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**PED 97/23/EC**  
**Art. 3.3 & Cat. 1**

**USE & MAINTENANCE MANUAL OF  
 BONETTI® PISTON VALVES - CAST IRON**

**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 minimize 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 BONETTI® Piston valves in cast iron material, manufactured by Cesare Bonetti S.p.A.

## 2.0 PRODUCT DESCRIPTION

The BONETTI Piston Valve is a device useful to intercept a fluid, liquid or gas.

Standard materials normally used for pressure containing part are Cast Iron GG-25 and Nodular Iron GGG-40.3.

If those materials are not suitable for the fluid, please note that Cesare Bonetti S.p.A. can provide same type of valves in forged or cast steel or in special materials according to Customer specification.

## 3.0 RATING

Max rating condition (pressure and temperature) and group fluid classification is stated by 97/23/CE Directive (PED), annex II, and are shown in following Table 1.

Table 1					
Material	Rating DIN 2401	T min. °C	Gr. Tab.	Art.3.3	Cat I
GG-25	PN 16	- 10	2 7	≤ DN 50	DN 65+200(*)
GGG-40.3	PN 40	-20	2 7	≤ DN 32	DN 40+100(**)
(*) Max allowable pressure:		DN 200:		15 bar	
(**) Max allowable pressure:		DN 40+65:		40 bar	
		DN 80:		37,5 bar	
		DN 100		30 bar	

**WARNING:** For valves equipped with PTFE rings, maximum allowable temperature is limited to 200 °C.

**GGG-40.3 nodular cast iron valves can be used with thermal oil only if the application does not exceed maximum admissible limit stated by Cat. I, Table 6 for Group 1 fluids in the PED Directive.** To verify if such limit is respected make following calculation: multiplying exercise pressure (PS) in bar for the valve ND (nominal diameter) in millimeter the result must be  $\leq 1.000$ .

## WARNING:

**Cast iron valves can not be used for "Lethal service". Lethal service is the use of valves with "Lethal Substances" as defined in ASME Section VIII Part UW:**

***By "lethal substances" are meant poisonous gases or liquids of such a nature that very small amount of the gas or of the vapour of the liquid mixed or unmixed with air is dangerous to life when inhaled. For purpose of this Division, this class includes substances of this nature which are stored under pressure or may generate a pressure if stored in a closed vessel.***

## 4.0 SAFETY CRITERIA

Proper working of valves 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 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 been suffered during transportation.

Check also that valve type, rating pressure/temperature as shown on Table 1 and valve material, as indicated on body, bonnet and/or label, comply with application.

Never exceed limits stated by such rating.

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

## 6.0 STORAGE

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

## 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 valve working, check carefully to:

- remove protection caps from valve end connections; verify absence of dirt inside valve;
- 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 single way valves according arrows indication on body;
- install valve so that it does not sustain piping weight, and sustain valve 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 valve ends. Check if face to face valve dimension fits correctly with distance between piping ends.
- avoid valve 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 valves check correct position and dimension of gaskets between valve flange and piping flange, apply the proper bolting torque to stay bolts. For screwed valves verify compatibility between valve and piping screw thread.
- 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 valves in safety conditions.
- Always verify , using a torque wrench, body/bonnet bolting torque restoring torque as indicated in Fig. 1065 - Bolting Torque section. This check must be performed as bolting torque could be lower after a while, due to sealing material settlement.

## 8.0 OPERATION

BONETTI's Piston Valves, usually, do not require maintenance.

Verify periodically that moving items - as stem or bushing - are properly greased, using graphite grease suitable for the exercise operating temperature.

If the valve can be corroded or oxidated by external atmospheric agents or by internal plant environment atmosphere, protect the valve using painting able to avoid or minimize such corrosion.

To minimize leakage risk, verify periodically body/bonnet bolting torque, restoring value as indicated in Fig. 1065.

This is particularly important if valve has intermittent working or variable exercise operating temperature.

If leakage appears from body/bonnet connection, close the valve and restore body/bonnet bolting torque.

**WARNING:** If there is any leakage from the packing, or from body/bonnet sealing, to stop such leakage operate with the packing gland or on body/bonnet bolting. If the leakage is not immediately stopped, packing or body/bonnet sealing ring can be damaged very soon, so requiring its complete change. A long time leakage can also irreparably damage metallic surfaces contacting the packing (as stem and stuffing box) or the upper ring (as valve body or piston).

On line sealing of BONETTI piston valves is obtained with a "soft" contact between internal surface of lower ring and piston introduced inside it.

Therefore do not force handwheel considering that piston stroke end is obtained:

- in valves with rising not rotating stem by antirotation/stroke indicator contacting bushing;

- in valves with rising and rotating stem, by handwheel contacting bonnet upper part.

**Therefore never force handwheel to avoid damage to stem or to piston.**

**For same reason do not remove handwheel from valve in exercise.**

If perfect sealing on line or from body/bonnet is not obtained applying the proper bolting torque to body/bonnet bolting (as indicated in Fig. 1065), valve must be maintained.

For valves having a stuffing box packing on stem, maintenance must be performed immediately, isolating valve, if leakage appears from packing and can not be eliminated operating on packing gland.

### 9.0 BEFORE MAINTENANCE OR DISMANTLING

Valve maintenance or dismantling must be always performed by qualified and skilled personnel, aware of all safety prescription as stated in this manual or stated by plant regulation or by law.

#### WARNING:

**Do not perform any valve maintenance or dismantling of valves from piping unless:**

- valve and piping has been isolated, intercepted, pressure discharged and drained. Do not trust on the pressure gauge only to assume that pressure has been discharged;
- valve and piping temperature cools down to ambient temperature to avoid burning;
- previous check that valve and piping upstream and downstream has been isolated and does not contain any process fluid;
- use protective gloves and eyeglasses, if useful or necessary;

User must generate inspection and maintenance charts.

Such charts can be properly generated only with a perfect knowledge of plant, service, process fluid, pressure and temperature, ambient and environment atmosphere.

Before starting maintenance, be sure to have any useful tools, checking tools good condition, and needed any spare part, checking their suitability.

Particularly, check to have:

- spare rings;
- spare stuffing box packing (if any);
- removing tool for seat rings;
- other spares (stem and/or spare piston and/or spare connecting ring and/or bushing), if some of such items have been damaged;

### 9.1 DISASSEMBLING

After checking all safety caution as in point 9.0, valve can be disassembled without dismantling valve from piping.

Operate as follows:

- Fully open the valve;
- Unscrew body/bonnet bolting nuts;
- Turn handwheel in closing direction (clockwise): so bonnet lift up;
- Turn bonnet so that bonnet holes do not match with body/bonnet studs;
- Again turn clockwise handwheel: piston shall lift up until it will be free from valve sealing rings. Now the bonnet/stem/piston assembly can be removed from body and sealing rings;

**WARNING:** be very careful to avoid any damage to grinded piston surface: shocks or scrapes could damage piston compromising valve sealing.

- Carefully check and change wear or damaged items;

#### 9.1.1 - SEALING RINGS CHANGING

- a) Using the removing tool (Fig. 1059, 1007, 1008 and/or Fig. A), extract sealing rings and lantern bush;
- b) Clean sealing rings housing and body internal;
- c) Insert new sealing rings and lantern with the proper sequence (1: lower ring, 2: lantern, 3: upper ring) and check they are well seated in their housing. Fig. 1043 shows a tool suitable to insert sealing rings in their housing.
- d) If present, Autoseal ring (Fig. 1021 No. 35) must be managed carefully, due to its structure. If Autoseal ring is not suitable while performing maintenance, valve can be assembled also omitting it;
- e) Never grease valve internal, nor sealing rings nor piston;

Table 2			
No.	Item	No.	Item
1	Body	8	Handweel nut
2.1	Lower valve ring	9	Bonnet
2.2	Upper valve ring	10	Stud bolt and nut
3	Lantern bush	11	Belleville washer
4	Piston	16	Threaded bushing
5	Split nut	17	Pin
6	Stem	41	Thrust plate
7	Handweel	50	Name plate

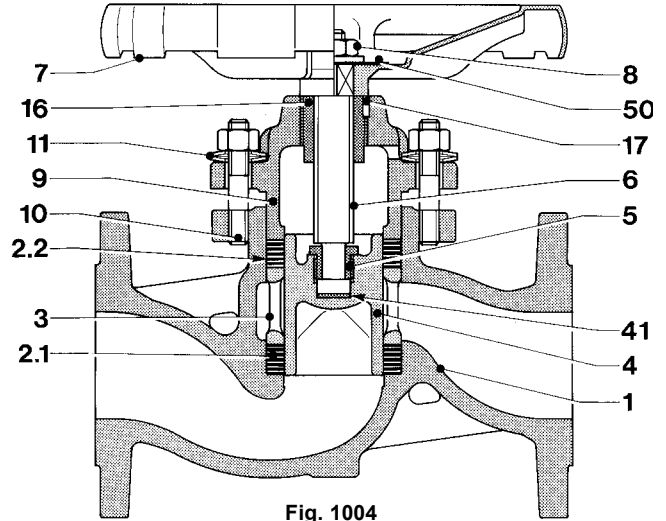


Fig. 1004

Table 3			
No.	Item	No.	Item
1	Body	30	Roller bearing
2.1	Lower valve ring	31	Balanced piston
2.2	Upper valve ring	32	Backseat
3	Lantern bush	35	Autoseal ring
7	Handweel	36	Stem
8	Handweel nut	37	Bonnet
10	Stud bolt and nut	38	Stem bushing
11	Belleville washer	39	Retaining nut
12.1	Stuffing box lower ring	40	Nut
12.2	Stuffing box upper ring	42	Retaining ring
13	Gland nut	43	Notched nut
23	Antirotation/Stroke indic.	50	Name plate
27	Non rotating disk	55	Lubricator
28	Locking washer		

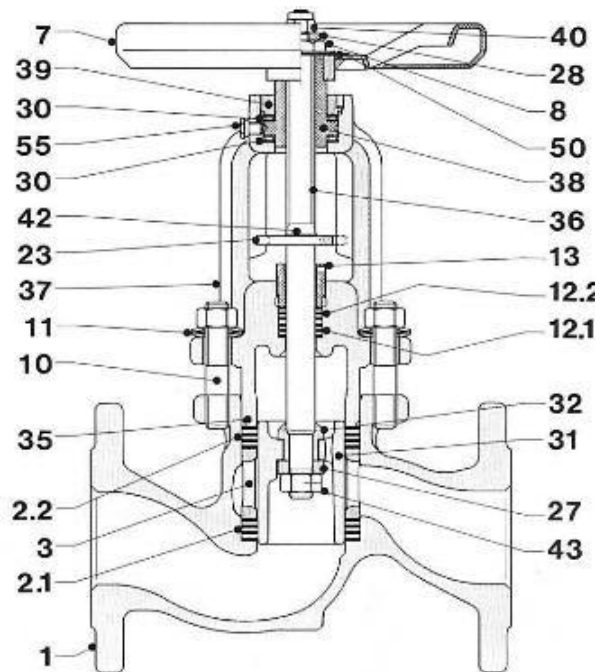
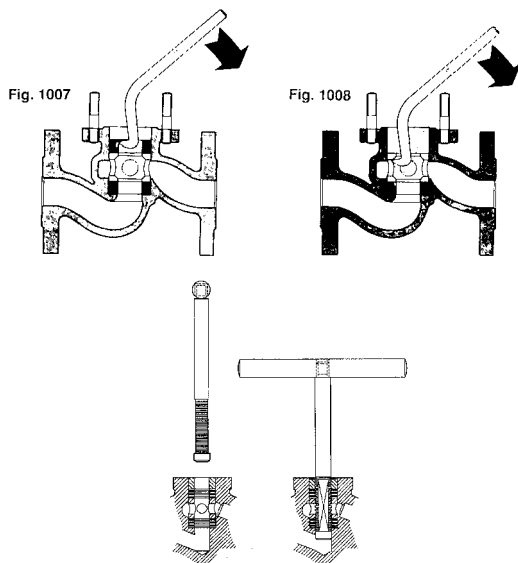
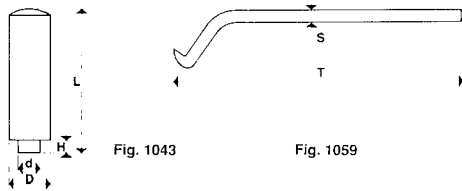


Fig. 1020



- f) Grease stem and bushing thread, using a grease suitable for the valve operating temperature;  
**WARNING:** as sealing rings contain thin metal sheets, handle with care to avoid injury.  
**WARNING:** Used sealing rings are deformed by mechanical pressure; they must be disposed and never be used again.  
**To assemble valve using same sealing rings could generate leakages and risk to people and environment..**

### 9.1.2 PISTON CHANGING

If piston shows scrapes on grinded cylindrical surface, it is no more suitable to perform a perfect valve sealing and must be changed.  
 To perform piston changing operate as follows:

#### A. Valves up to DN 50 included and valves with not balanced piston over DN 50 (without stuffing box - type BK, BV, BVR and BVn) - Refer to Table 2 and Fig. 1004

1. Remove handwheel (7), unscrewing handwheel nut (8);
2. Operate stem (6), using pliers with rubber covered nose to avoid stem thread damage, and screw stem clockwise until it exit from lower bonnet side;
3. Check wear of stem and bushing (16) thread: they must be in perfect condition with no evidence of picking-up, seizing, scratch or other damages or wear. If it is present some of said defect or damage, stem and/or bonnet (or bonnet bushing) must be changed too.

#### Valves up to DN 20 included:

4. Those valves have piston/stem connection mechanically bended: they can not be separated and, as spare, they are purchased together.
5. Grease stem and bushing thread with a grease suitable for the valve operating temperature and screw stem into bonnet, with care to avoid any damage to the grinded piston surface;

#### Valves DN 25 and bigger:

6. Fix piston (4) on a vice, protecting cylindrical grinded piston surface with a rubber layer to avoid any damage;
7. Unscrew split piston nut (5), **operating clockwise** (as it has left handed thread)
8. Separate stem from piston and check absence of wear or damage on stem part retaining split nut: if damaged, stem must be changed;
9. Check absence of wear or damages on split nut: if damaged, split nut must be changed;

10. Fix piston on a vice, protecting cylindrical grinded piston surface with a rubber layer to avoid any damage;
11. Fit split nut (two pieces) on it housing in the lower part of stem, greasing housing and split nut internal part;
12. Grease split nut thread and its housing on piston, than hand screw split nut on piston **carefully aligning thread of the two split nut pieces**. As split nut thread is left handed, screwing must performed **counterclockwise**.
13. Using a wrench, strongly screw split nut on piston;
14. Grease stem thread, and screw stem on its bonnet bushing: be careful to avoid any damage to the cylindrical grinded piston surface;
15. Fit handwheel, name plate and screw handwheel nut.

#### B. Valves up to DN 65 included and bigger than DN 65 with balanced piston (having stuffing box on stem - type BVe, BVd) - Refer to Table 3 and Fig. 1020

1. Remove antirotation device/stroke indicator retaining ring (42);
2. Fully unscrew stuffing box gland nut (13);
3. Unscrew handwheel nut (8) and remove locking washer (28);
4. Operate clockwise handwheel until it is free from lower part of bushing (38);
5. Extract stem and piston from lower part of bonnet: be careful when passing with stem thread through packing (12.1 and 12.2) to avoid stem thread damage;
6. Using a protective rubber layer, to avoid stem damages in the threaded part or in the part contacting packing, fix stem on a vice, so that it is possible to access the lower internal piston part;
7. Unscrew notched nut (43) **operating clockwise, as notched nut is left hand screwed**, and remove it and non rotating disk (27);
8. Remove piston (31) and carefully check absence of wear and/or damages on stem, backseat (32), non rotating disk (27); if there is evidence of any damage, scratch or wear, item must be changed;
9. Place backseat on stem, fit the new piston, than non rotating disk and screw, **operating counterclockwise**, notched nut, strongly fixing it with a wrench;
10. Remove gland nut (13) from stuffing box, extract old packing (12.1 and 12.2), clean stuffing box internal and fit new packing (12.1 and 12.2) in their housing, hand screwing lightly gland nut; Grease stem with grease suitable for valve operating temperature and insert stem inside bonnet having care to: avoid any damage to packing when passing through with stem thread; insert in the stem the antirotation/stroke indicator device (23) before stem reaches its bushing; check that antirotation device ends are well placed in bonnet guide
11. Screw stem in the bushing (operating counterclockwise with handwheel): be careful to avoid any damage to cylindrical grinded piston surface;
12. When stem appears out of its bushing upper part, fit locking washer (28), name plate and handwheel nut.
13. Fit antirotation device in its polygrooved stem housing and fix it with retaining ring (42)
14. Screw packing gland nut.

#### a) 9.2 VALVE ASSEMBLING

- Operate handwheel in opening direction (counterclockwise) until stroke end;
- Insert piston in upper sealing ring just and slowly push until stud thread appears through bonnet flange holes
- hand screw body/bonnet nuts
- operate handwheel in closing direction (clockwise) until stroke end, than operate in opening direction until bonnet lower part reaches upper sealing ring;
- unscrew body/bonnet nuts, lace washers and again hand screw nuts;
- Operate handwheel until valve closing and start to screw body/bonnet nuts, using a torque wrench in crossing sequence, until bolting torque stated in Fig. 1065 has been reached; Be careful: bonnet must descend perfectly straight and orthogonal respect to sealing rings plane.

**WARNING:** a lower bolting torque can generate leakage between body and bonnet. An exceeding bolting torque can generate high operating torque and stress able to damage body/bonnet flanges

## SPARES

**Only original BONETTI spares** must be used for BONETTI piston valves maintenance, to grant a proper and trouble free operation

Standard sealing rings are patented graphite metal armoured rings. PTFE or TMF1600 rings can be delivered on request.

For ring dimension see BONETTI piston valve catalogue.

Spare sealing ring are pre-compressed. Their height could variate respect to indicated height without any consequence on perfect sealing.

Main patented BONETTI armoured graphite sealing rings features

- are:
- perfect sealing
- long life
- suitable with temperature up to 550 °C
- good resistance against process fluid etching
- only one sealing material for any fluid: less spares
- low coefficient of friction: low operating torque  
less valve maintenance

A piston valve (Fig. 1004) requires:  
Sealing rings items No. 2.1 and 2.2.

A piston valve Fig. 1020 (balanced piston) requires:  
sealing rings (pos. 2.1 e 2.2) .  
packing rings (pos. 12.1 e 12.2)  
autoseal ring (pos. 35)

Generally spare sealing rings are delivered in "Kit" package in which all necessary spare sealing item is included. Specify type and dimension of valve when ordering spares.

Bolting torques are indicated in Fig. 1065

## 10.0 WORKING LIFE

Piston valve has been designed, tested and is granted for a long cycle operating life provided that rating condition (pressure and temperature) of the valve have been respected.

Valve contains items that are subject to fair and normal wear. Therefore valve 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.

Always avoid any valve improper use able to generate unfair valve wear as:

- do not use a stop valve or a on-off valve as regulating valve
- avoid in process fluid abrasive particles, or piping sandblasting
- residual, or swarf, or welding dross;
- avoid water freezing in cast iron or nodular iron valves;

If valves 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.

## 11.0 MAXIMUM ADMITTABLE WORKING TEMPERATURE

If valve has to be used in low temperature working condition, Customer or end user must verify valve material fitness.

## 12.0 WELDING AND QUALITY CONTROL

**No welding is admitted on cast iron valves.**

Any non destructive test must be performed by qualified personnel according to EN 473 o SNT-TC-1A.

## 13.0 FINAL WARNINGS

Preserve 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.

## WARNING:

If an actuator (electrical, pneumatic or hydraulic) is fitted to operate the valve, strictly follow instructions stated by actuator manufacturer in its operation and maintenance manual.

**In following Table 5 are listed residual dangers and stresses and useful skills to avoid such danger or stresses.**

Fig. 1065						BOLTING TORQUE		
PISTON VALVES						BV - BVR	PN 16	PN 40
						BVn		
Type	DN		Type	DN		PN 16 Nm	PN 16 Nm	PN 40 Nm
	mm	inches		mm	inches			
			BVR	15	3/8" 1/2"	5		
BV	10	3/8"				5		
BV	15	1/2"	BVR	20	3/4"	5		
BV	20	3/4"	BVR	25	1"	6		
BV	25	1"	BVR	32	1.1/4"	6		
BV	32	1.1/4"	BVR	40	1.1/2"	8		
BV	40	1.1/2"	BVR	50	2"	9		
BV	50	2"				10		
BVn	65					10		
BVn	80					5		
BVn	100					5		
BVn	125					14		
BVn	150					12		
BVe	65						12	20
BVe	80	3"					8	18
BVe	100	4"					8	20
BVe	125						18	27
BVe	150	6"					16	28
BVe	200						40	50

<b>TABLE 5 STRESS</b>	<b>RISK</b>	<b>CURE</b>
Internal pressure	Internal overpressure, mechanical instability	End user must avoid to exceed pressure limits stated on use and maintenance manual
Maximum and minimum temperature	Limit exceeding	End user must avoid to exceed limit as stated on use and maintenance manual
Fatigue	Mechanical instability.	To be analysed and calculated by end user. Under request, suitable data to calculate can be disclosed to end user.
Corrosion	Mechanical instability. Possible fluid leakage.	End user must select proper material according fluid characteristic. Under request, data concerning overthickness can be disclosed to end user
	Bolting corrosion	Bolting is not in contact with process fluid. If standard bolting material is not suitable for the atmosphere, Customer must indicate a different material or a suitable protective surface coating (as zinc, nickel or other)
	Chemical etching by plant washing fluid	Avoid valve use while washing plant
Erosion	Mechanical instability. Possible fluid leakage.	End user must select valve type and trim in material suitable for operating condition. Under request, data concerning overthickness can be disclosed to end user
Wear	Sealing surfaces wear and consequent leakages. Thickness reduction of pressure containing parts with material resistance reduction and working life reduction.	Do not partialize an on/off valve. Avoid process fluid containing abrasive particles, residuals or anything able to damage valve sealing.
Fluid static pressure	Mechanical instability..	Must be analyzed and calculated by end user. Under request, suitable data to calculate can be disclosed to end user. Avoid water freezing inside bellows sealed valves Avoid bellows sealed valves use with fluid leaving crystallizing substances, deposits, scale, fouling between bellows convolutions. Such residual could limit bellows correct moving limiting the bellows stroke.
Stress due to traffic, wind snow, hearthquake or dynamic solicitation	Mechanical instability.	Must be analyzed and calculated by end user. Under request, suitable data to calculate can be disclosed to end user.
Stress due to constraint, support, rest or other	Mechanical instability.	Must be avoided or calculated by end user. Under request, suitable data to calculate can be disclosed to end user.
External fire	Mechanical instability..	Must be avoided or prevented by end user
Shock	Breakage	
	Water or condensate hammer and consequent damage of pressure containing parts	Must be avoided or prevented by end user (as installing steam traps in the proper plant position to avoid condensate hammer)
Low or high or not correct bolting torque	Leakages between body and bonnet High operating torque	Strictly follow bolting torque values stated in maintenance manual
Thermal shock	Differential thermal expansion	Must be avoided or prevented by end user
Structure deformation due to not proper stresses (absence of sustain, stressed assembling due to incorrect face to face distance or flatness)	Breakage, fluid process leakage	Must be avoided or prevented by end user
Use of not original spare joints (or used joint installation)	Process fluid leakages to environment	Must be avoided by end user
Uncleaness of housing surfaces of sealing joints after disassembling	Process fluid leakages to environment	Must be avoided by end user Carefully clean housing surfaces of sealing joints before assembling
Mastic or glue used between body and bonnet or joints	Process fluid leakages to environment	Must be avoided by end user
Housing surfaces of sealing joints corroded by chemical etching	Process fluid leakages to environment	Must be avoided by end user Carefully clean housing surfaces of sealing joints before assembling
Sealing joints not complying or useful for operating condition	Not correct sealing joints material or dimension	Must be avoided by end user