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Air Breathers Series E700

Catalogue N°: 01E700GENR00-E

Revision: 00 of 15.05.2003

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Title:	Revision:
Operation and construction, functional and operating features	**00 – 15.05.03**

1.0 General information

The insulating materials used for the fabrication of the oil-insulated electric transformers (paper, cardboard, wood and the oil itself) are hygroscopic at various degrees, and when the humidity rate inside them rises, the dielectric features can decline considerably. Therefore it is necessary to provide the transformer with a system drying the air taken in during the cooling phase, to ensure that the humidity contained in the transformer is not transferred to the oil and the other insulating materials, which would compromise the insulation of the machine and have severe consequences.

The ETI Silica-Gel Breathers Series E700 are specifically designed for being used on electric transformers, and they offer a good solution to the above-described problem, within the limits of the system itself.

2.0 Description and operation

The ETI Silica-Gel breathers Series E700 generally consist of:

- A container suitable for containing the Silica-Gel charge, provided with a diffusion system evenly distributes the flow of air to be dried in the whole charge, with inspection windows for verifying the degree of saturation of the Silica Gel, and with a threaded or flanged coupling for the connection to the suction pipe taking in the air of the transformer.
- A closing system whose function it is to put the charge in contact with the ambient air only when there is effective suction; without this contrivance the Silica Gel, being highly hygroscopic, would continuously absorb humidity from the air, saturating rapidly.

Therefore the air taken in by the transformer during the cooling phase enters the breather through the closing system and, through the diffusion system, enters the container of the Silica-Gel charge, where it is dried; the dried air leaves the machine through the coupling fixed to the suction pipe of the transformer.

During the heating phase of the transformer, the expired air takes the opposite direction.

3.0 General features

The design and fabrication of the ETI Breathers Series 700 is aimed at accomplishing the following features for the single components:

3.1 Silica-Gel charge container

- The Silica-Gel container is manufactured such as to be completely and easily accessible; this facilitates replacing the charge and cleaning the inside, including the transparent through which the degree of saturation of the charge can be checked.
- The diffusion system distributes the air in the entire charge section, thereby allowing its complete utilisation; at the same time, it collects any Silica-Gel dust that might have formed, avoiding that it enters the closing system.
- The charge container is shock and weatherproof, thanks to a stainless steel sheet protection, which is provided with inspection windows for checking the degree of saturation of the charge. The interspace between the container and the protection is designed such as to avoid rainwater stagnation and to allow the air to easily circulate inside the container; this contrivance reduces the temperature of the charge when the machine is exposed to the sun, and thus increases its efficiency.

The container is available in fourteen different sizes with different charge capacities, such as to provide devices that may be used on transformers of all different sizes, features, operating and installation features.

3.2 Closing system

Four different closing systems are available, which differ in their operation, and more precisely:

- Closing system **"I":** this is an oil-seal hydraulic closing system that separates the charge completely from the environment, when there is no suction; it is sized such as to exclude oil leakages, even in case of considerable suction and expiration air flows.
- Closing system **"IV":** this is a closing system that works just like the previous one but has an oil container made of glass.
- Closing system **"H":** this is an oil-seal hydraulic closing system that not only guarantees that the charge is completely isolated but has the special feature of creating a negative pressure of 10 mbars inside the container during the suction phase, and a pressure of 20 mbars during the expiration phase; this closing system is sized for air flows of up to 30 dm3/min.
- Closing system **"P":** this is a closing system that consists of a metal filter made of sintered spheroidal bronze (PORAL).

3.3 Connection with the suction pipe of the conservator

The ETI Breathers Series E700 may be supplied with either a threaded ("D") or flanged ("F") coupling, suitably sized to support the weight of both the machine and the charge; in this case, the pipe must have the same diameter as the coupling.

A ½"-flange coupling ("B") is also available for the connection with a pipe of the same diameter; this coupling is provided with an anchor bolt.

Furthermore, the closing system "H" may be supplied with an anchor bolt for fixing the lower part of the machine.

4.0 Manufacturing features of the ETI Breathers Series E700

In general, the ETI Breathers Series E700 are designed and manufactured such as to resist even the heaviest service. In particular, the materials used for fabrication are weatherproof, thanks galvanic treatments and/or being painted with primer and finishing coat of epoxy paint, colour RAL7031.

All screws and bolts as well as the protection of the container are made of stainless steel.

For use in tropical areas, a tropicalisation treatment is provided, and it is also possible to supply the breathers with all their transparent parts made of glass.

5.0 Choosing the right type of Breather

As already said above, the ETI Breathers Series E700 are available in different sizes and consequently with different Silica-Gel charges.

The size of the machine can generally be chosen once the following parameters are known or established:

- Transformer oil volume;
- Operating cycle of the transformer;
- Temperature and relative humidity of the expired air;
- Required life of the charge.

For the choice of the breather, the operating cycle is the period of time during which the course of the oil-temperature diagram is analogous and repetitive.

Of course, while the oil volume and the required life of the charge are easily obtainable data, the operating cycle and the characteristics of the ambient air can hardly be defined a priori. Therefore, these data will have to be estimated.

If the above-said values are known or estimated, the breather can be chosen using tables A and B, which indicate:

Table A: the water vapour content in grams per m3 of air, as a function of temperature and relative humidity.

Table B: the data relating to the Silica-Gel charge for the various breather sizes (columns I and II) as well as the overall quantity of water absorbed by the saturated charge (column III) and the number of operating cycles under standard conditions (column IV).

The standard conditions the data of column IV are calculated for are the following:

- Standard transformer oil volume Vs=1000 dm3
- Total standard temperature variation for the operating cycle, obtained as the sum of temperature reductions causing suction ATs=10°C;
- Standard air humidity content Hs=10g/m3

The choice is then made as in the following example:

First of all, the effective volume (Ve) of the oil in the transformer is established, which is known from the design, and then the required life of the charge is determined on the basis of economical considerations and/or of the expected routine maintenance.

If the intended use of the transformer is known, it is possible to estimate the operating cycle and therefore both its duration (Tc) and the sum of effective temperature reductions (ATe) causing the suction of ambient air; finally, if the place of installation and the corresponding climate are known, it is also possible to estimate, using table A, the effective humidity content (He) of the air taken in.

We suppose, for example:

Ve	= 25,000 dm3
Tc	=12 h
ATe	=20° C
He	= 15 g/m3

and that a charge life of 90 days is required.

With the above-indicated data, the following coefficients are calculated:

Volume coefficient $Cv = \frac{Ve}{Vs} = 25$

Temperature coefficient $Ct = \frac{ATe}{ATs} = 2$

Humidity coefficient $Ch = \frac{He}{Hs} = 1.5$

which, if multiplied, make a total coefficient Ctot = Cv * Ct * Ch = 75

The required life being 90 days, and Tc = 12 h, one establishes in 90 * 2 = 180 cycles the minimum life of the charge, and in 180 + Ctot = 13,500 the number of cycles under standard conditions.

Ultimately, column IV of table B shows that the breather that best matches the requirements is that of size 744, with a number of cycles in standard conditions of 14,900; therefore, this is the right breather to use.

If several breathers are to be used on the transformer, the same procedure is adopted to make the right choice such as to make the moment, at which it is necessary to reprocess or replace the loads, coincide, thereby simplifying the maintenance.

6.0 Choosing the right closing system

It is recommended that the choice of the closing system, too, be made on the basis of the operating features of the transformer and of the ambient conditions.

- Oil-seal closing system “I“ or “IV“ completely impedes any contact between the ambient air and the Silica-Gel charge when there is no air suction and thus when the oil temperature is constant. It is therefore particularly suitable for being used on transformers that are to operate at a rather constant temperature.
- Closing system “H“ is also an oil-seal system, which, in addition, is characterised by the fact that during the suction phase it creates a negative pressure of 10 mbars while during the expiration phase it generates a pressure of 20 mbars inside the container. Thus minor oil temperature variations are compensated by the compression or expansion of the air in the conservator, without there being an effective suction or expiration of air, thereby prolonging the life of the charge. This effect increases with the air volume in the conservator.
  System “H“ is thus particularly suitable for being used on transformers that are to operate with slight temperature fluctuations caused by both charge variations and ambient temperature fluctuations.
- Closing system “P“ is characterised by a metal filter made of sintered spheroidal bronze. As the Silica-Gel charge is separated from the ambient air by means of a filter partition, it is always possible that the charge absorbs humidity from the air even when there is no suction; therefore the life of the charge, all other conditions being equal, will be slightly inferior to that of systems “I“, “IV“ or “H“.
  On the other hand, closing system “P“ is particularly indicated for the use in polluted and dusty environments and/or on transformers intended to operate at a continuously variable temperature rate, which would cause air to continuously enter the machine. A typical use of this type of closing system is on furnace transformers.

7.0 Establishing the different types

Also with reference to what is indicated above, the ETI Breathers Series E700 are characterised by an abbreviation that is composed as follows:

E	- Indicates that the machine is a breather
“I“, “IV“, “H“ or “P“	- Indicates the closing system
“D“, “F“ or “B“	- Indicates the type of coupling
711……747	- Indicates the serial number (7) and dimension of the container

Example:
EHF 746 – Indicates a breather (E) of the Series E700 with closing system “H“, flange coupling “F“ and a charge of 18 dm3 of Silica Gel.

The drawings at the end of the catalogue indicate the overall and mounting dimensions.

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8.0 Installation, operation and maintenance

Note:
The numbers of the parts corresponds to the numeration of the drawings at the end of the catalogue.

8.1 Installation

For the installation of the ETI Breathers Series E700, please proceed as follows:

- Remove the cover of the breather coupling, if the breather is supplied together with Silica Gel;
- Detach the container 2.0 from the coupling 1.0 by loosening the knobs 1.2;
- Mount the threaded or flanged coupling on the pipe 0.1, and, if necessary, secure the fastening bolts 1.5 and 3.7 (only for types with coupling “B“ and/or closing system “H“);
- Fill the container 2.0 with Silica Gel;
- Fix the container 2.0 to the coupling 1.0, using the knobs 1.2;
- For the hydraulic closing systems types “I“, “IV “ and “H“, demount the closing system itself by unscrewing the wing bolts or the three screws 3.4; after having filled the oil container up to the level line 3.6, remount the unit.

8.2 Operation

During operation, the ETI Breathers Series E700 do not require any special inspections apart from checking the colour of the Silica-Gel charge.

If, by looking through the inspection windows 2.61, it is noticed that the charge starts becoming Green (depending on the type of Silica Gel used), the charge should be either reprocessed or replaced.

8.3 Maintenance and replacement of the charge

To replace the charge, please proceed as follows:

- Demount the hydraulic closing system “I“, “IV“ and “H“, or Poral “P“ by loosening the wing bolts or the three screws 3.4;
- Remove the salt container 2.0 from the pipe by unscrewing the knobs 1.2;
- Empty the container 2.0, and thoroughly clean the inside, possibly using compressed air;
- Fill the container 2.0 with the new or reprocessed Silica-Gel charge;
- Remount the container 2.0 according to the instructions of point 5 above;
- Thoroughly clean the closing system;
- For the hydraulic closing systems types “I“, “IV“ and “H“, fill the oil in, and remount the unit according to the instructions of point 6 above;
- For closing systems of the type Poral “P“, remount the unit.

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TABLE A

Grams of water vapour contained in one cubic metre of humid air as a function of temperature and relative humidity (rh).

	RELATIVE HUMIDITY									
C°	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
0°	0.49	0.98	1.47	1.96	2.45	2.94	3.43	3.92	4.40	4.90
1	0.52	1.04	1.56	2.08	2.60	3.12	3.64	4.16	4.70	5.20
2	0.56	1.12	1.68	2.24	2.80	3.36	3.92	4.48	5.00	5.60
3	0.60	1.20	1.80	2.40	3.00	3.60	4.20	4.80	5.40	6.00
4	0.64	1.28	1.91	2.56	3.20	3.84	4.48	5.12	5.80	6.40
5	0.68	1.36	2.04	2.72	3.40	4.08	4.76	5.44	6.10	6.80
6	0.73	1.46	2.19	2.92	3.65	4.38	5.11	5.84	6.60	7.30
7	0.77	1.54	2.31	3.08	3.85	4.62	5.39	6.16	6.90	7.70
8	0.83	1.66	2.49	3.32	4.15	4.98	5.81	6.64	7.50	8.30
9	0.88	1.76	2.64	3.52	4.40	5.28	6.16	7.04	7.90	8.80
10	0.94	1.87	2.82	3.76	4.70	5.64	6.58	7.52	8.50	9.40
11	0.99	1.99	2.98	3.98	4.97	5.97	6.96	7.96	8.90	9.90
12	1.06	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.50	10.60
13	1.13	2.26	3.39	4.52	5.65	6.78	7.91	9.04	10.20	11.30
14	1.20	2.40	3.60	4.80	6.00	7.30	8.40	9.60	10.80	12.00
15	1.28	2.56	3.84	5.12	6.40	7.68	8.96	10.20	11.50	12.80
16	1.366	2.72	4.09	5.44	6.80	8.16	9.52	10.90	12.20	13.60
17	1.45	2.89	4.33	5.78	7.22	8.67	10.10	11.60	13.00	14.50
18	1.54	3.07	4.61	6.14	7.68	9.22	10.80	12.30	13.80	15.40
19	1.63	3.25	4.88	6.51	8.13	9.76	11.40	13.00	14.60	16.30
20	1.72	3.44	5.16	6.88	8.60	10.30	12.00	13.80	15.50	17.20
21	1.82	3.65	5.48	7.30	9.13	11.00	12.80	14.60	16.40	18.20
22	1.93	3.87	5.80	7.74	9.67	11.60	13.50	15.50	17.40	19.30
23	2.05	4.10	6.15	8.20	10.25	12.30	14.30	16.40	18.40	20.50
24	2.17	4.34	6.51	8.68	10.85	13.00	15.20	17.40	19.50	21.70
25	2.29	4.58	6.87	9.16	11.45	13.70	16.00	18.30	20.60	22.90
26	2.42	4.84	7.26	9.68	12.10	14.00	16.90	19.40	21.80	24.20
27	2.56	5.12	7.68	10.25	12.80	15.40	17.90	20.50	23.00	25.60
28	2.71	5.42	8.13	10.85	13.50	16.30	19.00	21.70	24.40	27.50
29	2.86	5.72	8.58	11.44	14.30	17.20	20.00	22.90	25.70	28.60
30	3.02	6.04	9.05	12.10	15.10	18.10	21.10	24.10	27.20	30.20
31	3.18	6.36	9.54	12.70	15.90	19.10	22.20	25.40	28.60	31.80
32	3.35	6.71	10.06	13.40	16.80	20.10	23.50	26.80	30.10	33.50
33	3.56	7.08	10.60	14.20	17.70	21.20	24.80	28.30	31.80	35.40
34	3.73	7.46	11.20	14.90	18.70	22.40	26.10	29.80	33.60	37.30
35	3.94	7.88	11.80	15.80	19.70	23.60	27.60	31.50	35.40	39.40
36	4.15	8.30	12.45	16.60	20.80	24.90	29.00	33.20	37.30	41.50
37	4.37	8.74	13.20	17.50	21.90	26.20	30.60	35.00	39.30	43.70
38	4.60	9.20	13.80	18.40	23.00	27.60	32.70	36.80	41.40	46.00
39	4.84	9.68	14.50	19.40	24.20	29.00	33.90	38.70	43.60	48.40
40	5.08	10.20	15.30	20.40	25.40	30.50	35.60	40.70	45.80	50.90
50	8.27	10.20	18.30	20.40	25.40	30.50	35.60	40.70	45.80	50.90
60	13.00	26.00	39.00	52.00	65.00	78.00	91.00	104.00	117.00	130.00

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TABLE B

Performance of ETI breathers Series E700

Size	Silica-Gel charge		Absorption capacity g/H2O	No. of standard cycles
	Volume [dm3]	Weight [kg]		
711	0.28	0.18	27	340
712	0.42	0.26	40	510
713	0.73	0.46	70	890
730	2.10	1.35	200	2500
731	3.20	2.00	300	3900
732	4.10	2.60	400	5000
741	6.30	4.00	600	7600
742	9.20	5.80	870	11100
743	10.50	6.80	1000	12800
744	12.30	8.00	1200	14900
745	15.00	9.80	1470	18400
746	18.00	11.70	1750	21800
747	21.00	13.70	2050	25700

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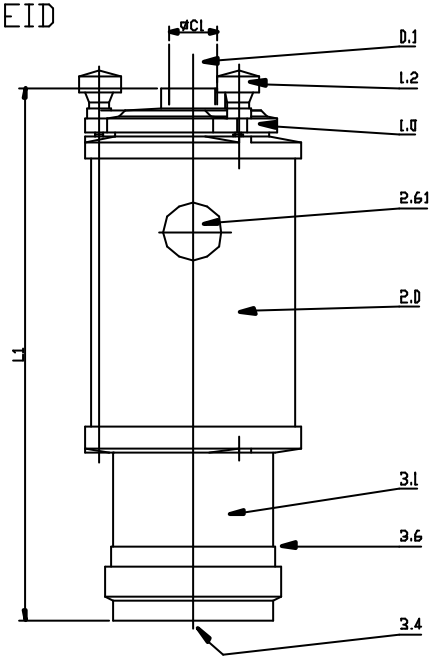

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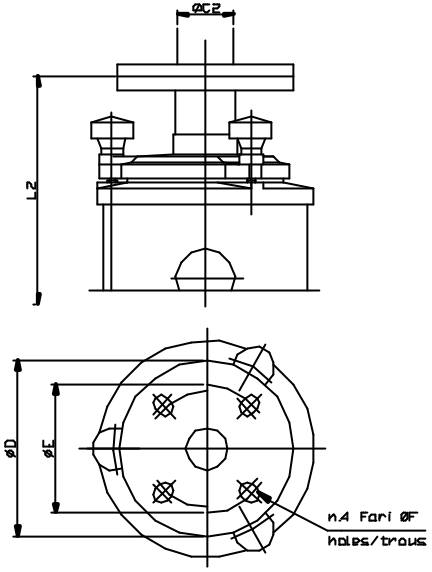

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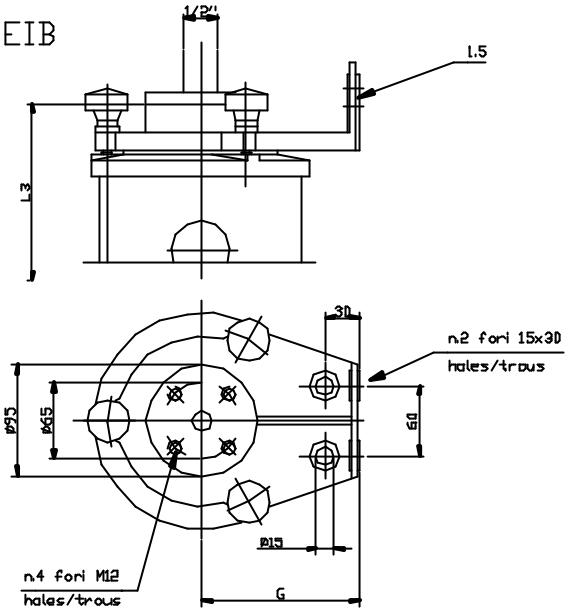

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L1	150	185	265	340	455	520	450	550	600	660	760	860	975
L2	185	220	300	390	505	570	495	595	645	705	805	905	1020
L3				340	455	520	445	545	595	655	755	855	970
øB	100			185			240						
øC1	1/2''			1''1/4			1''1/2			2''			
øC2	1/2''			1''1/2									
øD	95			150									
øE	65			100 / 110									
øF	14			14x19									
G				135			165						

N.rev	Nota sulla revisione	Data	Firma	Controllo

ELETTROMECCANICA SRL 20032 COGNANO ITALY	ESSICCATORI D'ARIA ASSECHEURS D'AIR AIR BREATHERS	SERIE EI..700			
	1.EI..700				

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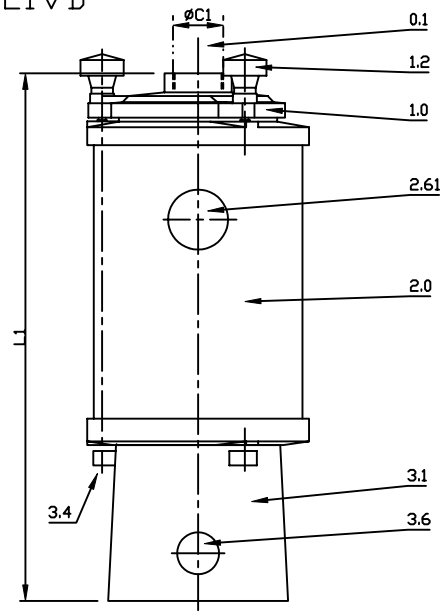

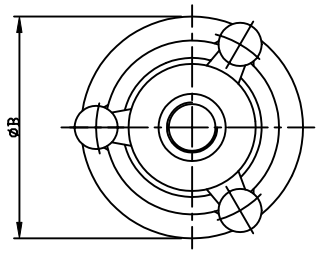

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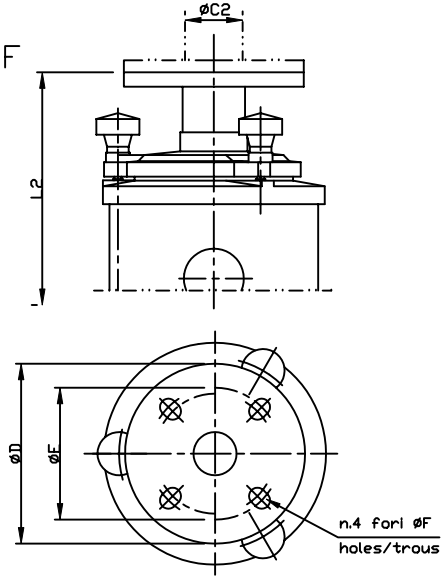

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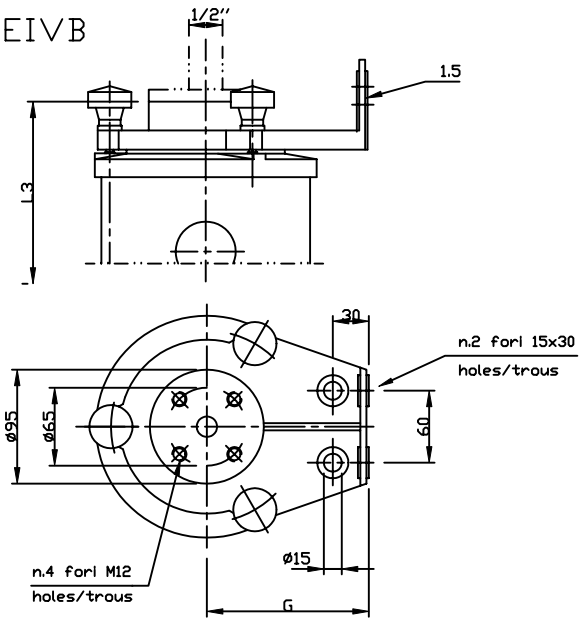

Tipo - Type	711	712	713	730	731	732	741	742	743	744	745	746	747
L1	150	185	265	330	445	510	440	540	590	650	750	850	965
L2	185	220	300	380	495	560	485	585	635	695	795	895	1010
L3				330	445	510	435	535	585	645	745	845	960
øB	100			185			240						
øC1	1/2"			1"1/4			1"1/2			2"			
øC2	1/2"			1"1/2									
øD	95			150									
øE	65			100 / 110									
øF	14			14x19									
G				135			165						

Rif.	Quantità	Titolo/Nome, designazione, materiale, dimensione, etc.			N. articolo/Riferimento	
Progettato da		Controllato da	Approvato da – data	Nome file	Data 01-01-97	Scala //

ETI ELETTRINDUSTRIA Srl
20032 CORMANO ITALY

Titolo/Nome
ESSICCATORI D'ARIA - AIR BREATHERS - ASSECHEURS D'AIR
Serie: EIV..700

Numero disegno 1.EIV.700 | Modifica | Foglio

Riproduzione vietata | Non misuratre le quote dal disegno

N.rev	Nota sulla revisione	Data	Signatura	Controllo

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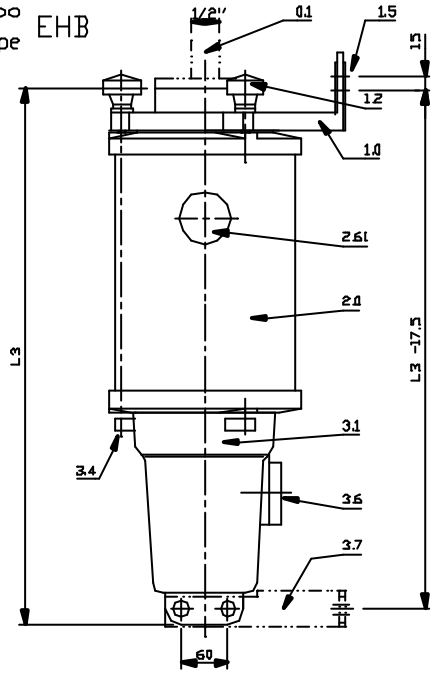

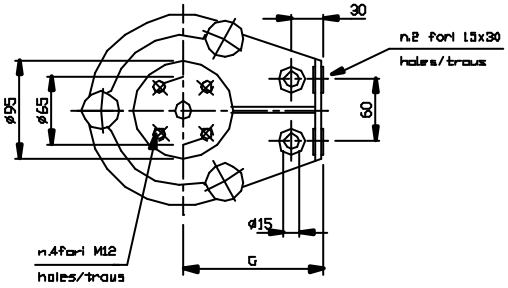

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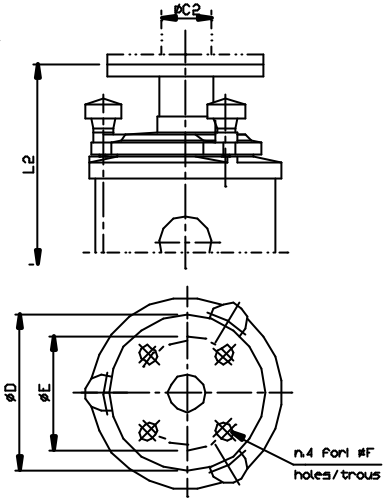

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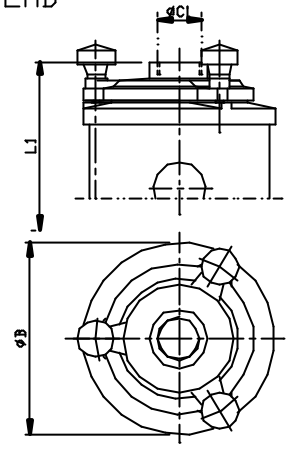


Tipo - Type		730	731	732	741	742	743	744	745	746	747
L1		410	525	590	520	620	750	730	830	930	1045
L2		460	575	640	565	665	795	775	875	975	1090
L3		410	525	590	515	615	745	725	825	925	1040
øB		185			240						
øC1		1"1/4			1"1/2			2"			
øC2		1"1/2									
øD		150									
øE		100 / 110									
øF		14x19									
G		135			165						

Pt.	Quantità	Titolo/Norma, designazione, materiale, dimensioni, etc.			N. ordinale/Riferimento	
Progettato da		Controllato da	Approvato da – data	Nome file	Data	Scala //

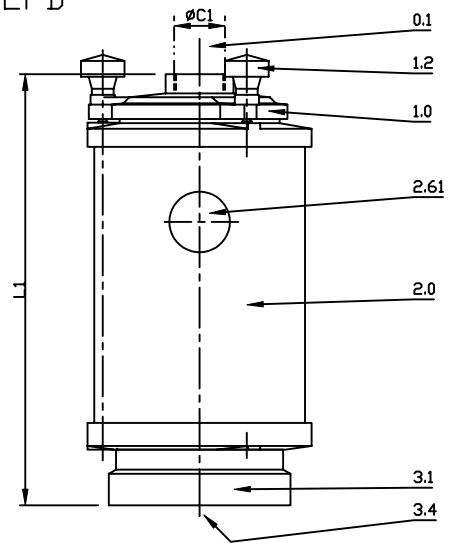
ELETTRINDUSTRIA SRL
20832 CORMANO ITALY

Titolo/Nome: ESSICCATORI D'ARIA SERIE EH..700
ASSECHEURS D'AIR
AIR BREATHERS

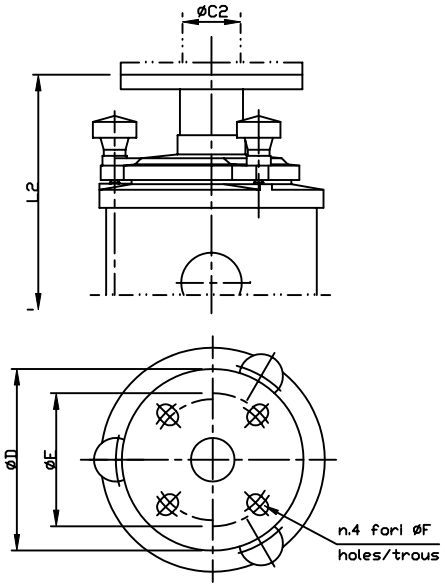
Numero disegno: 1.EH..700 | Modifica | Foglio

N_rev	Nota sulla revisione	Data	Signatura	Controllo

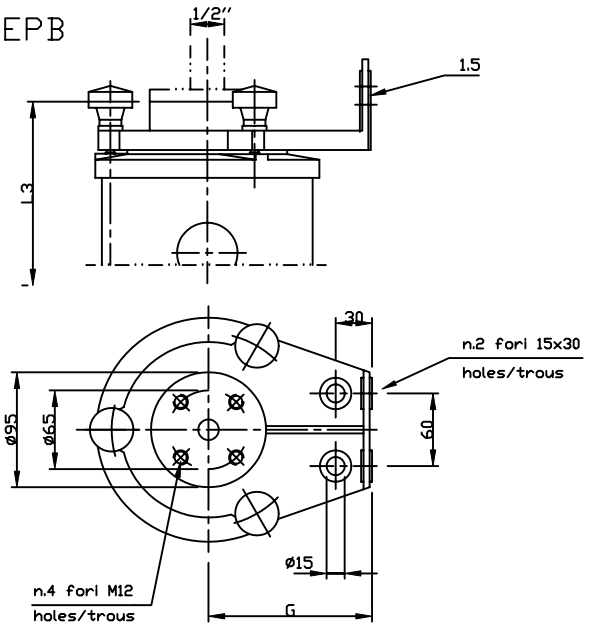
Tipo
Type EPD

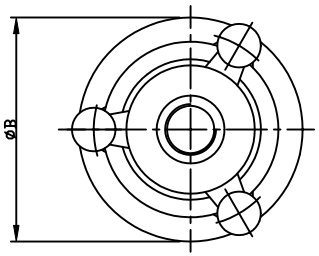


Tipo
Type EPF



Tipo
Type EPB





Tipo - Type	711	712	713	730	731	732	741	742	743	744	745	746	747
L1	115	150	230	245	360	425	355	455	505	565	665	765	880
L2	150	185	265	295	410	475	400	500	550	610	710	810	925
L3				245	360	425	350	450	500	560	660	760	875
øB	100			185			240						
øC1	1/2"			1"1/4			1"1/2			2"			
øC2	1/2"			1"1/2									
øD	95			150									
øE	65			100 / 110									
øF	14			14x19									
G				135			165						

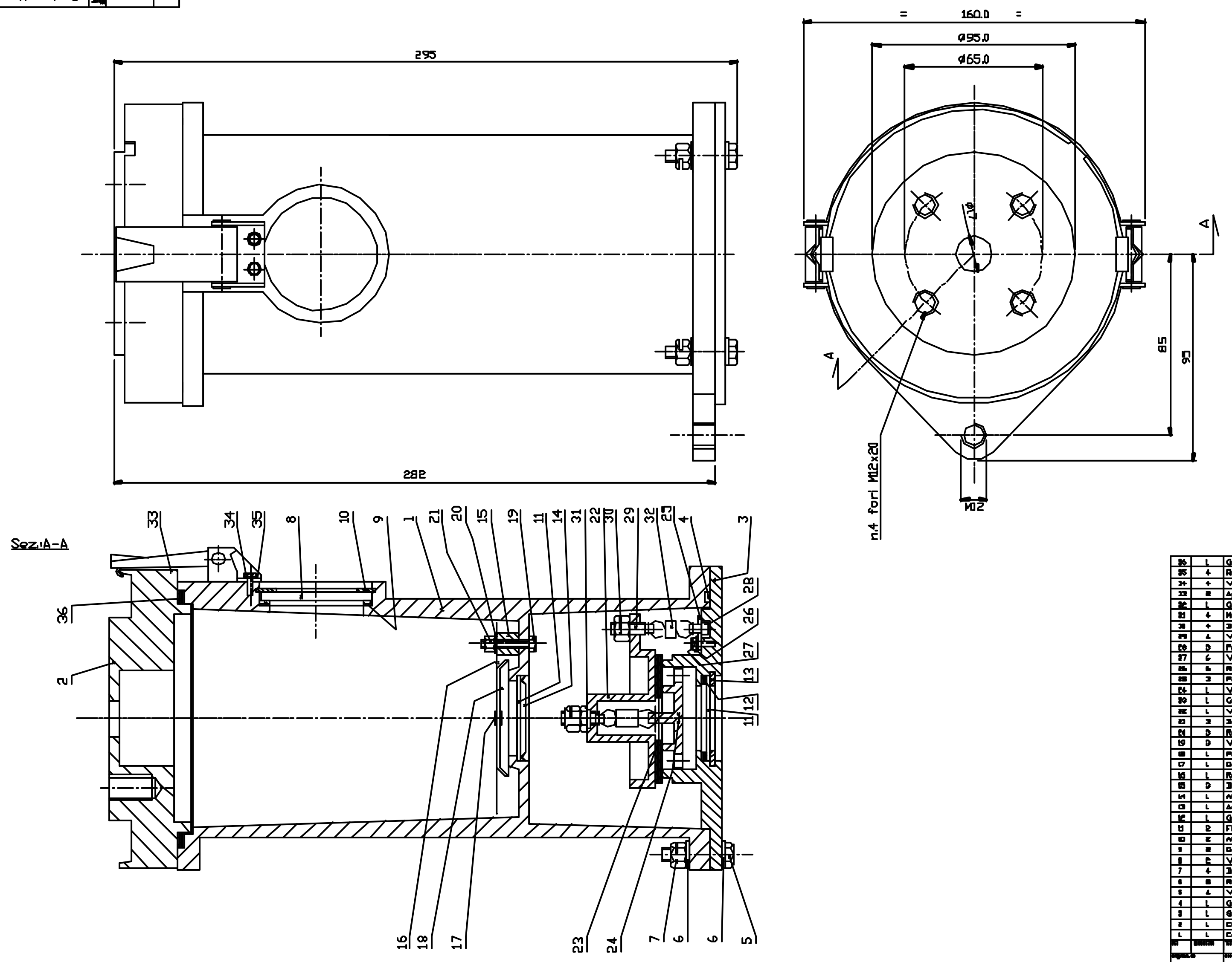
N.rev	Nota sulla revisione	Data	Signatura	Controllo

Rif.	Quantità	Titolo/Nome, designazione, materiale, dimensione, etc.			N. articolo/Riferimento	
Progettato da		Controllato da	Approvato da – data	Nome file	Data 01-01-97	Scala //

ETI ELETTRINDUSTRIA Srl
20032 CORMANO ITALY

Titolo/Nome
ESSICCATORI D'ARIA - AIR BREATHERS - ASSECHEURS D'AIR
Serie: EP..700

Numero disegno 1.EP.700 | Modifica | Foglio



Pos.	Q.tà	Denominazione	Materiale	Codice
36	1	Guarnizione coperchio	[illegible]	1.D00.001
35	4	Rondelle elastiche UNI1751	Inox	RE D
34	4	Viti TE UNI5739	Inox	VTE M3X10
33	2	Agganciatore	Inox	[illegible]
32	1	Contrappeso	Ottone	1.D00.0[illegible]
31	4	Molla	Inox	1.D00.0[illegible] R1
30	4	Dadi EL36	Inox	M6 H136
29	4	Viti	Inox	[illegible]
28	3	Ferro	Inox	1.D00.0[illegible] R3
27	6	Vite TE UNI5739	Inox	M3x8
26	6	Rondelle elastiche UNI1751	Inox	D3
25	3	Piastrina	Inox	[illegible] R2
24	1	Valvola espirazione	Alluminio	1.D00.115
23	1	Guarnizione valvola	EPDM	1.D00.022
22	1	Valvola di aspirazione	Alluminio	1.D00.134
21	3	Dadi EL36	Ferro z.	M4
20	3	Rondelle piane UNI1749	Inox	Ø4
19	3	Vite TE UNI5739	Inox	M4x25
18	1	Parapolvere	Alluminio	[illegible]
17	1	Dischetto	Ottone	[illegible]
16	1	Retina	Ferro z.	1.D00.110
15	3	Distanziali	Ottone	1.D00.0[illegible]
14	1	Anello seeger	Ferro	Z.J40
13	1	Anello seeger	Inox	J40
12	1	Guarnizione OR	NBR	OR3187
11	2	Filtro porol	Bronzo	[illegible]
10	2	Anello seeger	Inox	J32
9	2	Guarnizione OR	NBR	OR3150
8	2	Vetro finestra	Acrilico	[illegible]
7	4	Dadi EL36	Inox	M6 [illegible]
6	8	Rondelle piane UNI1749	Inox	Ø6
5	4	Vite TE UNI5739	Inox	M6x30
4	1	Guarnizione OR	NBR	OR4487
3	1	Supporto valvole	Ottone	1.D00.0[illegible]
2	1	Coperchio	Alluminio	[illegible]
1	1	Corpo	Alluminio	[illegible]

ETF-D
Assieme di montaggio
Data: 28/07/99
N. disegno: 1.B1D.4D
Formato: A

Designation des pieces