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BONETTI® MAGNETIC LEVEL GAUGES USE AND MAINTENANCE MANUAL

SAFETY GENERAL INFORMATION

FOREWORD

To have proper working of Cesare Bonetti S.p.A. products, any installation, start up, control and maintenance must be performed by qualified and duly instructed personnel, following prescription stated by maintenance manual.

To minimise any risk for people, goods and environment, those general instruction must be respected.

Cesare Bonetti S.p.A. is not responsible for damages outcoming from:

- use of product by non qualified personnel;
- incorrect installation;
- incorrect maintenance;
- product alteration or tampering;
- use of spares not original by Bonetti;
- non-performance of instruction stated in maintenance manual;
- extraordinary occurrence.

Any responsibility regarding correct selection of product and its proper material, depending on technical characteristic, application and purchasing standards and rules, belong to the system or plant engineer.

PRESSURE

Before starting maintenance operation be sure that pressure inside product is reduced to atmospheric value and be sure that product connection piping has been correctly isolated.

Do not trust on the Pressure Gage only to assume that pressure has been discharged.

TEMPERATURE

To avoid burning, wait until product temperature cools down completely, and use protecting gloves, eye glasses and dressing, if necessary.

DISPOSAL

Product can be recycled. No environment pollution risk occurs if proper procedure has been respected.

Warning: if product contains residue of process fluid, disposal and/or recycling prescribed procedures for such fluid must be respected.

In case PTFE sealing or gaskets is fitted on product, such material must be recycled separately, according to proper and/or prescribed procedures.

DANGEROUS GAS OR FLUID INSIDE PIPING

Be sure that any dangerous or flammable or explosive gas or fluid has been discharged from product and connected piping, to avoid any danger to maintenance people due to contact or inhalation

ENVIRONMENT DANGER

Evaluate carefully: explosion risk, oxygen leakages, dangerous gas leakages, fire risk due to maintenance operation or welding.

SEALING GASKETS

Graphite sealing gaskets to be removed or handled during maintenance, as spares, could contain thin steel layers able to injure, if non handled with care.

MAINTENANCE WORK

Maintenance work must be performed or supervised by qualified, duly instructed and skilled people. Personnel in charge of products maintenance, installation or exercise must be trained to carry out procedures according to use and maintenance manual.

Verify that tools to be used for maintenance are within their scope and that they are in good condition.

If special tools are requested, verify their availability and condition.

STORAGE

If products that are non self-draining are stored in low temperature, be careful to avoid or protect them from inside fluid freezing.

Good condition of stored products must be periodically verified.

PRODUCTS SENT BACK TO BONETTI COMPANY

According to laws and rules for safety, health and environment preservation, if any product is sent back to Cesare Bonetti S.p.A. for maintenance or any other reason, the sender must inform by written notice about risk and warning to be used depending on product mechanical damages, or inside and/or outside product fluid residue and/or contamination, that could be dangerous for health, safety or environment.

Such information must be completed with any useful safety instruction and safety data sheet regarding substances classified as dangerous or potentially dangerous.

This manual is exclusive property Cesare Bonetti S.p.A., under Copyright and any not authorized reproduction, in part or in total, shall be prosecuted.

Shown products are according the current production. Cesare Bonetti S.p.A. reserves to modify product characteristics according technical evolution or customer special request.

Verify if manual comply with used product.

GENERAL USE AND MAINTENANCE PRESCRIPTION

1.0 SCOPE

This manual states safety criteria, check and controls, installation instruction, use and maintenance instruction for magnetic level gauges shown in Table 1.

If the level gauge has intercepting valves or accessories fitted by Cesare Bonetti, this manual must be used together with the specific intercepting valve type or accessories manual.

2.0 PRODUCT DESCRIPTION

A magnetic level gauge is an instrument suitable to give the accurate level reading of a fluid contained in a vessel.

Operation of Bonetti Magnetic Level Gauge is based on some elementary physical principles:

- The principle whereby liquid in communicating vessels is always at same level;
 - Archimede's principle according to which a body immersed in a liquid receives a buoyancy equal to the weight of displaced liquid;
 - The principle of attraction between North and South poles of two permanent magnets and that of repulsion between like poles.
- This principle has two applications in the BONT magnetic level gauge:
- first between the magnet in the chamber float and every single magnet of the indicating scale;
 - second between the magnets of the indicating scale.

The fluid level is indicated by this indicating scale, whose bicolor cylinders, containing a small magnet, are rotating on an horizontal axis. The small magnets inside cylinder feel the magnetic force of the bigger magnet inside the float and they orient themselves according the pole (North / South) moved by the magnet of the float.

As such float magnet is placed on the floating level, the different colour shown by the scale cylinders indicates exactly the level of the fluid inside the vertical chamber of the level gauge and, accordingly, the level inside the vessel connected to the level gauge.

According to process fluid temperature, cylinders colour could be:

- red and white for temperature ≤ 200 °C
- black and white for temperature > 200 °C.

In both cases see point 7.1 for thermal insulation.

The scale could be fitted on the bottom part with some cylinder yellow/white: when float is correctly performing, the shown colour is white; if yellow colour appears, the float is on the bottom part of the level gauge because:

- no liquid is present inside the level gauge, or
- the float is damaged and has sunk.

Standard material normally used for the gauge body is Austenitic Stainless Steel.

If those materials are not suitable for the fluid, Cesare Bonetti S.p.A. can provide special materials according to Customer specification.

3.0 RATING

Magnetic level gauges included in operating conditions shown in Table 1 are classified in Category III of Pressure Equipment Directive 97/23/EC, with exception of level gauges that, depending on process fluid group and according to Annex II of said Directive, are included in Art. 3.3 or in Category IV.

Max rating condition (pressure and temperature) and group fluid classification are shown in following Table 1.

In Table 1 is also indicated the limitation to the Centre to Centre distance of connection to the vessel (CC in Fig. 1) depending on which the internal volume of the gauge in litre multiplied for operating pressure (PS x V) still consent to the gauge to be classified in Category III. For standard material minimum operating temperature, see Table 4.

4.0 SAFETY CRITERIA

Proper working of level gauges can be obtained if all steps regarding installation, start up, control and maintenance are managed by duly instructed, qualified and skilled personnel.

Therefore this use and maintenance manual, together with the use and maintenance manual of each intercepting valve type, must be deeply considered by such personnel.

If use and/or maintenance instruction are not applied, product may be damaged or work badly, generating risk of damage to people, plant or environment.

Prescription stated in section "SAFETY GENERAL INFORMATION" must be respected.

5.0 INSPECTION AT RECEIPT

When receiving goods, check carefully to verify that no damage has

TABLE 1													
Group 1 fluids													
Type MAG/	T.MAX. (°C)	-10+38	50	100	120	150	200	250	300	350	375	400	"CC" (mm)
MNP		9	9	9	9	9	9	9	9	9	7	7	69867
MLP		27	26	20	18	16	13	11	10	10	7	7	23209
TLP		60	60	50	45	39	22	17	12	10	10	9	10378
TLPS		60	60	60	60	58	58	52	48	42	39	27	10378
THP	PS (bar)	118	118	85	71	66	38	33	29	18	15	13	3908
THPS		118	118	118	115	115	98	88	80	67	65	63	3918
THPX		170	170	170	168	167	165	160	155	149	146	144	2972
210/THP		291	291	265	255	240	220	205	195	190	185	180	1062
210/THPS		388	388	388	385	385	385	370	350	335	330	325	1535
Group 2 fluids													
Type MAG/	T.MAX. (°C)	-10+38	50	100	120	150	200	250	300	350	375	400	"CC" (mm)
MNP		9	9	9	9	9	9	9	9	9	7	7	209840
MLP		27	26	20	18	16	13	11	10	10	7	7	69987
TLP		60	60	50	45	39	22	17	12	10	10	9	31374
TLPS		60	60	60	60	58	58	52	48	42	39	27	31374
THP	PS (bar)	118	118	85	71	66	38	33	29	18	15	13	11633
THPS		118	118	118	115	115	98	88	80	67	65	63	11633
THPX		170	170	170	168	167	165	160	155	149	146	144	9155
210/THP		225	225	225	225	225	220	205	195	190	185	180	4451
210/THPS		388	388	388	385	385	385	370	350	335	330	325	4846

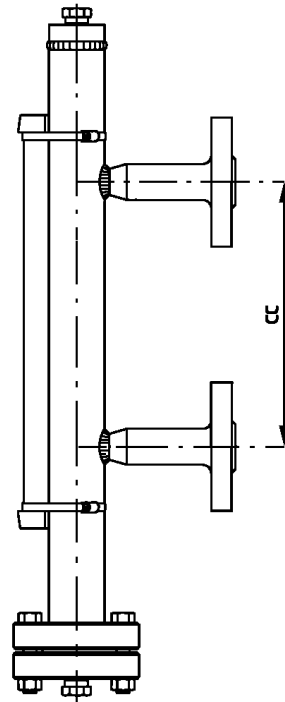


Fig. 1 - Center to Center distance (CC) of magnetic level gauge

been suffered during transportation.

Check also that level gauge and valve type, rating pressure/temperature as shown on Table 1 and material, as indicated on level gauge body, and (if any) on valve body and/or bonnet, comply with application.

Never exceed limits stated by such rating.

Verify and be sure that level gauge and valve material is suitable for process fluid and surrounding atmosphere.

6.0 STORAGE AND HANDLING

6.1 STORAGE

Level gauges must be stored protected from weather or contamination arising from dirt, mud and so on. If goods have to be stored for a while, we suggest to maintain them in the original packing. If storage is very long, check goods periodically (not less than twice a year) and verify surface and internal condition, removing any dirt, rust and/or corrosion from inside and outside.

6.2 HANDLING

To remove the indicators from their packing and move them it is better to grasp them by the ends of the tube. If the indicator has



weights and overall dimensions that are compatible with manual lifting within the legal limits, handle with care using gloves without rough parts to prevent damage to the outer protection. In the case of indicators longer than 1.5 metres it is necessary to grasp them in the middle area as well in order to avoid free spans of width over 1.5 metres.

If lifting means are required, it is necessary to use ropes certified according to normative EN 1492-1/2 (or similar in force in the country of installation), harnessing the instrument at the ends (see figure) with the ropes at an angle of no more than 45°, using appropriate necking to prevent damage to the outer protection or fragile zones such as the stair glass, handles of taps, micro switches or other accessories

In the case of harnessing the middle part, prepare cradles, coated in rubber, sponge or other suitable material that avoids damage to the fragile parts such as stairs or other accessories such as staves, micro switches, transmitters, etc.

The lifting ropes must stop the indicator from having a rise between two gripping points such as to surpass the elastic threshold of the materials. Pay particular attention to the stair glass and always manoeuvre with care not to deform the indicator.

Do not rest the indicator on its free flanges so as to avoid damage to the phonographic device.

7.0 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. Cesare Bonetti S.p.A., 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 minimise thermal expansion effect insert an expansion joint or use other systems able to minimise 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 Fig. 4 and in Table 2.

WARNING:

Considering magnetic principle according which is designed magnetic level gauge and its accessories operating, avoid to use any ferromagnetic item on level gauge and near the level gauge. Such ferromagnetic items could damage proper working of level gauge and/or give wrong level indication.

7.1 PRESSURE TEST

Magnetic level gauge is fitted with its float inside. Maximum float operating conditions are shown on the label fitted on magnetic level gauge.

7.2 BODY HYDROSTATIC TEST

Each magnetic level gauge has been pressure tested in our facilities. If anymore pressure test must be performed **FLOAT MUST BE REMOVED FROM THE LEVEL GAUGE.**

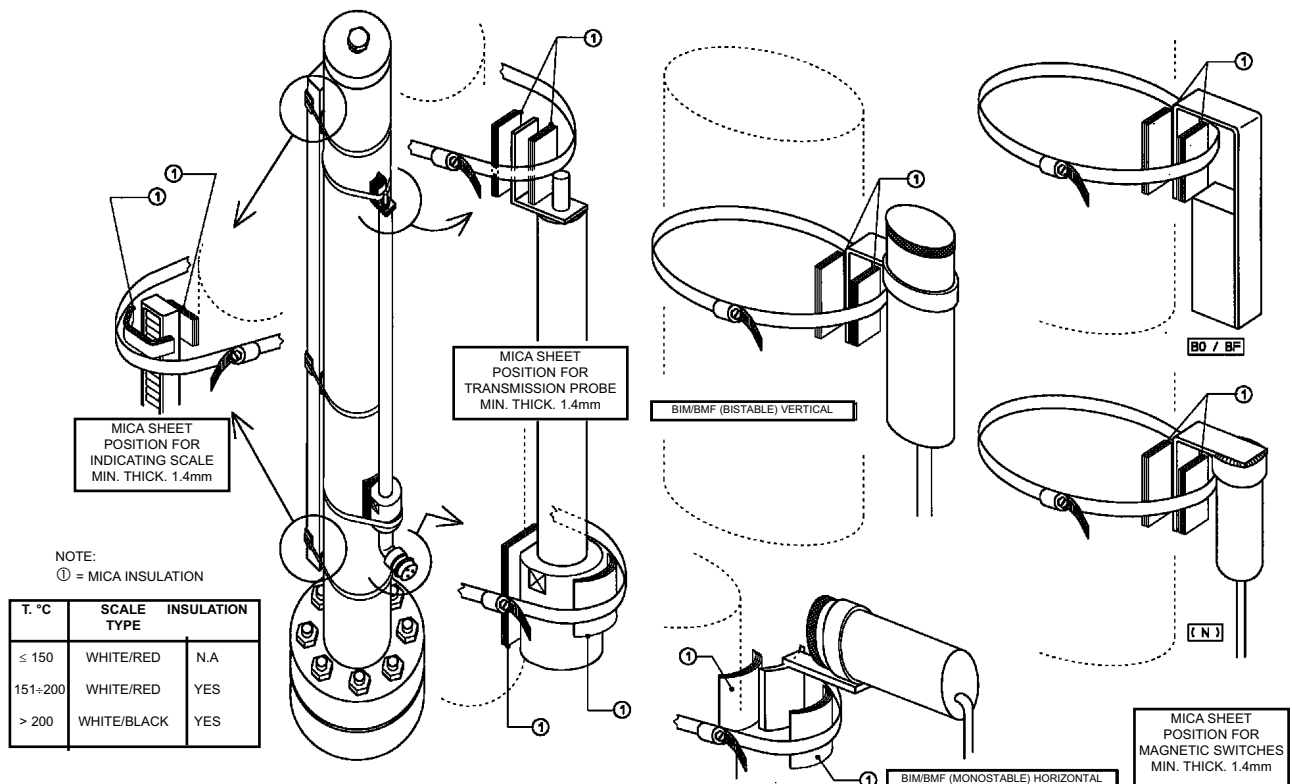


Fig. 2 - Accessories & thermoinsulation

Body test pressure must be limited to pressure indicated on gauge body label under "Body pressure test".

WARNING:

Testing gauge body without removing float could collapse float. Be careful when removing float, as float could be pressurised inside.

7.3 SEAL TEST

After placing float inside level gauge body, check sealing of joints, avoiding to exceed pressure and temperature limit prescribed for float, as indicated on the level gauge label under "Operating conditions".

8.0 START UP AND OPERATING

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

To minimise thermal shock in start up, slowly open, until fully open, the lower drain valve. Then slowly open, only partially, the upper intercepting valve: the instrument will increase gradually its temperature reaching the same temperature of the process fluid.

Now close the drain valve and, always operating slowly, completely open the upper intercepting valve. The condensate will start to flow inside the level gauge. Wait until the condensate fills the instrument. When the level reaches and exceeds the lower connecting pipe, slowly open the lower intercepting valve, until fully open.

In standard operating condition, intercepting valves must stay in totally open position.

To minimise leakage risk, periodically isolate level gauge and, when the gauges temperature drops down to the ambient temperature, check that bolting torque matches the value indicated in Table 2. This check is mandatory if level gauges are used in discontinuous operation or in variable operating condition.

WARNING: Sometimes level gauge (as Type MAG 210-THP) or valves are equipped with **safety check ball** to protect float from stress due to high differential pressure in start up.

In this case start up must be performed opening the intercepting valves very slowly and partially, to avoid the operation of safety check balls, that could obstruct the level gauge body filling.

While in operation valves must be in totally open position to permit the proper automatic safety ball intervention.

While plant shut down, leave open level gauge valves to consent a slow temperature and pressure decreasing on level gauge and to avoid any fluid trap inside the instrument.

9.0 HEAT INSULATION

Accessories as:

- magnetic reading scale,
- magnetic transmission probe,
- magnetic switches,

can not withstand high temperature: so they must be insulated from high temperature metal parts, as indicated in Fig. 2.

Avoid to insert such accessories inside heating jackets.

WARNING :

Not respecting above prescriptions could damage such accessories.

10.0 MAINTENANCE

Magnetic Level Gauges maintenance must be performed by skilled and qualified people, after complete reading of this maintenance manual.

WARNING:

Do not proceed with maintenance service unless:

- level gauge has been properly isolated from the pressurised part of plant;
- level gauge inside pressure has been totally discharged and safely vented to atmospheric pressure. Do not assume that the system has depressurised even when the pressure gauge indicates zero.
- level gauge temperature decrease until ambient temperature, to avoid burnings. Protective gloves, eyeglasses or other safety devices must be used, if necessary;

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

- leakages from joint gaskets
- leakages from connections between level gauge and intercepting valves
- if any corrosion is checked inside or outside any part of the level gauge
- indicating scale shows yellow cylinders, so indicating (if the level gauge is not empty) that float is damaged.

ITEM LIST			
N°	ITEM	N°	ITEM
1	BODY	7	NUT
1.1	UPPER CAP	8	STUD/BOLT
2	LOWER AND UPPER FLANGE	9	VENT SCREW PLUG
3	SEALING FLANGE	10	DRAIN SCREW PLUG
4	CONNECTION PIPE	15	SEALING JOINT
5	CONNECTION FLANGE	98	SPRING
6	MAGNETING SCALE	99	FLOAT

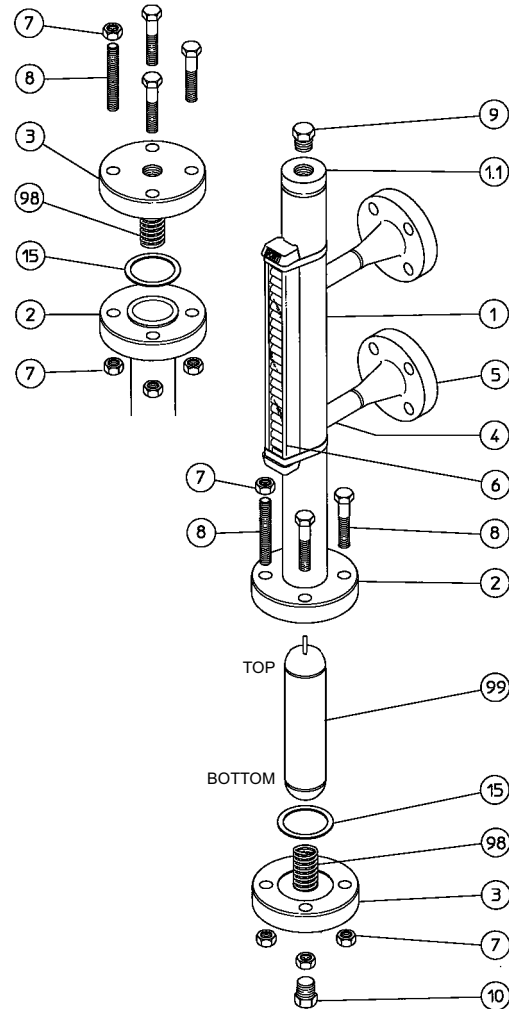


Fig. 3 - Magnetic Level Gauge Assembly typical dwg

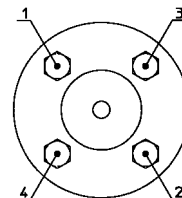


Fig. 4 - Screwing sequence

WARNING:

Proper inspection and maintenance schedules must be generated by end user according to his plant knowledge and experience. Such schedules must consider service, operating conditions, fluids and any internal and external media able to influence material used on instrument.

10.1 REMOVING

Warning: do not remove level gauge from 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.

GAUGE TYPE MAG/	FLANGE BOLTING TORQUE
	Nm
MNP/MLP/TLP/TLPS	30
THP/THPS/THPX	70
210THP/210THPS	250 ÷ 300

10.2 DISASSEMBLY

First of all close intercepting valves and isolate level gauge from the vessel pressure; check carefully valve perfect sealing.

After checking that all safety condition have been respected, operate as follows, referring to Fig. 3 to identify items:

- Unscrew nuts (7) following sequence shown in Fig. 4
- Remove bottom flange (3) and sealing joint (15).
- Remove float (99) carefully. **WARNING: in some case float could be pressurised inside.**

WARNING: Sealing joints must be destroyed and disposed. Never use again same sealing joints as their deformation could provoke leakages. Clean sealing surfaces (or joint housing) of flanges removing all residual of old sealing joints.

11.0 ASSEMBLING

Using new spare sealing joints and, in case it is damaged, a spare float, assemble the gauge as follows:

referring to Fig. 3 to identify items:

1. Insert float (99) inside body (1), looking for correct position, maintaining the small filling tube of float on the upper part of level gauge.
2. Place sealing joint (15) in its flange housing (3).
3. Clean studs or bolts (8) and nuts (7); grease threads and nut surface contacting flanges.
4. Hand screw nuts until they touch flanges, following sequence shown in Fig. 4.
5. Using a torque wrench, screw bolts using a 5 Nm torque, always following sequence in Fig. 4. Repeat 3 times with increasing bolting torques until final bolting torque, as shown in Table 2, has been reached.

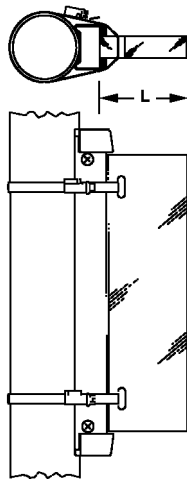


Fig. 5 - No frost plexiglass sheet

12.0 LOW TEMPERATURE OPERATING CONDITION

If the level gauge must operate in contact with process fluids having temperature under 0 °C, to consent level visibility notwithstanding frost, a plexiglass sheet contacting reflex or transparent glass must be fitted and sealed on level gauge scale, as shown in Fig. 5.

To seal the plexiglass sheet, must be used a mastic able to maintain softness and elasticity up to operating temperature. Apply the mastic avoiding to dirty glass surface.

Plexiglass height depends on process fluid temperature (see Table 3).

TEMPERATURE	NO FROST SHEET HEIGHT
From 0 °C to -19 °C	38 mm
From -20 °C to -49 °C	75 mm
From -50 °C to -99 °C	150 mm
Less than -100 °C	200 mm

WARNING: Check point 14.0 of this manual if level gauge must operate at low temperature.

13.0 WORKING LIFE

Magnetic level gauge has parts subject to fair wear (as sealing joints) and subject to damages (as float); therefore such items must be periodically inspected by user.

Inspection time scheduling and interval must be performed by user according plant working condition, process fluid and plant knowledge and/or experience. For new application inspection interval must be shortened, up to daily inspection, before establish the proper inspection interval.

Always avoid any improper of level gauge and intercepting valves use 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.

If level gauge must be used in temperature condition exceeding material creep temperature, Cesare Bonetti S.p.A. can give, under Customer request, technical data suitable for residual working life calculation, to be performed by Customer or by end user.

ES.	MATERIAL		T. MIN (°C)
	CONTACTING FLUID ITEMS	NOT CONTACTING FLUID ITEMS	
52	A312Tp316/A105	A105	+21
64	A312Tp316L	A105	-29
63	A312Tp316L	A312Tp316L	- 195

14.0 ALLOWABLE WORKING TEMPERATURE

If glass level gauge has to be used in low temperature working condition, Customer or end user must verify level gauge and intercepting valves material fitness.

Note: Rating as indicated in Table 1 refer to magnetic level gauges equipped with standard graphite sealing joints. If any other material is requested for sealing joints (PTFE, Viton, etc.), operating condition could change accordingly: therefore refer to rating limitation suggested by sealing material manufacturers. Suitability and compatibility of such sealing materials must be verified by user.

15.0 WELDING AND QUALITY CONTROL

Any welding must be performed by qualified personnel and using qualified procedures according EN 288/287 or ASME IX standard.

Any non destructive control must be performed by qualified personnel and using qualified procedures according EN 473 o SNT-TC-1A standard.

Intercepting valve welding must be performed with valve in semi-opened position, to avoid damages to sealing part.

16.0 FINAL WARNINGS

Preserve level gauge and intercepting valve specific maintenance manual together with this manual and let them consultable by maintenance personnel.

Be sure that maintenance personnel read any part of those manuals before any use or maintenance operation.

If you have lost the manuals, please contact Cesare Bonetti S.p.A. to obtain a copy.

Cesare Bonetti S.p.A. shall be happy to give you any further technical information.

Table 5 shows some residual risk or stress and appropriate warning and useful skills to avoid such danger.

TABLE 5	
GENERAL RISKS	
STRESS	REMEDY
Internal overpressure	Avoid to exceeding pressure limit as indicated on operation and maintenance manual and / or on the label.
Maximum and minimum temperature	Avoid to exceeding maximum and minimum temperature as indicated on operation and maintenance manual and / or on the label.
Creep	To be analysed and calculated by end user. Upon request, suitable data to calculate it can be disclosed to end user.
Fatigue	To be analysed by end user
Corrosion	To be analysed by end user
Fluid static pressure	To be analysed by end user
Traffic, wind, snow, earthquake or dynamic stresses	To be analysed by end user
Fixture or support stresses	To be avoided by end user
Unstable fluid decomposition	To be analysed and avoided by end user
Shock	To be avoided by end user.
Exceeding bolting torque	Use prescribed bolting torques as indicated in operation and maintenance manual
Not uniform bolting torque	Use prescribed bolting torques as indicated in operation and maintenance manual
Eccessiva sovrappressione interna	To be avoided by end user
Thermal shock	To be avoided by end user
Chemical etching by plant washing fluid	To be avoided by end user. Isolate level gauge while washing plant. If necessary, perform a complete maintenance as stated in operation and maintenance manual.
Deformation due to wrong installation (uncorrect CC, not flat flanging etc.)	To be avoided by end user
Fire	To be avoided by end user
2. LEAKAGES FROM SEALING JOINTS	
STRESS	REMEDY
Low bolting torque	Follow bolting torque values as indicated in operation and maintenance manual
Not uniform bolting torque	To be avoided by end user
Use of not original sealing joints or of used sealing joints	To be avoided by end user
Uncleaness of sealing surfaces on flanges	To be avoided by end user
Use of mastic between joint and flanges	To be avoided by end user
Corroded sealing surfaces or joint housing	To be avoided by end user
Joints not compliant with operating condition	To be avoided by end user
3. LEAKAGES FROM WELDINGS OR FROM SCREW PLUGS OR FROM VALVE CONNECTIONS	
STRESS	REMEDY
Shock	To be avoided by end user; perform welding according welding procedures to be requested to Cesare Bonetti S.p.A
Internal overpressure	To be avoided by end user; if a welding repair is necessary, perform welding according to welding procedures to be requested to Cesare Bonetti S.p.A.
Thermal shock	To be avoided by end user; if a welding repair is necessary, perform welding according to welding procedures to be requested to Cesare Bonetti S.p.A.
Chemical etching wear by plant washing fluid	To be avoided by end user; Isolate level gauge while washing plant. If necessary, perform a complete maintenance as stated in use and maintenance manual. If a welding repair is necessary, perform welding according to welding procedures to be requested to Cesare Bonetti S.p.A.
Deformation due to wrong installation (uncorrect CC, not flat flanging etc.)	To be avoided by end user; if a welding repair is necessary, perform welding according to welding procedures to be requested to Cesare Bonetti S.p.A.