphere as ambient light may affect the stability of readings.

3- 2- 8 Mounting Optical Units

The diagram below indicates the method of mounting to optical units on a steel duct or chimney. Mounting tubes are normally supplied and fitted by the steel fabricator and must always be installed in the horizontal plane.

The mounting tubes should be fabricated from 50A, Schedule 80 pipe and special flange O.D 115 mm X I.D 50mm X 15T
Installation details of stack adaptor

! To align projector & receiver correctly, You can exact alignment by using 40A pipe when stack adaptor installation as described below

To align projector & receiver
3-2-9 Positive Pressure Applications

On oil fired boilers a pressure wave may be caused when the burner ignites disturbing soot accumulations and depositing them on the lenses. Therefore, the units should be located as far as possible from the actual flue gas outlet of the boiler. Injecting clean air is not always effective as the momentary pressure can be severe. Accordingly, it is important to observe this precaution even when injected clean air is used during normal running conditions.

Installation details of sealing air

![Diagram of sealing air connections]

**SEALING AIR CONNECTION**
15mm X PF1/2

**AIR PRESSURE:**
0.3 - 1.0 kg/cm²

---

**Sealing Air**

To minimise sooting-up of the lenses during normal operation, air pressurised above the stack pressure should be fed via copper tubing into the PF1/4 inch BSP tapping provided on each unit. The air supply should be switched on before the boiler is fired and should not be switched off until after the firing sequence has shut down and the purge cycle is complete.

Air supply may be a compressed air line, Blower unit or from a boiler FD fan illustrated above. Purge air pressure must exceed duct or flue pressure.

Air Pressure: 0.3 - 1.0 kg/㎠
CHAPTER 4

4-1 Electrical Connections

4-1-1 Optical Units

Use instrumentation grade shielded cables for connection to the projector, receiver and control unit. Run the cables separately from any mains cable (300 mm minimum separation). Cable shields to be grounded only at control unit.

Maximum cable length is governed by the total loop resistance of the core and should not exceed the following limits:

Projector: 5 Ohms
Receiver: 25 Ohms
4-20mA Analogue Output: 25 Ohms

Wiring Diagram
4- 1- 2 Main Connection

The unit is normally supplied for 220V, 60Hz operation and, optionally, 110V, 60 Hz. For optimum performance the mains supply to the BI- SM2004 should never be interrupted.

4- 1- 3 Alarm Relays

Alarm relays are rated at 5 Amps 250 V.A.C. non-inductive load and provide non-committed change-over contacts for external circuits. These circuits may be used for alarm or control function and 5 A fuses must be provided in the customer's switchboard.

4- 1- 4 Analogue Output

The 4 to 20mA output corresponds to an obscuration span of 0 to 100% obscuration
<table>
<thead>
<tr>
<th>REV. NO.</th>
<th>DATE</th>
<th>DESCRIPTION</th>
<th>REMARKS</th>
</tr>
</thead>
</table>

* TOTAL 10 SHEETS WITH A COVER

OWNER : MODEL : BI-SM2004

APR. BY Y. S. KIM

chk. by

chk. by N. M. LEE

own. by S. H. KANG

PROJ. NO.

SCALE NON

DATE 2005. 03. 10

Dwg. NO. BI-SD12004-A

INSTALLATION FOR SMOKE DENSITY INDICATOR

BUILDER

DESIGNER B-1 INDUSTRIAL CO., LTD.

BI-SM2004.doc
INSIDE INSTALLATION OF BOILER PANEL
<table>
<thead>
<tr>
<th>NO</th>
<th>PART NO</th>
<th>DESCRIPTION</th>
<th>MAT' L</th>
<th>Q'TY</th>
<th>REMARKS</th>
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<tr>
<td>1</td>
<td>BISM1001</td>
<td>PLATE FOR GLASS FITTING</td>
<td>STEEL</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>BISM1002</td>
<td>GASKET</td>
<td>ASBESTOS FIBRE</td>
<td>4</td>
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**TITLE**
PROJECTOR & RECEIVER ASS'Y

**DESIGNED DRAWN**
S.H. KWG

**CHECKED**
N.M. LEE

**APPROVED**
Y.S. KIM

**DATE**
2005. 03. 10

**SCALE**
NON

**DRAWING NO.**
BI-SM12004-A

**SHEET NO.**
04
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**Title:** INSTALLATION OF SENSOR  
**Designed Drawn:** S.H. KANG  
**Checked:** N.M. LEE  
**Approved:** Y.S. KIM  
**Date:** 2005. 03. 10  
**Scale:** NON  
**Drawing No.:** BI-SD12004-A
POWER SOURCE
AC 220V / 60HZ

CONTORL UNIT

DPYC-1.25

TO PROJECTOR

DPYC-1.25

TO RECEIVER

DPYC-1.25

TO ALARM

DPYC-1.25

TO EOR (4-20mA)

CONNECTION DIAGRAM
FOR CONTROL PANEL

BI-SM2004.doc
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**BI-SM2004.doc**