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## INSTRUCTION MANUAL Multiport Bicolor Level Gauge BHO

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## 1 General health and safety instructions

- Avoidance of danger for persons and property
- Only use unit for intended purpose.
- No additional mountings and modifications on the unit without our approval.
- Adhere to the standards for prevention of accidents and to the plant specific safety regulations.
- Read and observe installation and operating instructions.

## 2 Application limits

Only use this unit according to these operating instructions and to the parameters agreed upon in the delivery contract (see identification plate) including the agreed operating conditions.

### 2.1 Avoidance of danger and damages

- Distribute these mounting and operating instructions to appropriate department “arrival of goods, works transport, mounting, commissioning and maintenance”.
- When passing the unit to a third party, these mounting and operating instructions must be enclosed in the national language of this third party.
- Only skilled and qualified personnel with special work order may work on the unit, which must be free of pipeline stress!
- Carefully read, observe and preserve these mounting and operating instructions.
- Observe and adhere to the precautions marked in bold characters in the sections of these mounting and operating instructions!
- Avoid shocks and impacts during transport, which could damage the unit.
- In case of intermediate storage take care for a dry and appropriate place where the unit cannot be damaged.

## Attention

The fitting is under pressure during operation!

If flange connections, screw plugs or stuffing boxes are unfixed, hot water and steam will escape.

Carry out assembly and maintenance works only if plant is completely depressurized!

The fitting is hot during operation!

Severe burns on hands and arms are possible.

Wait until the unit has cooled before carrying out assembly and maintenance works!

Severe burns and scaldings on the whole body are possible!

Wait until the unit has cooled. In case of opening and disassembling the unit, residual medium can escape. Further evaporation is also possible on depressurized plant.

Sharp-edged interior parts can cause cutting damages on the hands!

Always wear work gloves when exchanging packing, valve seat and valve cone!

Information: **Depending on the size and version of the level gauge the customer has to arrange a sufficient brace support (eg. spring suspension etc.).**

## 2.2 Intended use

The product corresponding to the EU 2014/68/EU.

Applied standards as per EN 13445 / EN 12952 / EN 12953 / AD 2000 or ASME-Boiler.

## 3.1 Scope of supply

The BHO level gauge is delivered in 2 parts. (see fig. 1)

Part 1 consists of:

- upper shutoff valve
- gauge body
- lower shutoff valve
- drain valve (option)
- vent valve (option)

Part 2 consists of:

- LED illuminator device
- Power unit

The complete level gauge assembled will be called Right hand or Left hand in relation to the position of the valve respect to the gauge body, Fig. 2 show how to recognize the two versions

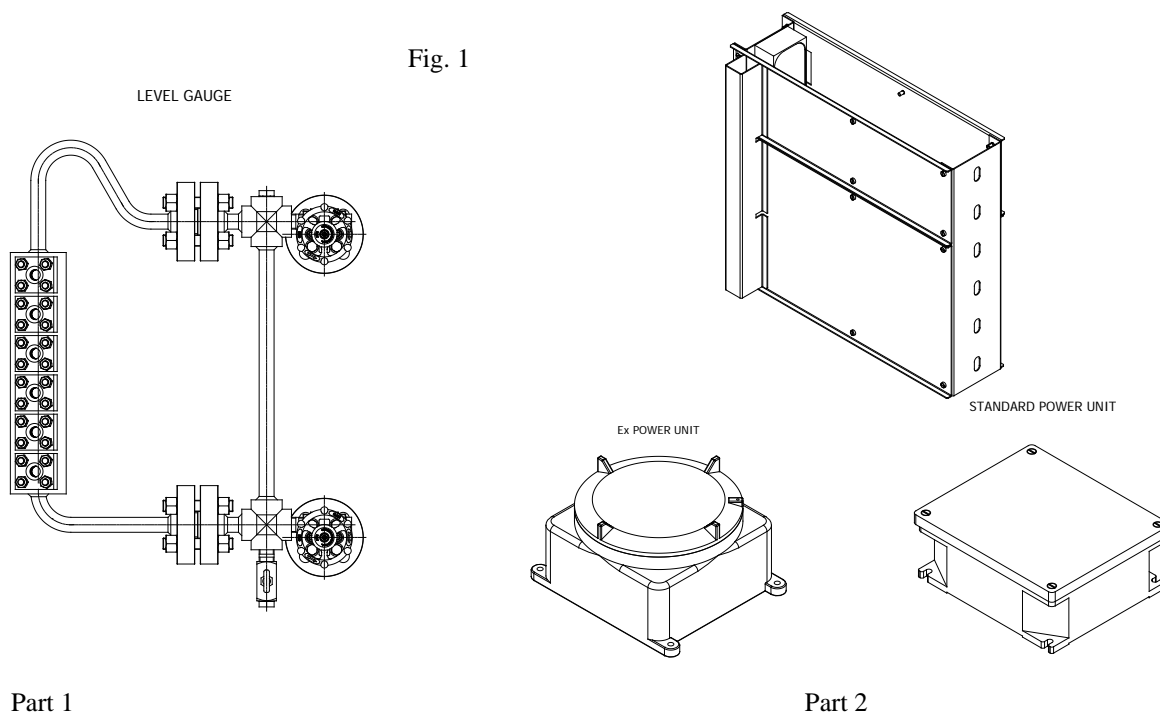
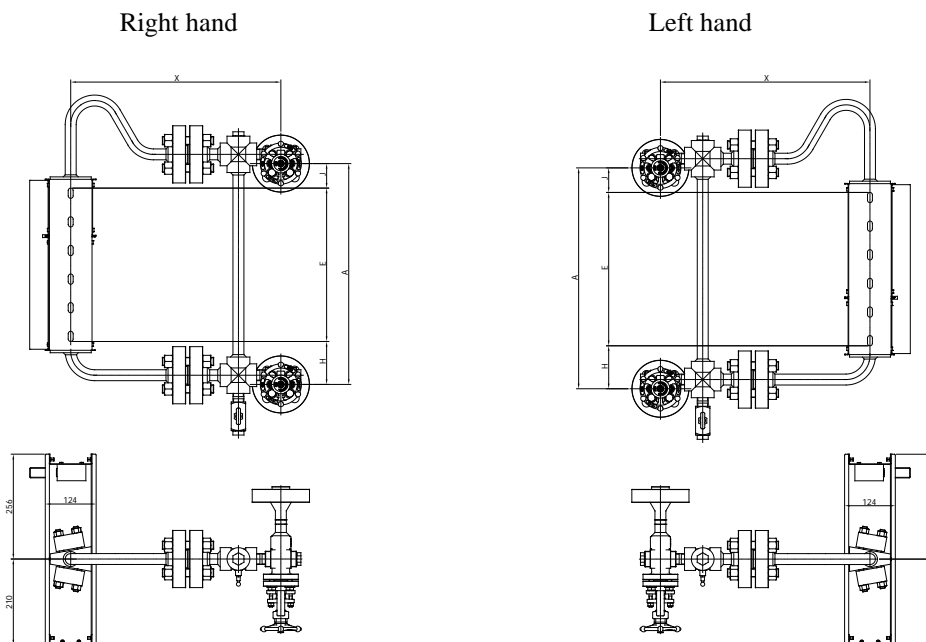


Fig. 2



**3.2 System description**

BHO glass level gauges have body and a number of cover plates fitted and fixed on both sides, each one containing a small, round and flat transparent glass.

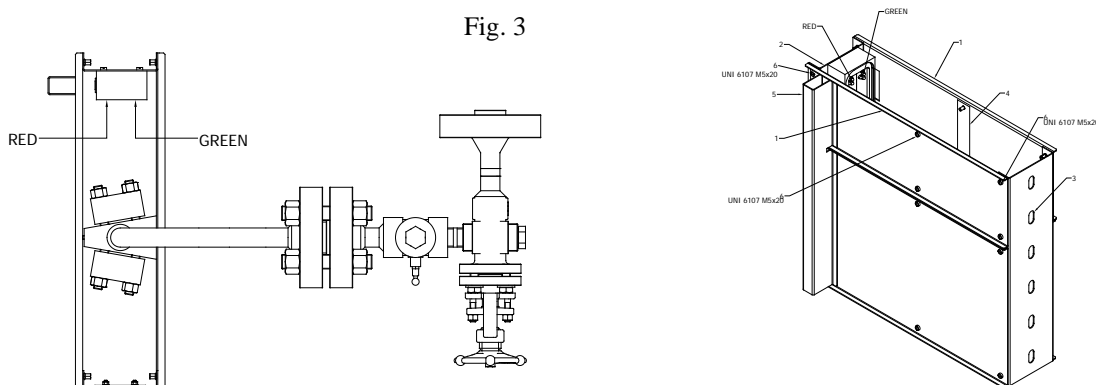
As the boiler water is aggressive, glasses are protected by mica shields placed in contact with process fluid, that otherwise could cause a chemical etching to the glass.

**3.3 Function**

The device works on the principle of communicating pipes. With the BHO model, the water level is shown by the rear LED illumination of the steam compartment. Red and green light, see Fig. 3 falls on the display unit. If there is water in the display area, then the light rays will be diverted in such a way that the green light beam falls on to the slit diaphragm of the display box. In the steam area the light rays are not diverted and the red light beam is projected.

As a result, in the BHO model the water compartment always appears green and the steam compartment red.

Fig. 3





## 4.1 Versions

Sight openings:

|      |     |     |     |     |     |     |     |     |     |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Size | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  |
| “E”  | 375 | 445 | 515 | 585 | 655 | 725 | 795 | 865 | 935 |

Calculation of sight length:  $E = (n-1) \times 70 + 25$

n= quantity of portholes

Shutoff valve: YY type with security ball

Drain valve: needle type

Vent valve: needle type

## 4.2 Connections

Standard: flanges according to UNI or ASME B 16.5

Welding end or Socket Welding according to UNI or ASME B 16.5

## 4.3 Materials

Parts in contact with the medium: Carbon steel or Stainless steel. Pressure holding components: Carbon steel or stainless steel according or ASME code.

## 4.4 Application limits

|                          |       |     |     |     |     |     |     |
|--------------------------|-------|-----|-----|-----|-----|-----|-----|
| Max. all. pressure PS    | [bar] | 32  | 50  | 80  | 100 | 160 | 200 |
| Max. all. temperature TS | [°C]  | 239 | 265 | 296 | 312 | 348 | 367 |

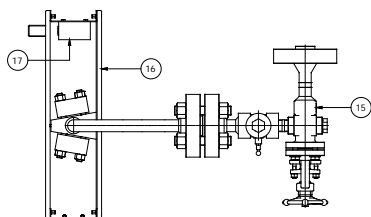
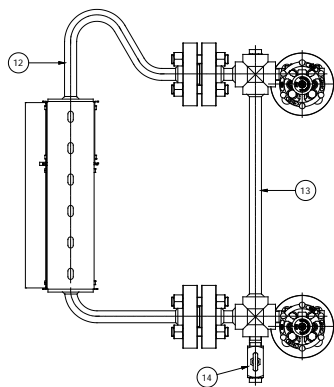
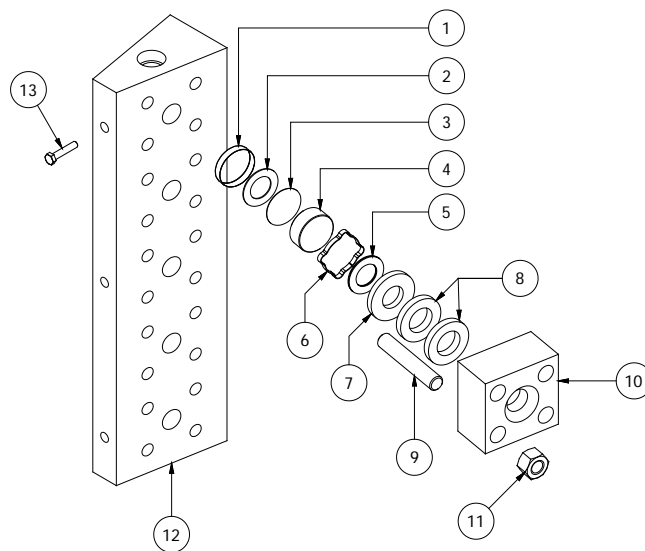
The safety of the unit is not influenced by corrosion if it is used as intended.

## 4.5 Identification plate / Marking

The following data are indicated on the identification plate:

\* marking depending on the realization

- A Date of manufacture
- B Model code
- C Tag number
- D Max. all. pressure
- E Max. all. temperature
- F Nominal pressure (not listed)
- G Materials
- H Atex / IECEx marking when needed
- I Manufacturer Logo



|    |                             |                    |
|----|-----------------------------|--------------------|
| 1  | Clip Ring                   | Stainless steel    |
| 2  | Sealing joint               | Graphite           |
| 3  | Mica shield                 | Mica               |
| 4  | Round glass                 | Aluminium silicate |
| 5  | Cushion joint               | Graphite and SS    |
| 6  | Guide ring                  | Stainless steel    |
| 7  | Support ring                | Stainless steel    |
| 8  | Belleville washer           | Stainless steel    |
| 9  | Stud                        | Stainless steel    |
| 10 | 10 Cover plate              | Stainless steel    |
| 11 | Nut                         | Stainless steel    |
| 12 | Gauge body                  | Stainless steel    |
| 13 | M5 screw illuminator fixing | Stainless steel    |

## 5 Installation

Installation must be done by qualified and skilled personnel. Before installing, to avoid structure deformation or any other damage that could cause leakage or bad working or glass breakage, check carefully to:

- remove protection caps from end connections;
- verify absence of dirt inside level gauge and intercepting valves (if any);
- be sure that upstream and downstream piping is clean and without any dirt coming from drilling or welding (as metal shaving or slag) or corrosion and so on;
- install the level gauge according to the proper working sense (look to the upper and lower part);
- install the level gauge so that it does not sustain piping weight, and sustain the level gauge if its weight could stress or danger flanges or piping, also considering vibrations, seismic stress or wind, if any. Officine Orobiche, on request, can provide you technical data to calculate, at your care, such stress
- avoid misalignment between piping and instrument ends. Check if face to face connecting dimension(CC) fits correctly with distance between piping ends.
- avoid instrument or piping thermal expansion able to stress the structure. To minimize thermal expansion effect insert an expansion joint or use other systems able to minimize such deformation.
- for flanged connections check correct position and dimension of gaskets between instrument (or intercepting valve) flange and piping flange, apply the proper bolting torque to stay bolts. For screwed connections verify compatibility between instrument (or intercepting valves) and piping screw thread.
- for connections with welding ends as BW as SW, see par. 11.0
- if possible, always use intercepting and draining valves between piping and level gauge, or, in the sketch assembly, always install systems able to section and interrupt upstream and downstream flow, with a draining system for said sectioned plant parts.

Those section and draining systems give also a good help when maintaining instruments in safety conditions.

- using a torque wrench, check level gauge bolting torque as indicated in Par 12.1.
- check carefully glasses must not have any scratch, corrosion, small etching or other defect. To better check, use a light with a 45° angle to the glass surface. Glass resistance is deeply reduced also by small defects and ratings. So any damaged glass must be changed immediately.
- any abrasive particle in the fluid can damage glass surface or glass protecting sheets (as mica or other).

To maintain as long as possible the perfect efficiency of level gauge, condensate passage inside level gauge must be eliminated or minimized.

Therefore sources of condensate have to be eliminated or fought, deviating condensate upstream the gauge, avoiding condensate passing through gauge.

Good remedy are:

- proper insulation of piping between boiler vessel and level gauge;
- a by-pass piping (water column) of adequate diameter, fitted upstream level gauge.

Condensate elimination or reduction gives also a better level visibility, not disturbed by the continuous flow generated by condensate on the internal surfaces of port holes.

A good shielding against weather (as rain, wind, snow, cold air) must be provided to avoid glasses thermal shock and to elongate glasses working life.

Avoid to connect level gauge with plant washing fluid (acid or alkaline washing)

## 6 Illuminator device

See proper manual for safe area or Atex area

## 7 Startup

Level gauge startup must be performed slowly to avoid any thermal shock or mechanical stress due to different temperature in different level gauge items.

Officine Orobiche BHO level gauges are equipped with aluminosilicate tempered glasses able to absorb a thermal shock up to  $T=255^{\circ}\text{C}$ . Nevertheless additional stresses, not easily manifest in startup, could reduce such resistance.

To minimize thermal shock in startup, intercepting valves must be slowly and only partially open to allow a slow heating gradient to the instrument. When the instrument temperature reaches the vessel temperature, valves must be regulated in totally open position.

In startup check closed position of vent and drain valves (if any). In operation intercepting valves must work in totally open position. A good start up can be performed as following:

- check all nuts are correctly screwed at a maximum bolting torque of 105 Nm. If not, using a torque wrench, gradually screw nuts with a crossing sequence as shown in Fig. A.
- check intercepting valves are in closed position;
- open partially drain valve;
- slowly and partially open upper intercepting valve, so that steam flows through the level body, increasing gradually its temperature; do not accelerate this step: it is very important a slow gradient; usually between 10 and 15 minutes is the correct needed time. Drain valve must be open in a position very near to closing (just leaking);
- when level gauge reaches boiler temperature, it is ready to start operation;
- close drain valve;
- slowly open lower intercepting valve: the boiler water shall grow up inside the level gauge, filling it up to upper part;
- when level gauge is full of water, open the upper intercepting valve: in a few the level shall settle;
- the level gauge is now operating.

To minimize leakage risk, periodically isolate level gauges and, when the gauges temperature drops down to the ambient temperature, check that bolting torque is 105 Nm. This check is mandatory if level gauges are used in discontinuous operation or in variable operating condition.

**WARNING:** if intercepting valves are equipped with safety check ball, while in operation valves must be in totally open position to permit the proper automatic ball intervention.

Safety check ball are an automatic safety device, able to interrupt fluid leak to environment in case of glass breakage. Safety check ball are purchased under Customer request, but we strongly suggest such protecting device. During plant shut down, leave open level gauge valves to allow a slow temperature and pressure decreasing on level gauge an to avoid any fluid trap inside the instrument.

## 8 Maintenance

Glass level gauges maintenance must be performed by skilled and qualified personnel, after complete reading of this maintenance manual.

### **WARNING:**

Do not proceed with maintenance service unless:

level gauge has been properly isolated from the pressurized part of plant;

level gauge inside pressure has been totally discharged and safe leaded to atmospheric pressure. Do not assume that the system has depressurized even when the pressure gauge indicates zero.

level gauge temperature decrease until ambient temperature, to avoid burning. Protective gloves, eyeglasses or other safety devices must be used, if necessary;

### **Level gauge maintenance must be performed immediately, isolating the level gauge, when:**

glass is losing its original transparency, or it looks, also partially, opaque;

if any roughness appears on the internal surface of glass, due to erosion or to corrosion;

if mica shields or Kel-F shields of transparent glasses look damaged and fluid is in contact with glass;

if leakages from connections between level gauge and intercepting valves

if any corrosion is observed inside or outside any part of the level gauge



## 9 Inspection

Any leakage must be immediately eliminated: otherwise sealing surfaces are eroded by fluid, therefore could be impossible re-establish sealing. A small leakage can be stopped restoring correct bolting torque of cover plate nuts. If such operation is not enough, cover plate must be removed to change wear parts.

Leakage could be generated by many factors, including belleville washers elasticity loosening.

Level gauge is tight if any glass is pressed on center piece (body) applying a calculated pressure. This pressure, obtained by cover plate bolting torque, must be nor too low (to avoid leakages), nor to high (to avoid glass or sealing joint breakage). To maintain correct pressure, notwithstanding level gauge temperature and internal fluid variation, 2 special belleville washers are fitted between glass and cover plate. Those belleville washers are calibrated to give the exact correct pressure when cover plate nuts are screwed on studs using a 105 Nm torque.

Those belleville washer could lose elasticity after a while, so a regular periodic changing must be scheduled.

All glass level gauges fitted on high pressure steam boiler need a periodic maintenance and wear item changing. Item involved in fair wear are:

- mica shield sheets, always contacting water/steam and subject to matting or to exfoliation;
- sealing joints and cushion joints;
- glasses.

Maintenance interval may vary depending on:

- operating pressure;
- ambient installation condition (on open air, special climate, weather exposition, etc.);
- preventive maintenance;
- boiler water chemical treatment

To eliminate dirt deposit on mica shield operate as follow:

- Close both intercepting valves upper and lower);
- Fully open drain valve;
- Very slowly and partially open upper intercepting valve: steam shall flow inside level gauge center piece, cleaning internal surfaces; operate carefully avoiding excess to preserve mica shield surfaces.
- Close drain valve;
- Slowly open lower intercepting valve: the boiler water shall grow up inside the level gauge, filling it up to upper part;
- When level gauge is full of water, open the upper intercepting valve: in a few the level shall settle;
- The level gauge is now operating.

This cleaning operation cannot be used for a long time nor repeated often, to valid damage to mica shield sheets

## 10 Glass changing

Maintenance of level gauge to change one or more glasses and/or mica shields can be performed without dismantling level gauge from its plant connection piping.

First of all, check to respect safety prescription of this manual, then proceed as follows:

1. Close both intercepting valves (lower and upper);
2. Fully open drain valve;
3. Unscrew nuts (11) and remove cover plate (10) and all contained items;
4. Dispose glass, mica shield, and both joints (as sealing as cushion). Recover centering ring (6), bearing washer (7) and both Belleville washers (8);

**WARNING: install the Belleville washers (8) as shown in the drawing (fig.1). Otherwise the incorrect assembly may damage the glass.**

5. Perfectly clean sealing surface on center piece (body), removing all residual of joint, rust or dirt; a very smooth emery cloth (ex. 400) can be carefully used to perform cleaning;
6. Carefully check absence of corrosion on center piece sealing surface. Only very, very small, not aligned and not close one to the other pitting point can be tolerated. If the corrosion or the pitting is evident, sealing surface must be machined with a grinding machine. Grinding can be machined many times with no level gauge functionality loosening;

**WARNING: avoid any scrape or damage on sealing surfaces. A bad cleaning or any residual dirty can generate a critical stress point able to break the glass.**

7. Carefully clean internal of cover plate, bearing washer and belleville washers.
8. Check belleville washers: they must not show cracking or flatness; total thickness of both belleville washers (8) and bearing washer (7) must be between 11.10 and 11.40 mm. If not, both belleville washer must be changed;
9. Insert both belleville washers in their cover plate housing, respecting exact facing, and bearing washer;
10. With clean and dry hands, extract from its casing the BHO Spare kit and fit around it the centering ring (6);

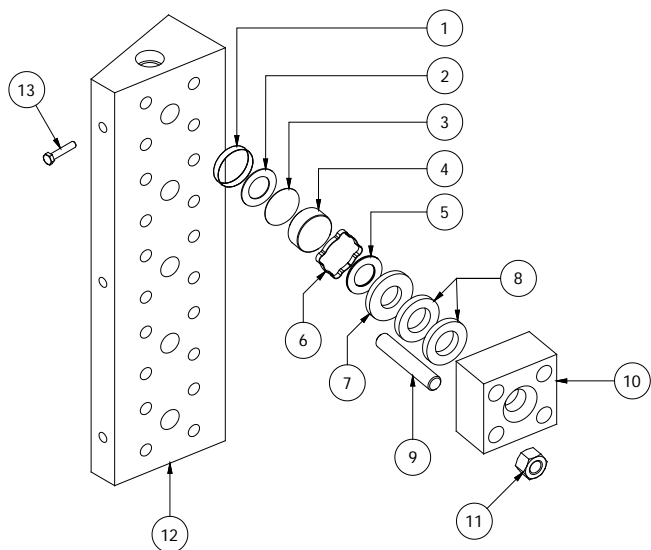
**WARNING: The Cushion Joint (5) must be place with the graphite side (G) facing the glass, and not the SS side. Otherwise the SS side would damage the glass.**

11. Insert spare kit into its cover plate housing, so that mica shield is facing to the level gauge body;
12. Clean threads on studs and nuts, removing any dirt, rust or paint residual;
13. Apply some grease on studs and nuts threads and on nut surface contacting cover plate;
14. Fit the cover plate and its contained items to the gauge body: be careful to avoid any damage to mica shield or to glass surfaces;
15. Check the clearance between center piece (body) and cover plate (10): clearance must be between 1.00 and 1.50 mm. Never use "Spare kits" if clearance is less than 0.80 mm.
16. Hand screw all 4 nuts until they touch cover plate;
17. Using a torque wrench, proceeding with a cross sequence as shown in Par. 12.1, screw nuts with a 35 Nm bolting torque; then repeat at 55 Nm, 75 Nm, 90 Nm, and, finally, with 105 Nm bolting torque. Do not go over such 105 Nm bolting torque. Use of a calibrated torque wrench is mandatory!
18. After bolting procedure, check parallelism between center piece surface and cover plate;
19. Check also bolting torque of all not maintained cover plate nuts;
20. If, during maintenance, level gauge temperature has drop down, follow prescription as in point 8.0 of this manual

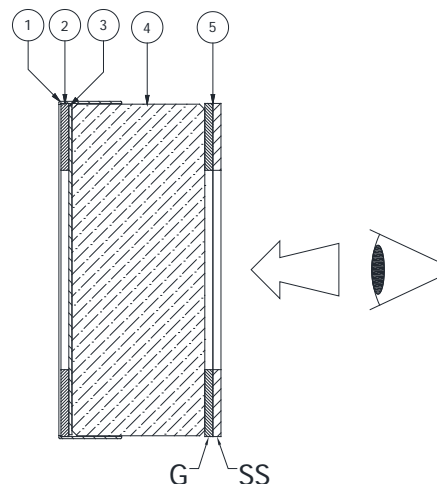
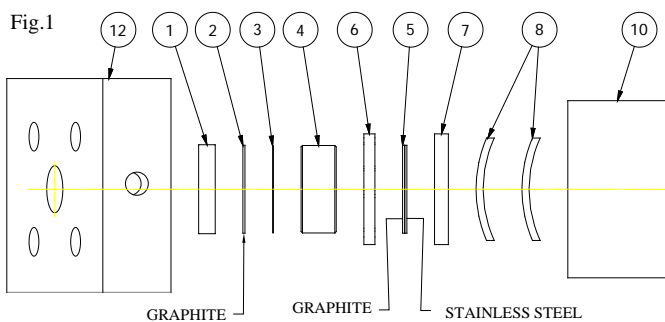
**WARNING: Cushion gasket, glass, glass mica or Kel-F shield (if any), and sealing gasket must be destroyed and dis- posed by approved methods.**

**Never use again same gaskets: residual deformation can generate leakages or glass breakage.**

**A used glass can hide defects or stresses due to past use under pressure and temperature: if reassembled on the gauge it could break under pressure, with danger and injury for people or environment.**



|    |                             |                    |
|----|-----------------------------|--------------------|
| 1  | Clip Ring                   | Stainless steel    |
| 2  | Sealing joint               | Graphite           |
| 3  | Mica shield                 | Mica               |
| 4  | Round glass                 | Aluminium silicate |
| 5  | Cushion joint               | Graphite and SS    |
| 6  | Guide ring                  | Stainless steel    |
| 7  | Support ring                | Stainless steel    |
| 8  | Belleville washer           | Stainless steel    |
| 9  | Stud                        | Stainless steel    |
| 10 | 10 Cover plate              | Stainless steel    |
| 11 | Nut                         | Stainless steel    |
| 12 | Gauge body                  | Stainless steel    |
| 13 | M5 screw illuminator fixing | Stainless steel    |



## 11 Demounting

First of all close intercepting valves and isolate level gauge from the vessel pressure; check carefully valve perfect sealing. Remove the level gauge (leaving intercepting valves on site) and fix it on a workbench to avoid any injury to maintenance people

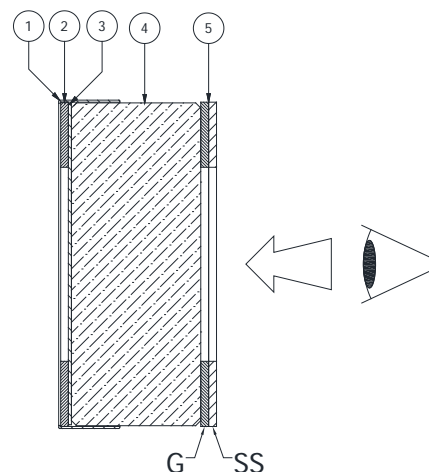
**Warning: do not remove level gauge from plant connecting piping unless all internal pressure has been discharged and safety vented to the atmospheric pressure; wait until the temperature of level gauge falls down to the ambient temperature; carefully check that any process fluid has been discharged and drained out.**

## 12 Spare parts

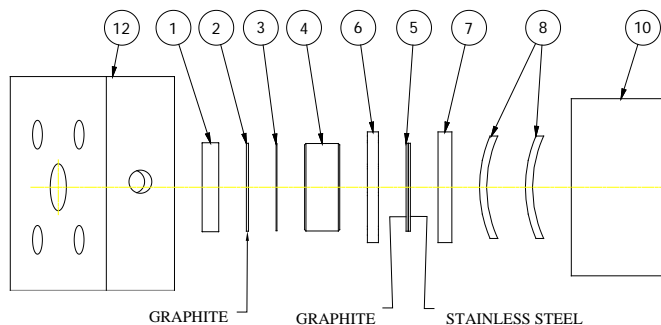
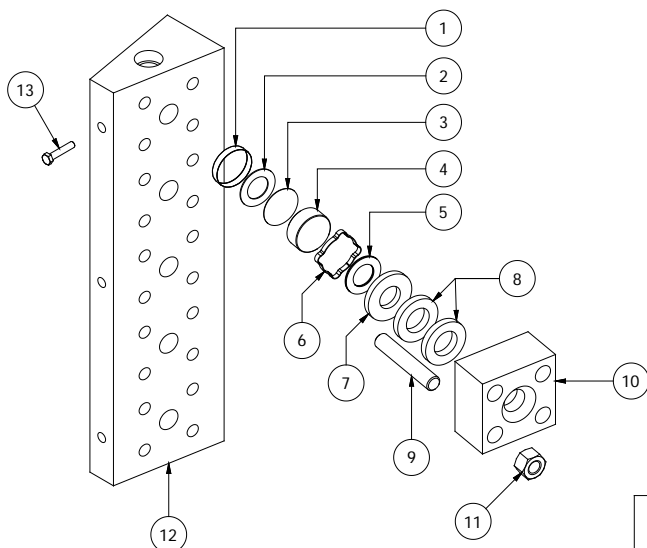
All spare parts must be original Officine Orobiche spares. The use of not original spares cannot guarantee the proper and safe working of the level gauge and can damage the gauge itself. Always check any transportation or handling damage to spares.

Before to proceed with maintenance, following spares for each single port hole must be available and checked:

- Spare kits, each consisting of:
  - 1) Clip Ring
  - 2) Sealing joint in graphite
  - 3) Mica shield
  - 4) Round glass
  - 5) Cushion joint in SS and graphite\*
- Centering ring (item 6), if damaged; stainless steel centering ring can be recovered and used many times;
- 2 Belleville washers (item 8), if damaged. Belleville washer, in special alloy for high temperature spring can be damaged by cracking or age wear;
- Bearing washer (item 7), if damaged;
- 4 studs (item 9), if damaged;
- 4 nuts (item 11), if damaged;
- Cover plate (item 10), if damaged.



\* The Cushion Joint (5) must be place with the graphite side (G) facing the glass, and not the SS side. Otherwise the SS side would damage the glass.



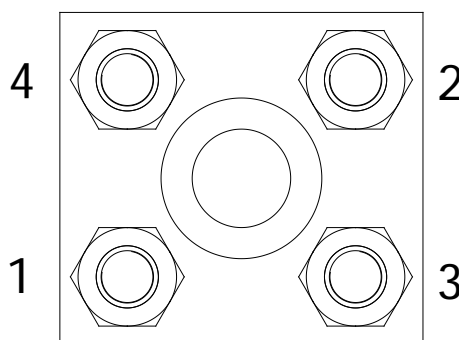
**13 Tightening torques**

All working pressure for BHO multiport bicolor level gauge from 20 to 200 bar

| TIGHTENING TORQUE Nm (IN STEPS) |    |    |    |     |
|---------------------------------|----|----|----|-----|
| 1                               | 2  | 3  | 4  | 5   |
| 35                              | 55 | 75 | 90 | 105 |

Follow the closing sequence (from 1 to 4) as per picture below increasing the tightening torque step by step from 1 to 5

Fig. A



Tightening torques shall be checked after each drum shut-off.

**14 Working life**

Glass level gauge contains items that are subject to fair and normal wear. Such items are glasses, joint and mica protection shield. Therefore glass level gauges and its parts must be periodically inspected by user. Inspection time scheduling and interval must be performed by user according to plant working condition, process fluid and plant knowl- edge and/or experience. For new application inspection interval must be shortened, up to daily inspection, before establishing the proper inspection interval.

Always avoid any improper use of level gauge and intercepting valves able to generate unfair valve wear as:

- do not use an on-off valve as regulating valve
- avoid in process fluid abrasive particles, or piping sandblasting residual, or swarf, or welding dross;
- avoid water freezing inside level gauges.

**15 Disposal**

Dismount unit and separate waste products. When disposing the unit, observe legal regulations for waste disposal.

**16 Warranty**

All the bicolor level gauge device are guaranteed to be free from manufacturing faults over a period of 12 months from the date of shipment. In the event of failures, implying return of goods within the limit specified above, OFFICINE OROBICHE will replace (shipment fees not included) all damaged parts free, provided that the failure does not ensue from incorrect use. OFFICINE OROBICHE shall never be held responsible for any incorrect use of their products when these are used for purposes other than those mentioned in the specifications approved at the order stage. In these cases, no complaints will ever be taken into consideration. No damage and/or fee, whether direct or indirect, ensuing from an incorrect installation or use shall ever be debited to OFFICINE OROBICHE.