ETI-Elettrindustria srl
EQUIPAGGIAMENTO TRASFORMATORI ITALIA
T: +39 0245475074 | F: +39 0245475787
E-mail: cobETI@eti-elettrindustria.it
Website: www.eti-elettrindustria.it

Buchholz Relays Series RR - RRF - GQ

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1 General information

Transformers and reactors, particularly the medium and high-power ones, play a very important role in the distribution of electric energy, because the supply of energy to very extensive and/or densely populated areas as well as to important industrial plants, including those working 24 hours a day, depends on them. Moreover, they are a very expensive equipment, especially the high-power units, the construction or repair of which requires long periods of time.
Therefore, the consequences of a sudden breakdown are very expensive because they result in failure to provide service to the consumers and interruption of production as well as on account of the repair or replacement costs. The great amount of power concentrated inside such unit's cause breakdowns to result always in very heavy damages if not in a destruction of the unit itself. It is therefore necessary to ensure good working of this equipment by preventing breakdowns so as to be in a position to program repairs without interrupting the distribution of electric energy and to reduce the damages by providing it with apposite control and protection devices.

2 The Buchholz Relay

The working experience shows that in transformers and reactors insulated and cooled with dielectric liquid, usually mineral oil, and equipped with conservator (transformer types which assure maximum power and voltage ratings) breakdowns are always connected with specific symptoms or caused by anomalous working conditions, described in more detail below. If these conditions are discovered and signalled in good time, they permit to avoid the breakdown or limit its consequences.

The Buchholz relay, which derives its name from the designer who was the first to set out its working, is a device capable of sensing breakdown symptoms and working irregularities typical of transformers and consequently is of great importance where the protection of such equipment is concerned.

2.1 Functions of the Relay Buchholz

The irregularities detected and signalled by Buchholz relay are the following:

Presence of air bubbles
Air bubbles may appear inside the unit - particularly immediately after activation - owing to insufficient degassing of oil, faulty filling or imperfect gasket tightness; air bubbles, by reducing the insulation, may produce jump sparks and it is therefore necessary to detect their presence and to eliminate them;

Formation of gas
Electric discharges due to reduced insulation, stray currents, and local overheating - even if not detectable from outside - may lead to the formation of gas inside the transformer owing to the combustion of insulating material or oil. As the time passes, these defects, although not impeding the working of the unit, may degenerate into a serious breakdown and, therefore, it is advisable to follow its development by controlling the quantity of gas forming with the passing of time, also for the purpose of programming the repair. The said gases may be analysed in order to ascertain whether they originate from combustion of oil or some other insulating material.

Oil Flow to the Conservator Tank
If not eliminated in good time, the defects described above may aggravate and cause strong discharges accompanied by formation of electric arc, which vaporises the oil instantly and brings about a violent formation of gas accompanied by a rapid rise in the pressure inside the unit. The pressure increase, in its turn produces a flow of oil in the piping connecting the transformer tank to the oil conservator.
Oil flow with speed exceeding normal values is therefore always a sure indication that a grievous fault has occurred and must be announced.

Lowering of Insulating Oil Level
In order to ensure insulation, the live parts of the unit must always be immersed in oil; if, owing to erroneous refilling, combustion or leakage, the oil level falls, it is necessary to have a warning of this danger-

ous situation in order to eliminate its cause.

As it can be seen, the above described working anomalies are all symptoms of potentially very serious defects which may even lead to the destruction of the unit; it follows that they must be signalled at the right time in order that they may be remedied. No wonder then that the Buchholz relay is considered one of the most important protective devices for this type of equipment.

2.2 Construction and operation of the Buchholz Relay

Right because of its importance, construction and operation of the Buchholz relay are described by many national and international standards, such as the new European standard EN 50216.

Generally the Buchholz relay consists of a flanged casing to be mounted on the piping connecting the transformer tank to the oil conservator and containing inside a mechanism which detects and gives warning of the above indicated operation irregularities. Normally it is fitted on the conservator pipe so as to permit the gases and air bubbles to gather inside the device and allow the oil flow to pass through it; as a matter of fact, the shape of the pipe must be such as to favour this taking place. Moreover, in case of leakage or loss of oil, the piping empties itself before the active parts of the transformer become exposed or uncovered.

The presence of air bubbles, gas formation and lowering of insulating oil level inside the unit are detected by one or more floats which move following the level of the oil within the casing, whilst the flow of oil towards the conservator is detected by calibrated paddle (oil flow vane) situated on the axis of the piping and moving under the pushing force of the flowing oil. The floats and oil flow vane in their turn, activate electric contacts which, connected to the signalling or disconnecting circuits, give warning of irregular working and permit to keep it under control or even - if the detected defect leads to believe that a serious trouble is taking place - action the switch disconnecting the transformer from the line in order to avoid that the unit might suffer more serious damages.

It becomes clear, therefore, that the working of Buchholz relay must be absolutely reliable in order to ensure both a better protection of the transformer and to exclude erroneous interventions.

3 ETI Relay “Custos”, Series RR

“Custos” is the name of all ETI Buchholz system relays.

This catalogue, regarding Series RR, shows all the features of the article with regard to the construction, working and compatibility with climatic conditions of installation common to all devices of this series, irrespective of their size and dimensions and installation which comply with different national standards as well as working, installation, maintenance and testing characteristics specific to every single sub-series or type as given in the technical index-cards relating to every execution.

Generally speaking, the working of ETI “Custos” relay, series RR is of course that of a Buchholz relay as described above however, the devices of this series can be supplied in numerous variants meeting the most diverging employment requisites, ensuring, at the same time, a full, correct and long-lasting working even under most severe conditions of use.

3.1 Characteristics of the Product

We believe that, for a better understanding of particular characteristics of this series of relays, it would be advisable to indicate the project decisions matured thanks to the experience gained by ETI in a period of over 50 years in the production of the previous series. This experience endows ETI “Custos” relays, series RR with characteristics of reliability and flexibility in use which distinguish them considerably from the previous series and products of other manufacturers.

3.1.1 Choice of the Type of Contacts

The function of the contacts is to signal irregularities or disconnect the transformer from the line only when they are operated by the detection elements. Therefore, there are two important selection criteria:

- insensitivity to all other external influences such as accelerations or shocks produced by the transformer itself both during normal duty and in case of a short circuit, magnetic fields which,

given the powers involved, may be even very strong, and seismic phenomena; all these events must not cause an erroneous intervention of the contacts;

- high interruption capacity both under AC and DC so as to activate directly the main line switch in case of disconnection without intervention of servomechanisms which anyhow involve possibility of breakdowns or delays.

For ETI "Custos" relays, Series RR magnetically operated contacts have been chosen because they possess the highest interruption power available on the market, are protected against accidental breakdowns and magnetic by a metal casing and operated by high-quality magnets.

3.1.2 Reliability of Detection Elements

Similarly, the system detecting irregular working of the transformer must not cause inopportune interventions:

- all materials employed in the manufacture of ETI "Custos" relays, Series RR are non-magnetic and the internal part is made entirely of stainless steel;
- the floats and impeller are fitted on counterbalanced levers to compensate the effects of seismic accelerations and stresses;
- the floats are made of closed-cell foamed plastic material ("unsinkable") in order to exclude the possibility of inopportune interventions following a puncture of the floats themselves.

3.1.3 Flexibility of Use

By the term flexibility of use is meant the fact that the detection and signalling of Buchholz relay may take place in different ways. Special construction solutions have been employed for this purpose, namely:

- the detection and signalling assembly comprises three mechanically completely independent groups operated respectively by the upper float, the lower float and the impeller sensitive to oil currents. Since each group detects a different type of irregularity and signals it through an electric contact, it is possible to determine the irregularity taking place and to undertake the necessary action without intervening on the spot;
- each group can operate 2 independent electric contacts;
- however, the impeller group can be rigidly connected to the lower float group and thus to operate a total of 4 electric contacts;
- the contacts of a group may be arranged in such a way as to be operated contemporaneously or in succession (series RFR relays are an exception);
- the calibration of the impeller may be set on values varying from 0.µ to 2.µ m/sec;
- the impeller group may be equipped with manual reset provided with optical indicator of the executed intervention; in this way, even if the lower float and the impeller activate the same contacts, it is possible to determine whether the warning is given because of a strong formation of gas or lowering of oil level or owing to an oil current (series RFR relays are an exception);
- the lower float group can intervene only when there is a fall in oil level or when a continuous or significant formation of gas takes place.

Thus, owing to many possibilities offered by the detection system it is possible to adapt ETI "Custos" relays, series RR to many different service requirements with intervention methods particular to each situation.

3.1.4 Wide Range of Accessories

ETI "Custos" relays, series RR may be equipped, upon request, with numerous accessories which meet most variegated service and maintenance requirements. Apart from the already mentioned optical indicator of impeller intervention, there is the possibility of controlling the working of contacts by means of a control situated at the transformer base and/or by means of air injection, as well as supply of a set of gas bleeding, draining and drawing cocks proposed in numerous alternative executions so as to render them

suitable for the most varied requirements.

3.1.5 Denominations of Types of ETI “Custos” relays, series RR

As already mentioned under point 2.0 above, ETI “Custos” relays, series RR can be supplied with dimensions and working features complying with principal national and international standards. At present, relays complying with the following standards:

UNEL 21006, DIN 42560 (in sizes DN 5 and DN 8 only), NF C 52-108, and special ones for the Australian market are available.

An identification abbreviation of all types corresponds to each standard of reference as per the list below:

UNEL 21006	Series RR - Types: RR 025, RR 050, RR 080, RR 100
DIN 42566	Series RRD - Types: RR 050, RR 080
NF C 57-108	Series RFR - Types: RFR 025, RFR 050, RFR 080
Australia	Series GQ - Types: GQ 025, GQ 050, GQ 080

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1.0 Contents of specification

The specification outlines the function and gives the construction and operating features of the devices in reference as well as the environmental and operating conditions for which the devices are designed. These last depend mainly on the compatibility of the materials, components and finishing with the environmental and operating conditions of the transformer, and, for the electrical circuits and the contacts, from their degree of protection.

The compatibility limits are indicated for the different executions.

2.0 Function

The Buchholz relay detects and signals following irregularities that can produce themselves during the operation of the transformer:

- Presence of air bubbles due to faulty initial filling or faulty seal of gaskets;
- Formation of gas due to burning of oil or solid insulation;
- Lowering of oil level due to leak of the tank;
- Oil flow from tank to conservator due to explosion or short circuit.

The analysis of the gases accumulated inside the Buchholz relay as well as the speed of accumulation give a rough indication about the functionality of the transformer.

3.0 Construction Features

3.1 Materials and Components

- Body and head with terminal box of aluminium casting;
- Tempered glass spy holes;
- Glass frames and cover of terminal box of nylon reinforced by glass fibre;
- Nickel coated brass cocks;
- Antimagnetic stainless steels internal active part;
- Unsinkable closed cell expanded floats;
- Gaskets as specified for the different executions;
- External screws of stainless steel;
- External parts of brass galvanised.

3.2 Reference Drawings

Assembly and overall dimensions:

Series RR - dimensions according to standard UNEL 21006

- Type RR 025 — N° 4.501.30
- Types RR 050 - RR 080 - RR 100 — N° 4.900.00

Series RRF - dimensions according to standard NF C 52-108

- Types RRF 050 - RRF 080 — N° 4.650.00

Series GQ - dimensions according to Australian standard

- Types GQ 050 - GQ 080 — N° 4.900.10

Accessories and fittings — N° 4.900.20
Definition of execution — N° 4.900.003
Assembly on pipeline — N° 4.900.001

Other dimensions are available on request.

3.3 Electric Circuits and Contacts

- Hermetically sealed, inert gas filled, magnetically operated contacts with Teflon insulated cables;
- Junction box with degree of protection IP 65 and ventilation system;
- Nickel coated brass terminals, insulated by nylon reinforced with glass fibre and identified as per specification of wiring diagrams by a number on a label inside the cover of the junction box. Terminals are designed and mounted so as to avoid rotation while tightening the cable on the terminal; the fixing nut is of the self-locking type.

The characteristics of the contact, the junction box, the terminals and the electric circuits are explained in details by specification N° 04RRCONRxx.

3.4 Contacts Check Device

The standard mechanical contacts check device is mounted on the head of the Buchholz relay, protected by an oil tight cap, and operates by rotation. A label inside the terminal box explains how to carry out the test.

On request, following features can be supplied:

- the mechanical check device can be connected at man's height to the device CCC, in order to be able to effect the test from the ground.
- The device resets the oil flow vane if the vane is requested to be manually reset;
- The operation of the oil flow vane contacts can be tested also by injecting gas into the relay;
- The operation of the contacts of the lower float can tested by gas injection.

3.5 Gas Sampling and Gas and Oil Discharge Taps

The Buchholz relays Series RR can be supplied with a gas sampling tap on the lower part of the body as well as on the head of the relay; this disposition allows an easier sampling when the minimum oil level in the conservator is only slightly higher than the relay head. The oil drain plug can be supplanted by a cock with or without connection for a copper pipe to ground level.

For the analysis of the gases collected by the relay, the EG5 gas test device can be mounted either on top of the Buchholz relay or on the gas collector RA-GA "B" at ground level.

3.6 Floats

The floats are made of closed cell expanded material based on nitrile rubber and therefore are not subject to punctures or to be damaged by overpressures, thus loosing the buoyancy.

3.7 Tightness and Resistance to Pressure

The Buchholz relays Series RR are:

- Oil tight to transformer oil at 100°C and 1 bar;
- Mechanical and electrical resistance to vacuum (10 torr);
- Mechanical resistance to pressure up to 4 bar.

3.8 Resistance to Dynamical Stress

The Buchholz relays Series RR are designed to operate without undue contacts to the following dynamical conditions:

- Sinus vibrations with frequency <= 120 Hz and amplitude <= 250 µ;
- Dynamical conditions with accelerations with:
  - Max 3g on every axis, sinus form, amplitude <= 20 mm;
  - Shock max 10g on every axis

3.9 Painting and Protection against Corrosion

Casting and head are painted internally and externally by one coat of epoxy primer and externally by one finishing coat of polyurethane paint, final colour RAL 7031. The primer paint is resistant to transformer oil up to 120°C

The painting cycle is agreed by the Italian electricity authority ENEL.

The specification N° 00VERRxx describes in details all the relevant characteristics of the painting.

4.0 Operation and Installation

The following description applies only to Series RR, RRF and GQ in the dimensions ND 50, ND 80 and ND 100.

4.1 General Features

The active part of the Buchholz relay consists of three mechanically independent units, operated respectively by the upper float, lower float and the oil flow vane. Every unit can work one or two contacts, according to the chosen wiring diagram as indicated by specification N° 04RRCONRxx.

The oil flow vane can operate also the contact or contacts of the lower float unit. Furthermore the oil flow vane unit can be linked rigidly to the lower float unit, thus making it possible to work a total of four contacts for low oil, persistent gas accumulation and/or oil flow.

4.2 Operation for Gas Accumulation, Low Oil and Oil Flow

In standard execution the contacts are set to operate as specified by standard EN 50216-2. The specification N° 04RRSCHRxx indicates for every wiring diagram the operation values.

In special execution the relays Series RR, RRF and GQ can be supplied:

- With the oil flow vane set to operate for oil flow from 0,5 to 3,0 m/sec; the setting is fixed and can be changed only in our factory;
- With independent contacts for low oil and oil flow;
- With the lower float operating also for continuous gas accumulation;
- With manual reset of the oil flow contact and optical indication.

4.3 Installation

The Buchholz relays have to be mounted on the pipe between tank and conservator. The pipeline must be laid out so as to assure that all gas formation inside the transformer is piped into the Buchholz relay. The pipeline diameter, which determines also the diameter of the Buchholz relay, must be such as to assure that the oil flow generated by a fault or a short circuit inside the transformer can flow to the conservator without excessive hydrodynamic resistance.

To meet these conditions, in some cases it may be advisable to install more than one Buchholz relay on the transformer.

An arrow on the casting of the head shows the installation direction and must be installed pointing to the conservator. The four mounting screws of the head on the casting are unevenly spaced so as to make a faulty assembly impossible.

5.0 Operating Limits

The materials and the components determining the operating limits of these Buchholz relays are mainly those used for the gaskets and for the insulation of the contacts cables as well as the contacts themselves.

5.1 Standard Execution

Gaskets are of nitrile rubber and the admitted operating conditions are:

Ambient conditions:

Ambient temperature	-20°C - +50°C
Relative Humidity	95% at 20°C - 80% at 40°C - 50% at 50°C

Insulating liquid:

Mineral oil or silicone oil

Temperature range	-20°C - +110°C

5.2 Execution Sil

Gaskets are of silicone rubber for low temperature and the admitted operating conditions are:

Ambient conditions:

Ambient temperature	-50°C - +50°C
Relative Humidity	95% at 20°C - 80% at 40°C - 50% at 50°C

Insulating liquid:

Mineral oil

Temperature range	-50°C - +130°C

5.3 Special Executions

For other ambient or operating conditions to be defined specifically.

6.0 Type Identification

Taking for example relay Buchholz type **RR 050 04-101C R16 Sil**, type name which identifies a:

- Buchholz relay Series RR;
- Nominal diameter 50 mm;
- Wiring diagram 04-101C according to specification N° 04RRSCHRxx;
- Fittings and accessories R16 according to drawing N° 4.900.003;
- Silicone rubber gaskets for low temperature, execution Sil

Buchholz relays Series RR are identified as follows:

RR	050	04-101C	R16	Sil
Identification of the series	Identification of nominal diameter	Identification of wiring diagram according to specification N° 04RRSCHRx	Identification of fitting and accessories according to drawing N° 4.900.003	Identification of execution with silicone rubber gaskets

7.0 Reference Specifications

• Wiring diagrams	N° 04RRSCHRxx
• Features of contacts, terminals and electric circuits	N° 04RRCONRxx
• Ground level device to check contacts operation CCC	N° 08CCGENRxx
• Ground level device for gas accumulation RA-GA "B"	N° 07RBGENRxx
• Gas sampling device EG5	N° 09EGGENRxx
• Painting and corrosion protection	N° 00VERRxx

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Website: www.eti-elettrindustria.it

Specification N°	Product:	Page N°
04RRCONR02-E	Buchholz Relays "Custos" Series RR, RRF, GQ	**1 of 2**

Title:	Revision N°
Contact's performance - General features of wiring diagrams	**02 - 18/09/02**

1.0 Contents of specification

The specification outlines the characteristics of the contacts as well as their electrical and mechanical performance and the different wiring diagrams that can be supplied; for the detailed description of the operation and disposition of the contacts for every wiring diagram see specification N° 04RRSCHRxx.

2.0 Electric contacts

2.1 Contact's type

The contacts used for the Buchholz relays Series RR, RRF and GQ are hermetically sealed, inert gas filled, magnetically operated contacts, which can be of the normally open (NO), normally closed (NC) or changeover type (SC). They are made up by two blades, a rigid and a flexible one, which both have at one end a contact cap and are rigidly fixed in a sealed glass cylinder at the other end that encloses them; the glass cylinder is filled with inert gas. By bringing a magnet near the free end of the blades, the flexible blade is pressed against the rigid one (or separated from the rigid one in a NC contact) thus closing (or opening) the contact. The SC contact has two rigid blades and the flexible blade switches between the two ones.

2.2 Materials and contacts performance

- Contact's cap material — Silver
- Cable insulation — heat shrinking Teflon
- Admissible temperature range — -50°C / +125°C
- Interruption power for $1x10^5$ cycles and max 3 operations per minute
  - NO and NC contacts — 250 W / 400 VA
  - SC contact — 200 W / 300 VA
- Insulation to earth at 20° C — 2.500 V
- Insulation of the open contact at 20°C
  - NO and NC contacts — 2.500 V
  - SC contact — 2.000 V
- Maximum current — 2 A
- Maximum current admissible for 1 sec. — 100 A
- Admissible tension — 2a V / 250 V
- Electrical resistance of the closed contact — 500 mΩ

3.0 Feasibility limits of the wiring diagrams and performance

The wiring diagrams described in detail by specification N° 04RRSCHRxx are those most commonly used. Other wiring diagrams can be obtained within the limitations shown below.

3.1 Limits of the wiring diagram

3.1.1 Buchholz Relay Type RR 025 (MD 25 mm)

Maximum two independent contacts; one operated by upper float and one operated by lower float and oil flow vane. Maximum 6 terminals.

3.1.2 Buchholz Relay Series RR, RRF and GQ with MD 50 mm

For this Buchholz relay the lower float operates always also for continuous gas accumulation, after the upper float has operated; therefore all wiring diagrams which contemplate the operation of the lower float only for the low oil condition are not possible.

3.1.3 **Buchholz Relays Series RR, RRF and GQ with MD 50, 80 and 100 mm**

Maximum 2 contacts for each one of the following positions:

- The upper float;
- The lower float;
- The oil flow vane.

The lower float can be linked rigidly to the oil flow vane and therefore for these two positions a total of four contacts operating for low oil and oil flow can be obtained.

Maximum 12 terminals; the maximum number of terminals that fit into the junction box is 12; should it be necessary to connect a higher number of cables from the contacts, more than one cable can be connected to the same terminal.

3.2 **Performance of the wiring diagrams**

3.2.1 **Gas accumulation and low oil**

The tables of specification N° 04RRSCHRxx show for every wiring diagram the standard operating values of every contact for gas accumulation and low oil; these values correspond to those of standard EN 50216-2; the admitted tolerance is +/- 30 cm^3.

On request, the operation for gas accumulation of the upper float can be set between 100 cm^3 and 350 cm^3; the lower float can operate between 450 cm^3 and 850 cm^3. For the lower float the indicated gas volume is the one inside the Buchholz relay.

The operation of the lower float for the low oil condition happens before the oil level inside the relay reaches the C/L of the pipe.

3.2.2 **Oil flow**

If not otherwise required the standard operating value for the oil flow vane is 1,0 m/s; on request his value can be set between 0,5 m/s and 3,0 m/s; the setting is made in the factory.

The admitted tolerance is +/- 10% of the nominal value.

3.3 **Operation of the contacts**

If 2 contacts are present in one position, these can be set to operate simultaneously or, only for gas accumulation and low oil, in sequence; for gas accumulation and low oil the operation of two contacts set to operate simultaneously must happen within the tolerance indicated above.

4.0 Reference specifications

- Wiring diagrams N° 04RRSCHRxx

ETI-Elettrindustria srl
EQUIPAGGIAMENTO TRASFORMATORI ITALIA
T: +39 0245475074 | F: +39 0245475787
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Website: www.eti-elettrindustria.it

1.0 Performance and description of the wiring diagrams

The specification gives a complete description of the performance and function of the wiring diagrams.

2.0 Wiring diagrams

2.1 Identification by numbering of the wiring diagrams

The identification numbering of the wiring diagrams follows criteria that allow to identify the type and approximate operation of the wiring diagram from its number.

2.1.1 Key to numbering of wiring diagrams

Every position in the number identifying a wiring diagram is related to a function of the Buchholz relay. Taking as an example the standard wiring diagram 04-101C, the numbering has the following meaning:

04-101C

04-xxxx = Wiring diagram for Buchholz relay;

04-**X**xxx = Number and type of contacts worked by the upper float; in the example 1 normally open contact;

04-x**X**xx = Number and type of contacts worked exclusively by the oil flow vane; in the example (0) no contact is worked exclusively by the oil flow vane.
N.B.: If, like in the example, no contact is worked by the oil flow vane, the vane is connected to the lower float so as to lower it when the oil flow trips the vane, thus operating the lower float contact. If one or more contacts are worked exclusively by the oil flow vane (value ≠ 0) the vane is independent from the lower float.

04-xx**X**x = Number and type of contacts worked by the lower float; in the example 1 normally open contact;

04-xxx**X** = Operation of the lower float:
C = operation only for low oil; **F =** operation for low oil and gas accumulation.

2.1.2 Meaning of the numbers or letters

The numbers or letters of every position in the number of the wiring diagram indicate number and type of contacts operated by every function of the Buchholz relay according to following list:

One contact for every function

0 = no contact for this function

1 = 1 contact NO;	**2** = 1 contact NC;	**3** = 1 contact SC

Two contacts for every function, operating simultaneously

5 = 2 NO contacts;	**4** = 2 NC contacts;	**6** = 2 SC contacts;
7 = 1 NO + 1 NC contact;	**8** = 1 NC + 1 SC contact;	**9** = 1 NO + 1 SC contact;

Two contacts for every function, operating in sequence

A = 2 NO contacts;	**B** = 2 NC contacts;	**C** = 2 SC contacts;
D = 1 NO + 1 NC contact;	**E** = 1 NC + 1 SC contact;	**F** = 1 NO + 1 SC contact;

Oil flow vane and lower float linked rigidly

Y = the letter Y in the positions of the oil flow vane indicates that the oil flow vane is connected rigidly to the lower float. The letter Y is followed by two numbers, the first indicating the total number of contacts for the two positions and the second indicating the type of contact.

3.0 Notes on tables of function and performance of wiring diagrams

The most commonly used wiring diagrams are described in detail in the following tables. The indicated operation values correspond to the standard setting, which is supplied if the customer makes no special demand.

On request the contacts can be set to operate within the following values:

3.1 Gas accumulation and low oil

The operation for gas accumulation of the upper float can be set between 180 cm^3 and 300 cm^3; the lower float can operate between 450 cm^3 and 850 cm^3. For the lower float the indicated gas volume is the one inside the Buchholz relay.

The operation of the lower float for low oil condition happens before the oil level inside the relay reaches the centreline of the pipe.

3.2 Oil flow

The operating values for the oil flow vane can be set between 0,5 m/s and 3,0 m/s; the setting is made at the factory.

The admitted tolerance is +/- 10%.

3.3 Operation of the contacts

If two contacts are present in one position, they are set to operate simultaneously, but on request they can be set to operate in sequence. For gas accumulation and low oil the operation of two contacts set to operate simultaneously must happen within the tolerance indicated above.

3.4 Notes on tables of wiring diagrams

The following tables showing the performance of the wiring diagrams refer to the normal exercise condition of the Buchholz relay. The normal exercise condition (NE) is when the Buchholz relay is full of oil and the oil flow vane is in the off position.

The standard operation values (SOV) are the ones supplied if no specific request for different values is made by the customer.

4.0 Tables of function and performance of wiring diagrams

The most commonly used wiring diagrams are described in detail in the following tables.

4.1 Wiring diagram N° 04-101C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
3-4	Open	1 normally open contact operated by upper float, closes for gas accumulation and low oil at the indicated value	200 cm^3
1-2	Open	1 normally open contact operated by lower float and oil flow vane, closes for low oil and oil flow at the indicated values	< C/L pipe 1,0 m/s

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-101F**

4.2 Wiring diagram N° 04-202C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
3-4	Closed	1 normally closed contact operated by upper float, opens for gas accumulation and low oil at the indicated value	200 cm^3
1-2	Closed	1 normally closed contact operated by lower float and oil flow vane, opens for low oil and oil flow at the indicated values	< C/L pipe 1,0 m/s

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-202F**

4.3 Wiring diagram N° 04-303C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	**Open**	1 changeover contact operated by upper float, switches for gas accumulation and low oil at the indicated values	**200 cm3**
1-3	**Closed**		
4-5	**Open**	1 changeover contact operated by lower float and oil flow vane, switches for low oil and oil flow at the indicated values	**< C/L pipe 1,0 m/s**
4-6	**Closed**		

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-303F**

4.4 Wiring diagram N° 04-105C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	Open	1 normally open contact operated by upper float, closes for gas accumulation and low oil at the indicated value	200 cm^3
3-4	Open	2 normally open contacts operated by lower float and oil flow vane, close for low oil and oil flow at the indicated values	< C/L pipe 1,0 m/s
5-6	Open		

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-105F**

4.5 Wiring diagram N° 04-111C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	Open	1 normally open contact operated by upper float, closes for gas accumulation and low oil at the indicated value	200 cm^3
3-4	Open	1 normally open contact operated by lower float, closes for low oil at the indicated value	< C/L pipe
5-6	Open	1 normally open contact operated by oil flow vane, closes for oil flow at the indicated value	1,0 m/s

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-111F**

4.6 Wiring diagram N° 04-115C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	Open	1 normally open contact operated by upper float, closes for gas accumulation and low oil at the indicated value	200 cm^3
3-4	Open	2 normally open contacts operated by lower float, close for low oil at the indicated value	< C/L pipe
5-6	Open		
7-8	Open	1 normally open contact operated by oil flow vane, closes for oil flow at the indicated value	1,0 m/s

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-115F**

4.7 Wiring diagram N° 04-505C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	Open	2 normally open contacts operated by upper float, close for gas accumulation and low oil at the indicated values	200 cm^3
3-4	Open		
5-6	Open	2 normally open contacts operated by lower float and oil flow vane, close for low oil and oil flow at the indicated values	< C/L pipe 1,0 m/s
7-8	Open		

Notes: On request Lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-505F**

4.8 Wiring diagram N° 04-707C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	Open	1 normally open contact operated by upper float, closes for gas accumulation and low oil at the indicated value	200 cm^3
3-4	Closed	1 normally closed contact operated by upper float, opens for gas accumulation and low oil at the indicated value	
5-6	Open	1 normally open contact operated by lower float and oil flow vane, closes for low oil and oil flow at the indicated values	< C/L pipe 1,0 m/s
7-8	Closed	1 normally closed contact operated by lower float and oil flow vane, opens for low oil and oil flow at the indicated values	

Notes: On request lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-707F**

4.9 Wiring diagram N° 04-606C

Terminal N°	Contact in NE	Functional description of wiring diagram	SOV
1-2	Open	2 changeover contacts operated by upper float; they switch for gas accumulation and low oil at the indicated values	200 cm^3
1-3	Closed		
4-5	Open		
4-6	Closed		
7-8	Open	2 changeover contacts operated by lower float and oil flow vane; they switch for low oil and oil flow at the indicated values	< C/L pipe 1,0 m/s
7-9	Closed		
10-11	Open		
10-12	Closed		

Notes: On request Lower float can operate also on gas accumulation; in this case the number of the wiring diagram is followed by the letter F instead of C. Example: **N° 4-606F**

ETI-Elettrindustria srl
EQUIPAGGIAMENTO TRASFORMATORI ITALIA
T: +39 0245475074 | F: +39 0245475787
E-mail: cobETI@eti-elettrindustria.it
Website: www.eti-elettrindustria.it

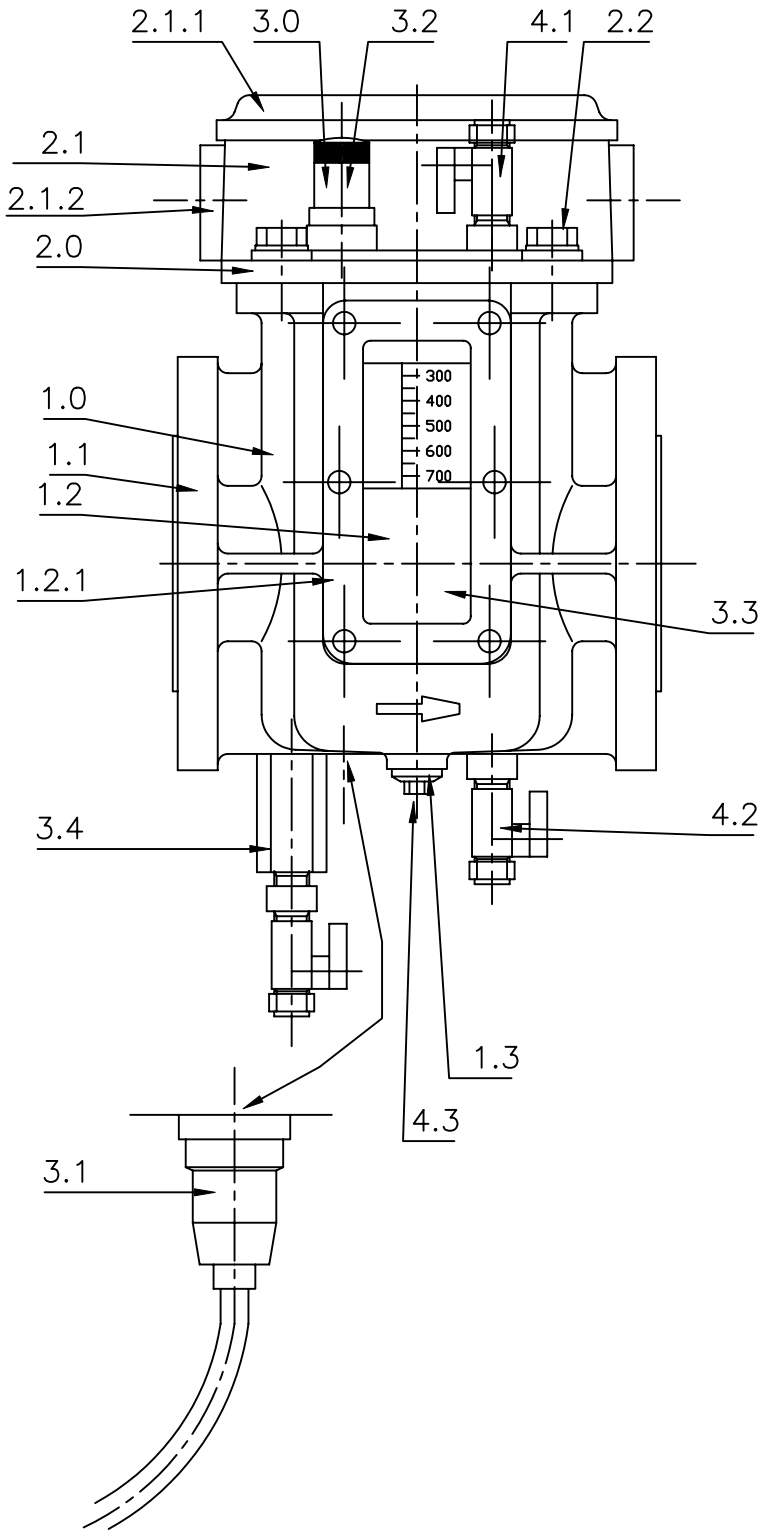
Nomenclature N°:	Reference drawing N°:	Page N°	Revision N°:
04RRACCR03-E	**4.900.20**	**1 of 1**	**03 of 18.09.2002**

Product:

Buchholz relay ETI "Custos" Series RR, RRF, GQ - Accessories and fittings

Pos.	Part denomination	N°	Material
	Standard execution		
1.0	Casing	1	Aluminium
1.1	Mounting flange	2	
1.2	Visor with gas volume graduation	2	Tempered glass
1.2.1	Visor frame	2	Nylon + 30% glass fibre
1.3	Oil drain plug	1	Brass nickel coated
2.0	Head with junction box	1	Aluminium
2.1	Junction box		
2.1.1	Junction box cover	1	Nylon + 30% glass fibre
2.1.2	Cable entries - max 1" or PG 29 thread	2	
2.2	Head mounting screws	2+2	Stainless steel
3.0	Manual contact's test device	1	Brass galvanised
4.1	Gas drain tap with cap - connection 1/4" male	1	Brass nickel coated
	On request		
3.1	Connection of manual test device 3.0 to ground mounted accessory CCC for test made at man's height		
3.2	Reset of oil flow vane when oil flow vane has manual reset		
3.3	Visual indication of latched oil flow vane		
3.4	Connection for test of oil flow vane by compressed air or gas - tap with cap thread 1/4" or 1/8" inch male		
4.1	Gas drain tap with cap - connection 1/8" male	1	Brass nickel coated
4.2	Gas drain tap with compression fitting for 8x6 mm copper pipe mounted on bottom of casing for easier connection to ground mounted gas receiver RAGA B	1	Brass nickel coated
4.3	Oil drain tap with cap thread 1/4" or 1/8" male or with compression fitting for copper pipe 8x6mm	1	Brass nickel coated

N.rev	Nota sulla revisione	Data	Firma	Controllo



Pos.	Quantità	Descrizione		Materiale	N. articolo
Progettato da	**Controllato da**	**Approvato da – data**	**Nome file**	**Data**	**Scala** //

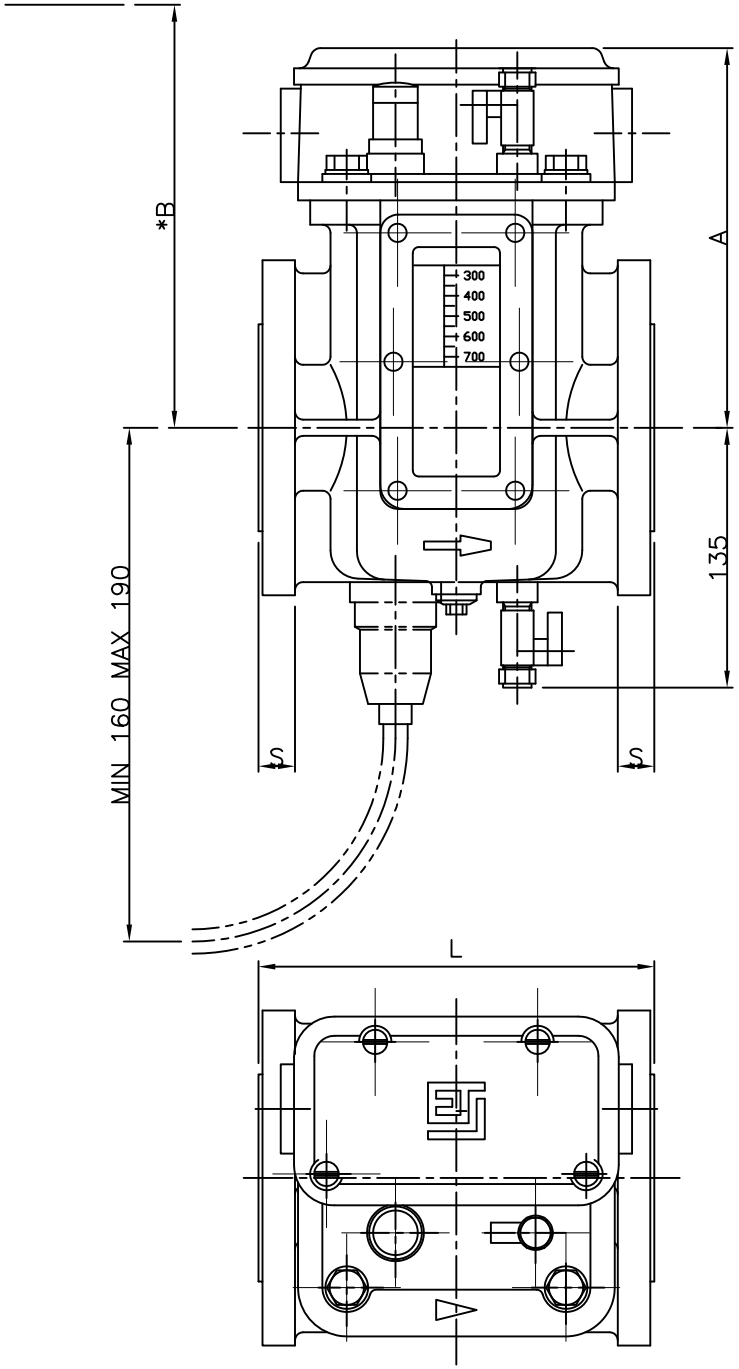
ELETTRINDUSTRIA SRL
20032 CORMANO ITALY

Titolo/Nome

RELE BUCHHOLZ SERIE RR

ACCESSORI – ACCESSORIES – ACCESSOIRES

Numero disegno	Modifica	Foglio
4.900.20		



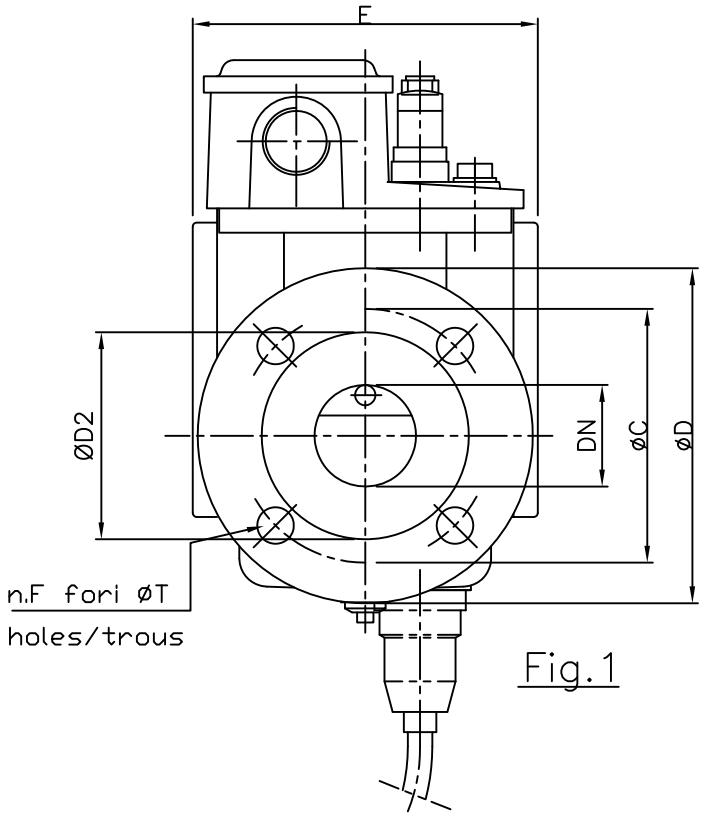


Fig.1

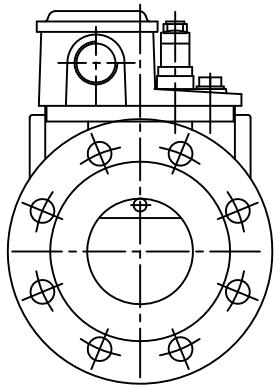


Fig.2

Tipo	DN	A	B	C	D	D2	E	L	S	F	T	Fig.
RR 50	50	185	310	125	165	102	170	195	18	4	18	1
RR 80	80	185	310	160	200	138	170	195	18	4	18	1
RR 80–8	80	185	310	160	200	138	170	195	18	8	18	2
RR100	100	185	310	180	220	158	170	220	18	8	18	2

*B = Ingombro di smontaggio
Encombrement de demontage
Disassembling height

N.rev	Nota sulla revisione	Data	Signatura	Controllo
B	Aggiunta quota ØD2 in su disegno e tabella	16/04/10	LZ	
A	Aggiunto tipo RR80–8 e fig.2	28/02/01	GL	

Rif.	Quantità	Titolo/Nome, designazione, materiale, dimensione, etc.			N. articolo/Riferimento	
Progettato da		Controllato da	Approvato da – data	Nome file	Data 01-01-98	Scala //

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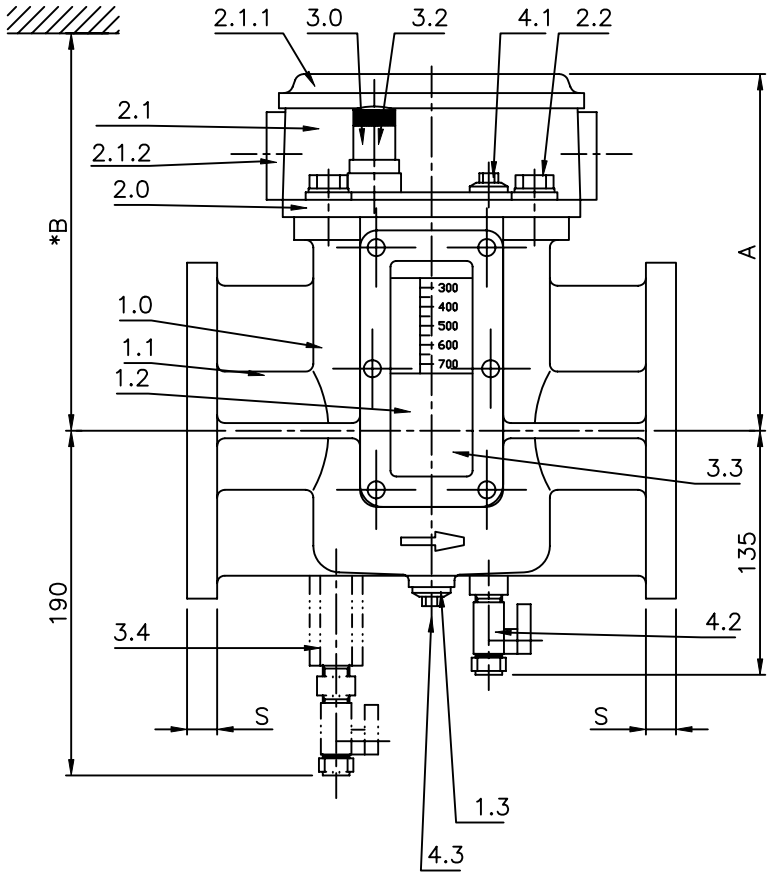
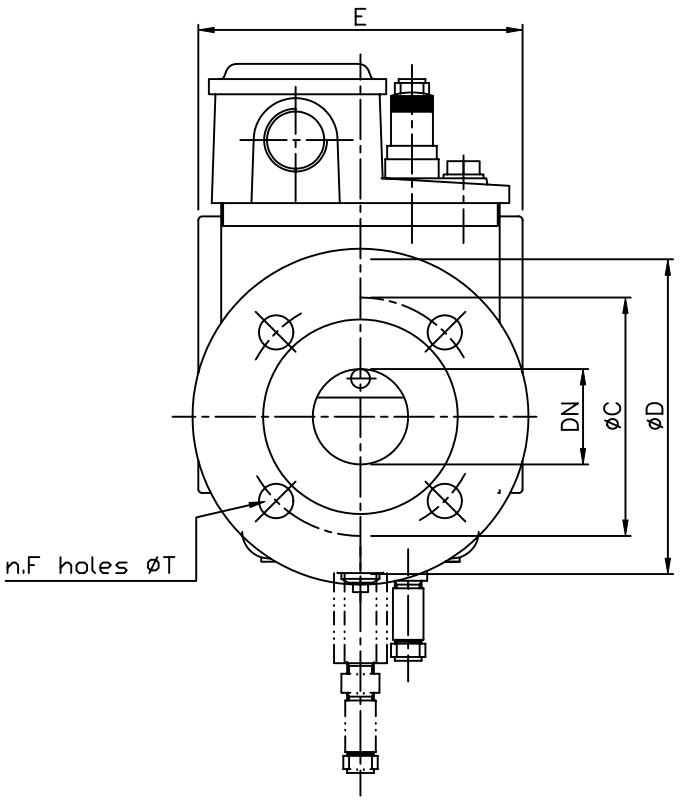
20032 CORMANO ITALY

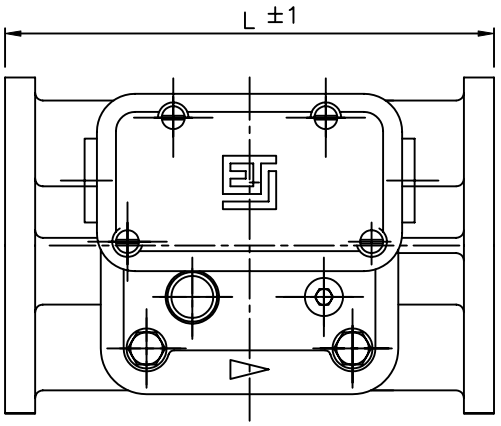
Titolo/Nome: BUCHHOLZ RELE - BUCHHOLZ RELAY
Serie: RR

Numero disegno: 4.900.00 | Modifica: B | Foglio:

Riproduzione vietata | Non misuratre le quote dal disegno







Tipo	DN	A	B	C	D	E	L	S	F	T
RR–F 50	50	185	310	125	165	170	240	15	4	18
RR–F 80	80	185	310	160	200	170	240	15	4	18

*B = Disassembling height

N.rev	Nota sulla revisione	Data	Signatura	Controllo

Rif.	Quantità	Titolo/Nome, designazione, materiale, dimensione, etc.	N. articolo/Riferimento
Progettato da	Controllato da	Approvato da – data / Nome file	Data 12/10/01 / Scala //

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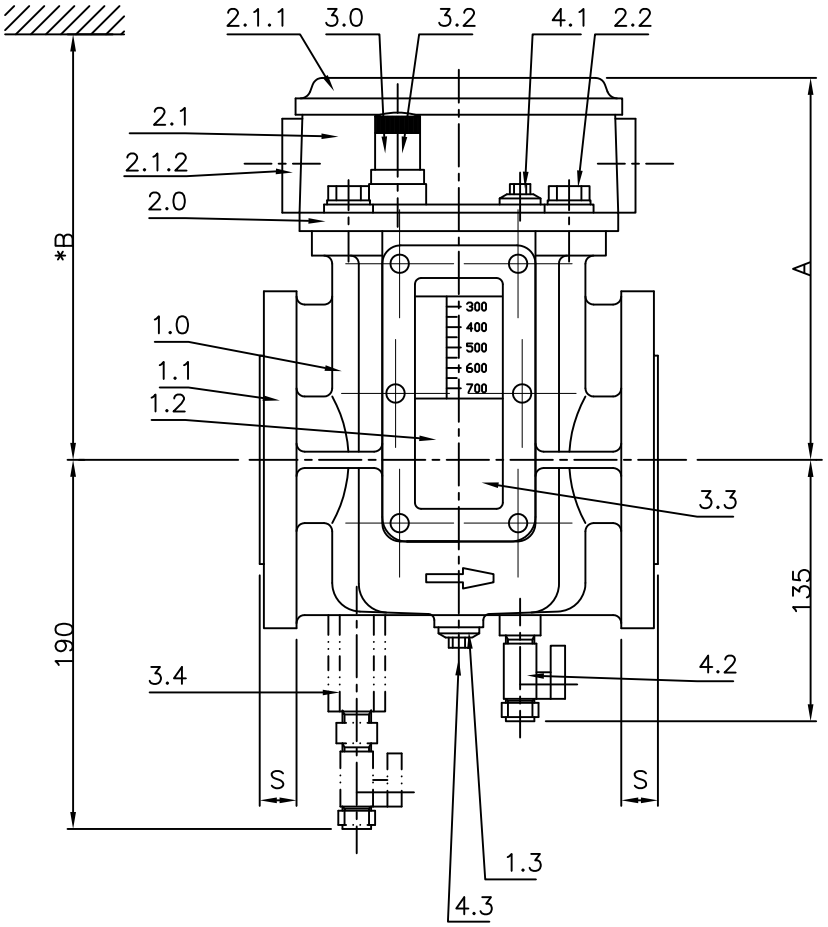
Titolo/Nome: RELE BUCHHOLZ SERIE RR–F
OVERALL DIMENSIONS

Numero disegno: 4.650.00 | Modifica | Foglio



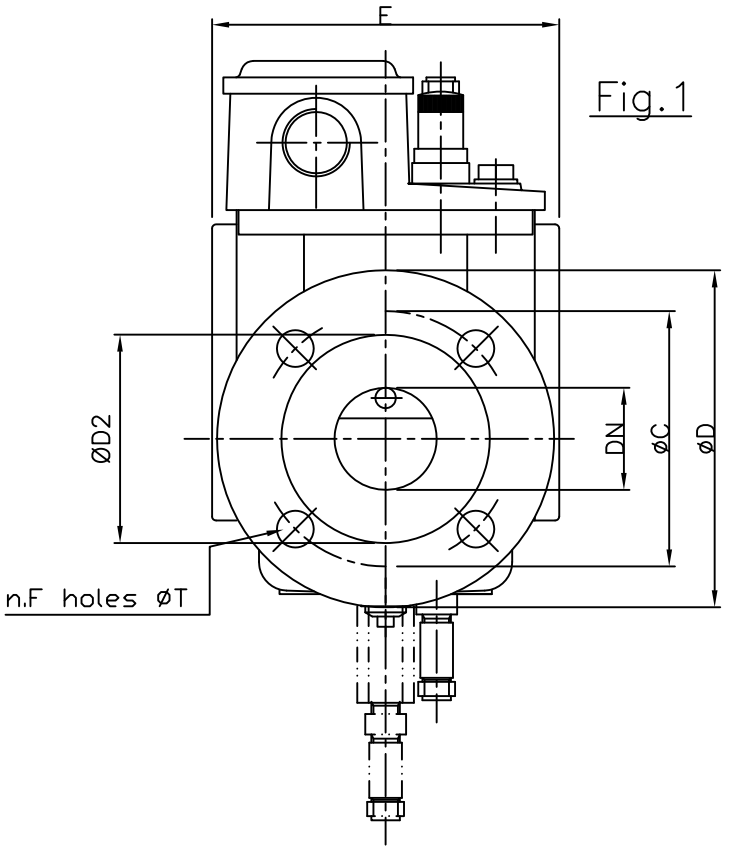


Fig.1

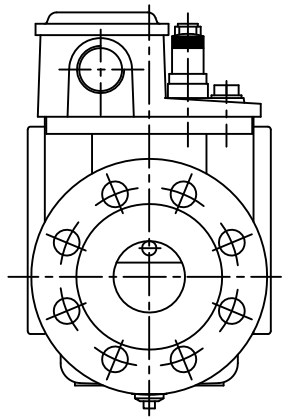
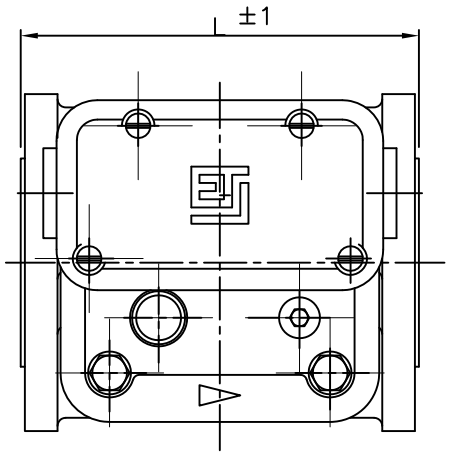


Fig.2



Tipo	DN	A	B	C	D	D2	E	L	S	F	T	Fig.
GQ 50	50	185	310	114	155	95	170	190	18	4	18	1
GQ 80	80	185	310	146	190	125	170	197	18	4	18	1
GQ–F 80	80	185	310	165	205	145	170	197	18	8	18	2

*B = Disassembling height

N.rev	Nota sulla revisione	Data	Signatura	Controllo
C	Aggiunta quota ØD2 su disegno e tabella	16/04/10	LZ	
B	Aggiunto tipo GQ–F80 e Fig.2	18/06/01		

Rif.	Quantità	Titolo/Nome, designazione, materiale, dimensione, etc.			N. articolo/Riferimento	
Progettato da		Controllato da	Approvato da – data	Nome file	Data	Scala //

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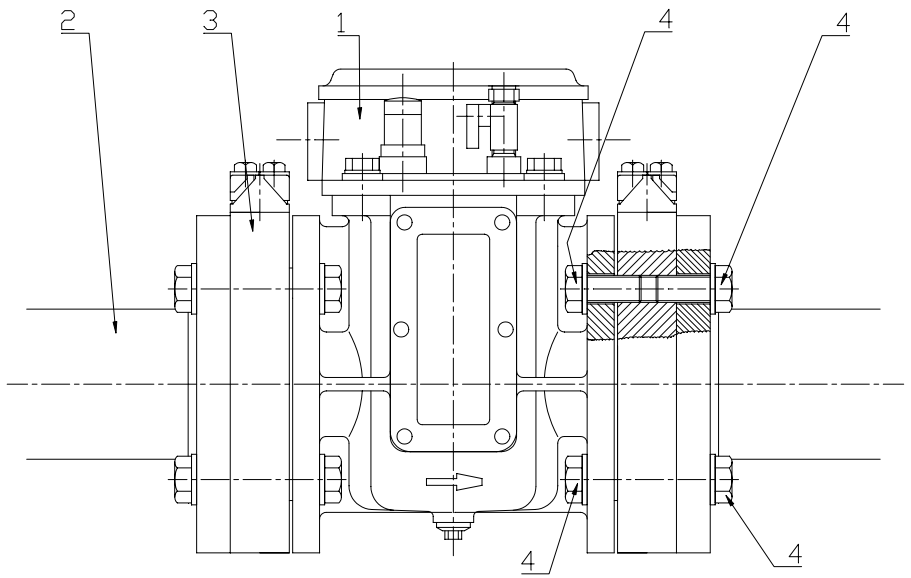
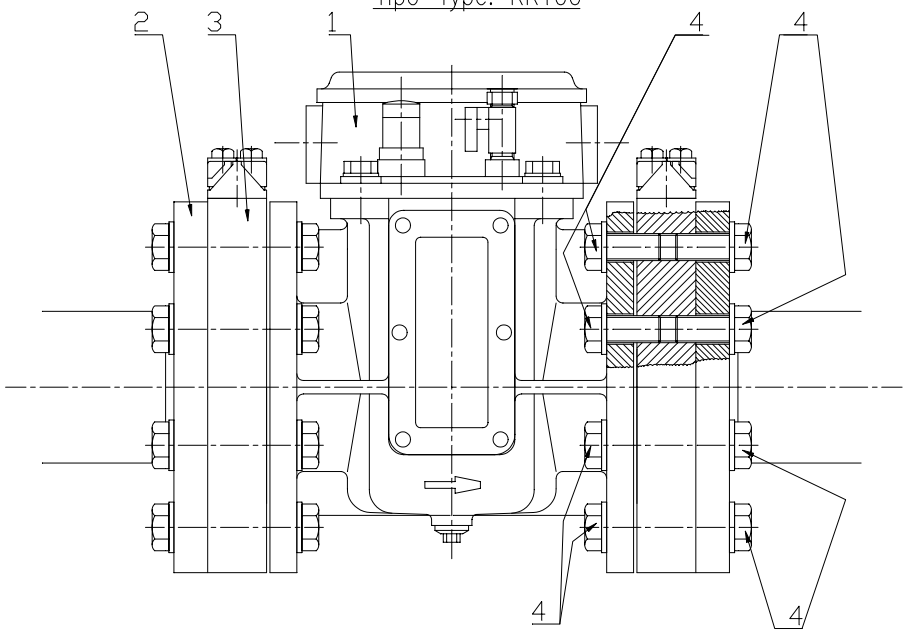
Titolo/Nome
RELE BUCHHOLZ SERIE GQ
OVERALL DIMENSIONS

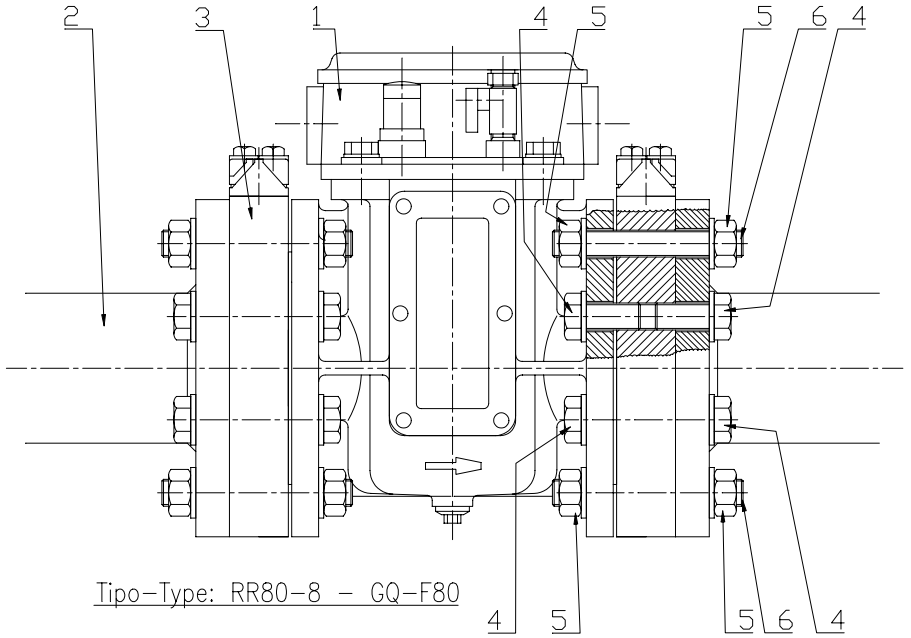
Numero disegno	Modifica	Foglio
4.900.10	C	

Tipo-Type: RR50-RR80 - GQ50-GQ80



Tipo-Type: RR100





Tipo-Type: RR80-8 - GQ-F80

N.rev	Nota sulla revisione	Data	Firma	Controllo

Rif.	Quantità	Titolo/Nome, designazione, materiale, dimensione, etc.			N. articolo / Riferimento	
Progettato da		Controllato da	Approvato da - data	Nome file	Data 28/02/01	Scala //

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20032 CORMANO ITALY

BUCHHOLZ RELE - BUCHHOLZ RELAY
Serie: RR - GQ
Esempio di montaggio - Assembling examples - Exemples de montage

Numero disegno	Modifica	Foglio
4.900.001		