Formula Air
Supporting your performance

Compact cartridge filter

CFL

Maintenance manual (EN)

As of 2019 - V1.0-2021

Content

1. Introduction

This manual cannot be reproduced, even partially, without prior written consent by Formula Air Group. Every step of the filter range has been deeply analyzed by Formula Air Group in the expected area during the design, construction, and user manual creation. However, it is understood that nothing can replace the experience, training and good sense of those professionals who work with the device.

Ignoring the cautions and warning from the present user manual, using improperly parts or the whole device supplied, using unauthorized spare parts, manipulating the device by non-qualified personnel, violation of any safety norm regarding design, construction and use expected by the supplier, exempt Formula Air Group from all responsibility in case of damages to people or properties.

Formula Air Group does not take any responsibility for the non-observance of the user about the preventive safety measures presented in this user manual.

Failure to comply with the requirements of the user manual or incorrect use of the filter during operation can lead to the damage of the filter and improper functioning of the filter itself. This will result in termination of the warranty on the item and will release the manufacturer from any liability.

Warranty

Regarding to the device's warranty, see the sales general condition.

Attention !

All drawings and references contained within this user manual are non-contractual and are subject to change without prior notice at the discretion of the Formula Air Group and its partners.

1.1. EC- declaration of incorporation

EC-Declaration of Incorporation for Partly Completed Machinery

Machinery Directive 2006/421EC Annex IIB

The undersigned manufacturer and authorized for the elaboration of technical documentation for partly completed machinery and by due request hand over the technical dossier to the national authorities :

Manufacturer: v.Aa.Gram A/S

Klintevej4,6100Haderslev,Denmark

Tel.:+457452 30 75,Fax:+45745301 64

The undersigned hereby declare that:

Partly completed machinery: Cyclone filter

Name: Gram

Type: CACF 39
CACF 52
CACF 52 H
CACF 65
CACF 78 H
CACF 91
CACF 104 H
CACF 117
CACF 130 D
CACF 130 H
CACF 182 D
CACF 182 H
CACF 234 D
CACF 234 H
CACF 260 DH
CACF 364 DH
CACF 468 DH

Was manufactured in conformity with the following essential health and safety requirements in the Machinery Directive 2006/42/EC Annex1:

The following harmonized standards were used:

ISO 14121
EN/I.S013857
EN60204

The partly completed machinery may not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with all relevant health and safety requirements in the Machinery Directive 2006/42/EC and other relevant Directives

Position : XX
Name : XX

Company : V.Aa.Gram A/S

Date : XX.XX.XXXX XXX

(Signature)

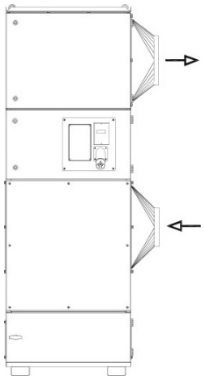
2. General description

Filterline type CFL is a complete filter unit equipped with fan type VE/RV.

Unit is used for separation of dust from process air.

Only ATEX-Zone XX-marked unit may be used in explosion dangerous environments.

3. Functioning



Process air is led in at (A), where after the air passes the pre-separator and filter elements.

Air leaves the unit after the fan at (B).

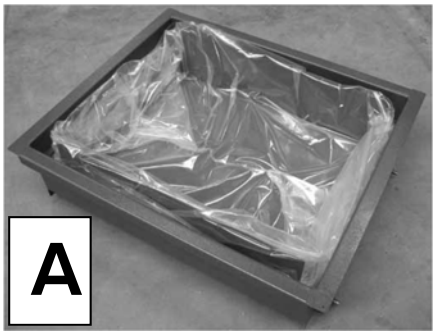
Filtered material is collected in an emptyable dust container.

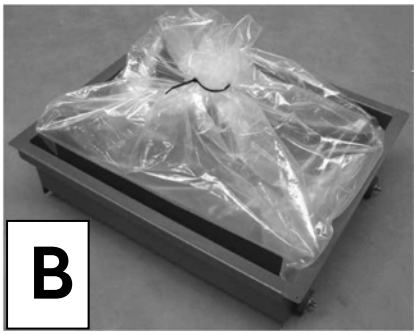
3.1. Daily maintenance

Differential pressure (display) or watch is monitored daily. The pressure may not exceed 2,300 Pa. However, with filter elements G115A and G116A, this may be increased up to 3,000 Pa.

Dust container is emptied according to need, but may never be filled more that max. 75% of its volume.

At work with dangerous dust a plastic bag is placed in the dust container. The surplus plastic bag is turned over the dust container (point A). When the bag must be removed, it is straightened out in its full length and is closed with 1 plastic strip, before it is taken out of the dust container to be destroyed according to governmental demands (point B). Sack must always be mounted, when a relief hose is mounted.





4. Unit condition during operation

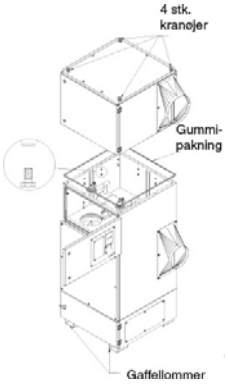
All filter doors must be closed and secured. The dust container must be mounted and locked correctly during all steps of filter operation.

5. Intentional / unintentional application

Filter line type CFL may not be used for the extraction of burning or glowing substances, like e.g. cigarettes, matches, metallic dust or chips, paper, cleaning wipes etc. Unit may not be used for larger chips and the like. For this a cyclone type CY is used as a coarse separator.

Repairs may only be performed with original spare parts.

6. Mounting



Filter line type CFL 26 and CFL 52 are delivered completely assembled. Filter line type CFL52H and CFL 104 are delivered on 2 pallets.

Filter part is lifted by fork pockets to an even, stabile surface.

Fan part is lifted into place on top of the filter part by crane lifting points and straps.

The two parts are assembled through the tank area with the included bolts. Check that the seal is undamaged. All bolts must be mounted.

6.1. Electrical connections

6.1.1. Electrical connection for Filter type CFL without fan

Electrical connection must be made by the CE-plug on the unit front side. The following must be connected:

- 1 x 230 V, 50 Hz
- 1 x 0
- 1 x surface

Electrical connection must be active and connected after fan stop for at time of min. 5 cleaning cycles for all valves in unit. Control box diagram is enclosed.

Unit may not be used without this connection.

6.1.2. Electrical connection for Filter type CFL with fan

Electrical connection must be made by the CE-plug on the unit front side. The following must be connected:

- 3 x 400 V, 50 Hz
- 1 x 0
- 1 x surface

Unit may not be used without this connection.

At units that are delivered in two parts the cable from the motor protection must be connected with motor according to diagram in motor connection box.

CFL 52/RV 45, CFL 104/VE 7500, CFL 52H/RV 45, CFL 104/RV 45 and CFL 104/RV 50 are equipped with star / delta starter. Pilot cable and power supply cable from the total control box are connected to star / delta starter box, as the enclosed diagram in the back shows.

Electrical connection must be active and connected after fan stop for at time of min. 5 cleaning cycles for all valves in unit. Control box diagram is enclosed.

Fan type	kW	AMP. current	Working current consumption	Start current consumption	Motor starter type
VE 2200	2.2	16A	4.76	33.37	Direct hand-operated motor protection
VE 3000	3.0	16A	6.12	45.75	Direct hand-operated motor protection
VE 4000	4.0	32A	7.79	48.00	Direct hand-operated motor protection
VE 5500	5.5	32A	10.45	72.80	Direct hand-operated motor protection
VE 7500	7.5	32A	14.25	99.75	Automatic star-delta starter
RV 35/2S	5.5	32A	10.45	72.80	Direct hand-operated motor protection
RV 35/3	5.5	32A	10.45	72.80	Direct hand-operated motor protection
RV 45	7.5	32A	14.25	99.75	Automatic star-delta starter
RV 50	11.0	32A	20.70	144.80	Automatic star-delta starter

6.1.3. Electrical connection for Filter type CFL with fan / without motor starter

Electrical connection for motor on right unit side. Motor must be protected against overload.

At use of motor protection, this may never reconnect automatically after thermal failure. This must be done manually.

The electrical connections of the fan must be in accordance with EN 60204 and the engine cover plate.

At frequency regulation, a bimetallic sensor should be found in the motor (not a requirement).

Further the installation must be fitted with a hand-operated lockable supply switch for use at repair and service.

Connection :

- 3 x 400 V, 50 Hz
- 1 x jord
- Possible bimetallic sensor for frequency converter.

Connection for differential pressure control type ECO-S mounted on filter unit front side : 1 x 230V AC, 50Hz. Unit may not be used without this connection.

Electrical connection must be active and connected after fan stop for at time of min. 5 cleaning cycles for all valves in unit. Control box diagram is enclosed.

6.1.4. Electrical connection for REM units

Electrical connections and compressed air connection are connected to overhanging cables and hoses. Be aware of valve voltage!

6.1.5. General for Filterline type FL with fan

Supply voltage must be disconnected, before fan impeller is checked.

BEFORE start-up the fan impeller must be rotated manually by hand to check, whether it runs freely and do not hit the cabinet.

If fan impeller hits the cabinet, it can be due to fan damages or motor has moved during transport.

If it is due to damages, please contact FORMULA AIR for rectification of it.

The sense of rotation must be checked. This is done through the front door or top lid on fan module, where cooling wing sense of rotation must be in accordance with the arrow on the cooling plate.

Check for vibrations at first fan start, where fan impeller rotates correctly. If there are any abnormal vibrations, stop immediately fan operation and contact manufacturer. Hereafter it will be determined, what should happen.

Electrical connection must be active and connected after fan stop for at time of min. 5 cleaning cycles for all valves in unit.

6.2. Compressed air connection

The compressed air connection must give min. 5.5 - max. 6.0 bar dry compressed air. The connection is made at the end of the header tank. A reduction valve and water separator (½") can be advantageous.

DO NOT FORGET compressed air at possible after-cleaning.

6.3. Ducting connection

The ducting connection must be made with approved ventilation pipes.

For ATEX-units, it must be secured that piping cannot be blown away at a possible explosion.

6.4. Adjustments

Every filter unit is dimensioned for a certain workload which may not be exceeded as it would result in an improper function of the unit or a premature lifespan.

The unit is dimensioned following the following criteria's :

Maximum air volume

Type of dusts

Type of fan :

Type of cartridges : xx cartridges G1 xx

Total surface area: xx m²

6.5. Differential pressure control

Filter element cleaning takes place by differential pressure control type ECO-S, which is programmed at the factory.

Be aware that the CFL unit with differential pressure control cleans as required.

Unit must always clean at exceeding of differential pressure of 0.9kPa (900 Pa).

Standard opening time for valve may not be changed from standard setting (0.24 sec).

Be aware that the pressure tanks in clean air chamber must be able to be filled between every shot.

Control is automatically operational upon receipt. Display shows first differential pressure when it is at minimum 200 Pa.

Instructions for differential pressure control type ECOMATIC-S - see in the back of these instructions.

6.6. Alarm on EN 15012-1 units

When a differential pressure is created over the filter elements that is larger than allowable, a yellow flashing light (ø57mm) on the control box will light up.

If an alarm is requested at the affected work places, yellow flashing lights can be connected parallel with the mounted light.

7. Noise damping

Average noise level excluding cleaning shot cycles : more or less 75 dB (A).

Average noise level including cleaning shot cycles : more or less 85 dB (A).

7.1. Noise data (Laeq [db]) for units with fan

Filter type	Operation without cleaning	Operation with cleaning	Without operation with after-cleaning
CFL 26/VE 2200	72	8	85
CFL 26/VE 3000	73	8	85
CFL 26/RV 35/1	79	8	85
CFL 26/RV 35/2	79	8	85
CFL 26/RV 35/3	79	8	85
CFL 26/HV 65	83	8	85
CFL 52/VE 4000	73	8	85
CFL 52H/VE 4000	73	8	85
CFL 52/VE 5500	75	8	85
CFL 52H/VE 5500	75	8	85
CFL 52H/RV 45	80	8	85
CFL 104/VE 5500	75	8	85
CFL 104/VE 7500	76	8	85
CFL 104/RV 45	80	8	85
CFL 104/RV 50	80	8	85

8. Maintenance

Filter unit must be maintained 1 to 2 times a year to work optimally.

Differential pressure settings are checked (see instructions for differential pressure control type ECOMATIC-S in the back of these instructions). Differential pressure may not exceed 2,300 Pa (3,000 Pa with filter material G115A and G116A) at max. set operation point for air volume.

Check that all valves shoot correctly. If the valves are checked with open clean air chamber, you must use ear defenders for 95-110 dB(A) (SNR=35).

With electrical supply removed check the tightness of pipe connections, tank and valves. Tank is emptied for water through connection.

When compressed air is disconnected, check clean air chamber for possible dust.

If dust occurs, check filter sealing and filter elements for tightness between elements. Sealing at doors and dust container are checked for damages - possible defects are corrected, of if necessary seals are replaced.

At filter defects, tight filters that cannot be washed (G105 and G104A), or worn-out filters must be replaced. Use protective clothing, gloves, and respirator with filter adjusted according to work place dust type.

Filter cartridge durability is variable, depending on circumstances such as filter stress, dust type and volume. Filter cartridges get blocked with time due to very fine particles that attach themselves to the fibers.

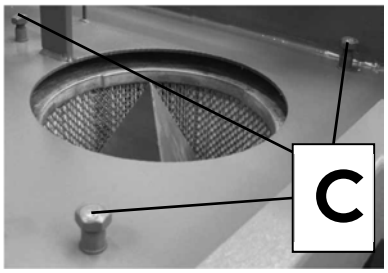
Also be aware whether compressed air operates with defect pressure reducing valve with water separator. This means an internal dirtying of filter cartridges. Under normal circumstances there will be a certain dust layer on the outside of cartridge, even after compressed air cleaning.

This layer increases the filtration capacity and the differential pressure.

If noticeable capacity reduction occurs, we recommend cartridge cleaning with high pressure cleaner (see point 8.2).

Every filter cartridge is mounted with bayonet grip attached with 3 bolts in filter mounting plate.

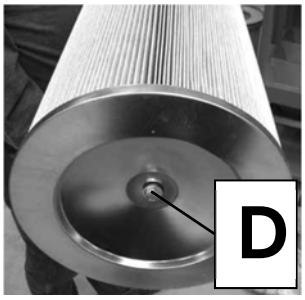
8.1. Cartridge replacement

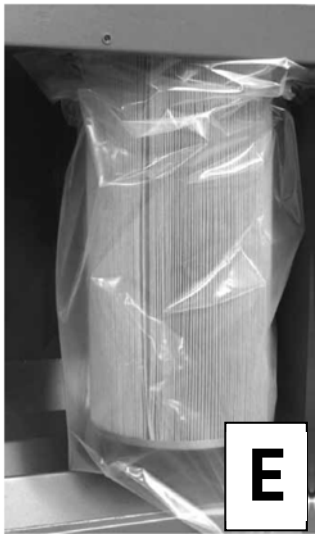


Every electric supply must be disconnected as well as pressure tank emptied for air before filter replacement from clean air side.

Side doors to clean air and row air chambers are dismounted. All filter bolts in clean air chamber are screwed completely down (point C).

Bolts for filter cones are removed (point D). Now the filter cartridges can be removed.



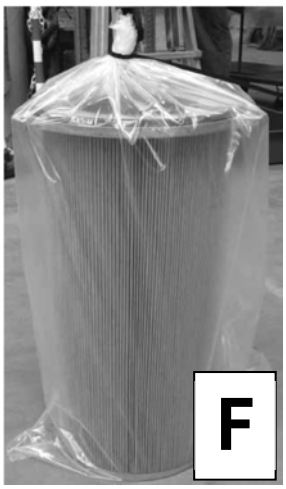


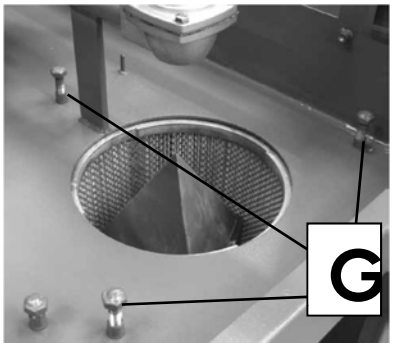
This is done by guiding a plastic bag up around the filter cartridge from beneath (Point E), gripping the cartridge and turning it clockwise until it is released from the bolts.

Filter cartridges are removed from the filter units, filter cone is removed, and plastic bag is closed with 1 plastic strip (point F).

The new filter cartridges (check sealing) are hung on the filter bolts. They are fastened hereafter (point G). Doors are mounted.

Certificated units W2 and W3 must use plastic bag and strips at filter change. Used filter elements must be disposed of according to governmental demands.





8.2. Cartridge cleaning

The filter cartridge type G103 can be cleaned, after having been dismounted from the filter as described in the procedure point 8.1. These can be cleaned with a high pressure cleaner with a maximum temperature of 50°C. Soap WITHOUT detergent can be used if needed.

The fitter cartridges G104 and G105 **CANNOT** be cleaned.

Place the cleaner nozzle at a distance of 30 to 50 cm from the cartridge (on WIDE spread). Only clean the outside of the cartridge.

The cartridges must be completely dry before reinserting them in the filter unit.

New filter elements must in dimension be equal to original cartridge. Filter cloth quality must be according to filter job.

Original type of filter elements can be seen on machine marking.

8.3. Jet valve exchange / repair

Exchange may only take place, when supply and compressed air are not connected to unit, and compressed air tank is emptied by compressed air connection.

Coil, membrane and valve top are exchangeable by disconnecting electric plug, where after 4 pcs. M6-bolts are loosened and new coil and membrane are mounted.

8.4. Fan maintenance and repair

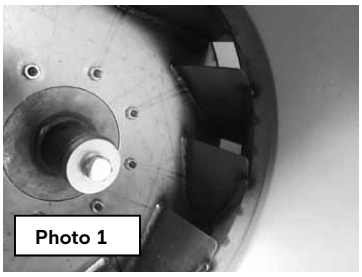


Photo 1

Fan can be maintained by front door or top lid.

At service maintenance personnel must be aware of hot surfaces - especially the electric motor.

At service take care that fan impeller does not rotate (check motor cooling impeller), even though power is cut off.

Fan maintenance personnel must be aware of the dangers with fan service and those substances that the fan possibly transports.

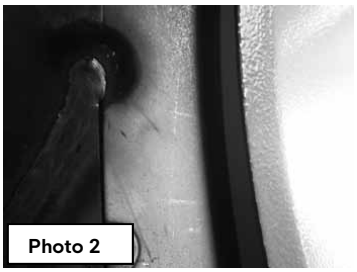


Photo 2

During service you must be aware of the fact that the fan impeller can be very sharp and can rotate in connection to motor.

Below you find those points that have to be checked at service.

At service please check the following:

- Whether fan impeller rotate correctly according to rotation arrow marking.
- Whether fan impeller is in balance during operation.
- Check whether fan impeller is dirty (this can cause unbalance), if yes:
- remove it through washing, brushing or scraping. Be careful: do not damage impeller.
- Check whether no desired foreign matter is present in fan impeller or housing, if yes:
- remove it and find cause.
- Check whether electrical connection is intact.
- Clean on and around fan.

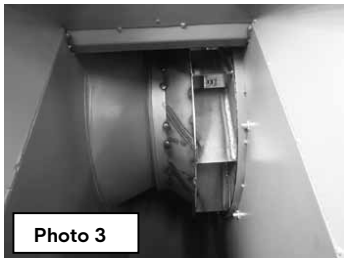


Photo 3

8.5. Exchange of motor or fan impeller

At disassembling you must take care that fan wheel is not rotating (check motor cooling impeller) and that current is disconnected and dismounted.

Personnel that disassembles fans must be aware of the dangers at fan disassembling, where dangerous substances or gases can be present in fan housing.

Motor flange, motor and impeller are taken off fan housing through top lid on filter line type CFL. Wheel locking screw is loosened. Fan impeller can be pulled off and replaced by new original wheel.

If motor must be changed, it is loosened from motor flange. Electro motor may only be exchanged with original type. After ended service all bolts and washers must be mounted again and tightened up.

Always use suitable lifting gear, hand gloves and suitable personal protection.

8.5.1. Fine tuning the impeller in the fan housing (only on models RV & HV)

The space between the inlet of the fan housing and the inlet of the impeller of the fan must be uniform. (Photo 1 & 2, page 10)

This is achieved by tightening the bolts of the motor onto the fan chair. Check that the impeller turns freely without friction on the housing once everything is tightened.

At the same time, make sure that the back of the fan impeller hasn't moved too much forward towards the inlet. (Photo 3, page 10)

8.6. Irregularities

In case of unbalanced fan impeller we recommend that you send the impeller (motor + motor flange and fan wheel as complete unit) to our factory for balancing. Do not forget to inform FORMULA AIR that you request us to balance the fan impeller.

Submitting requires a case number, before we can handle the case.

Irregularities can normally be found through changed noise picture and changed pressure.

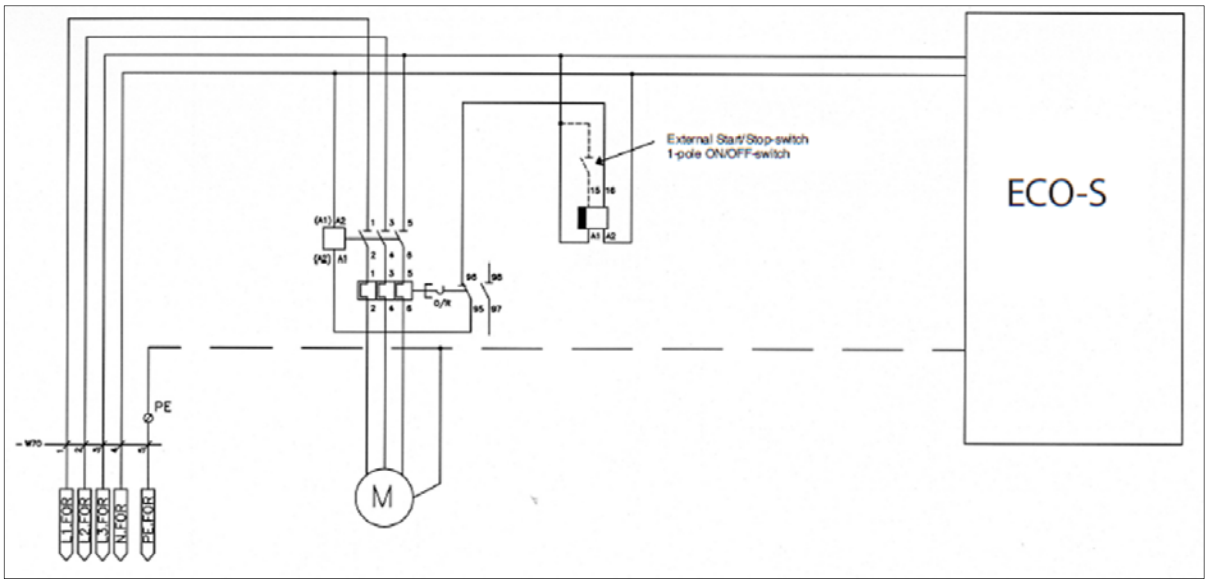
Changed pressure can be seen directly as alarm on statutory control device (valid for Denmark) for process ventilation units.

9. After maintenance

After the maintenance operations are completed, make sure that all electrical and pneumatic connections are established.

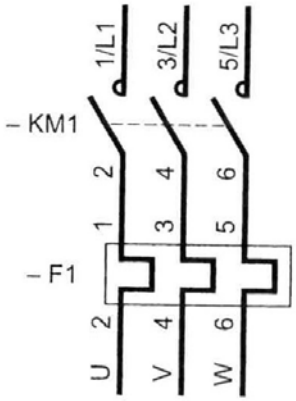
Test and control the filter unit before operation.

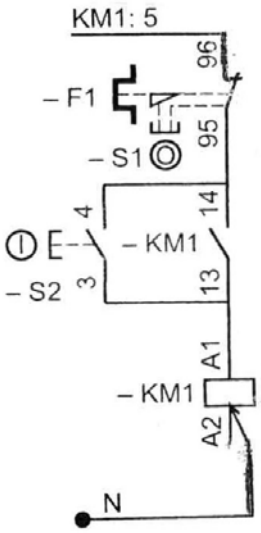
10. Diagram for FL/VE with OFF-DELAY

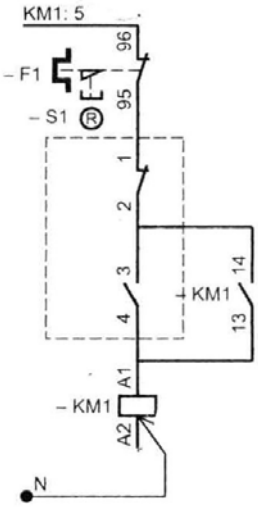


11. Diagram Schneider electromagnetic motor protection

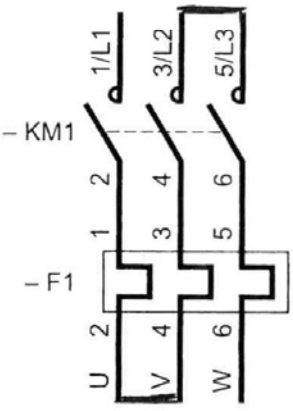
3x400



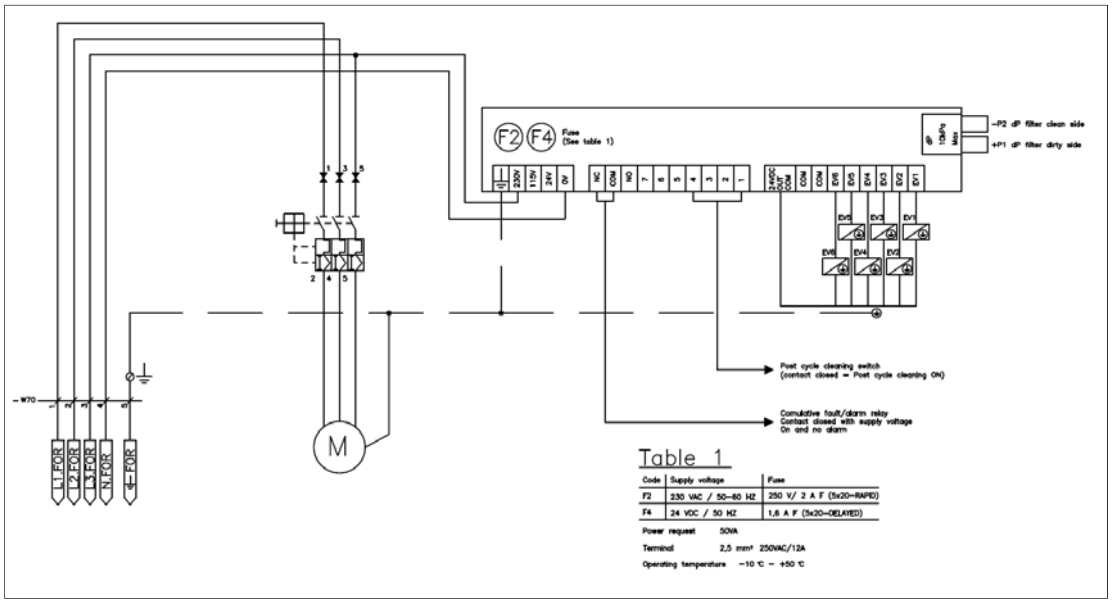




1x230V



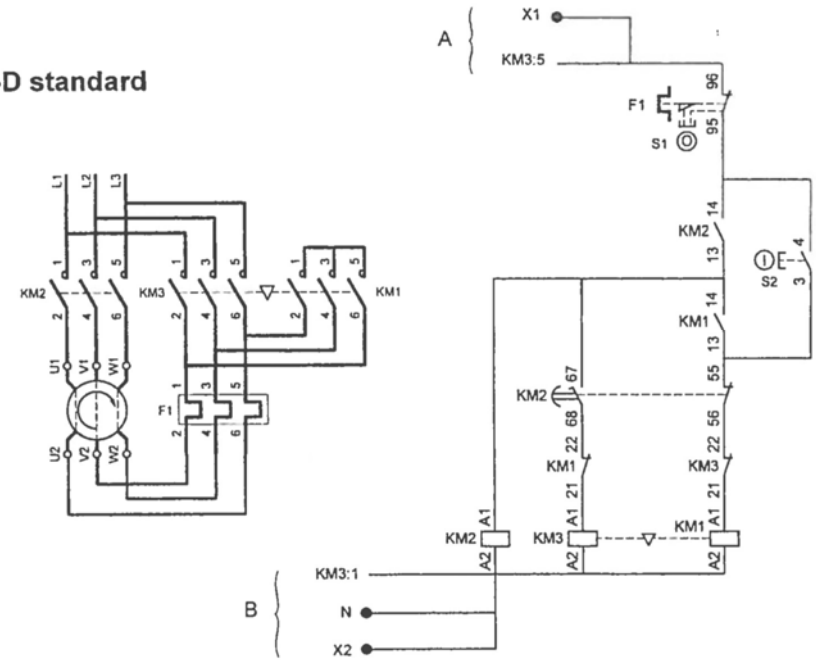
12. Diagram for manual motor protection on FL26/VE2200 & FL104/VE5500



1. Diagram for Star/Delta starter on CFL 52H/RV 45, CFL 104/RV 45, CFL 104/RV 50 and CFL 104/VE 7500

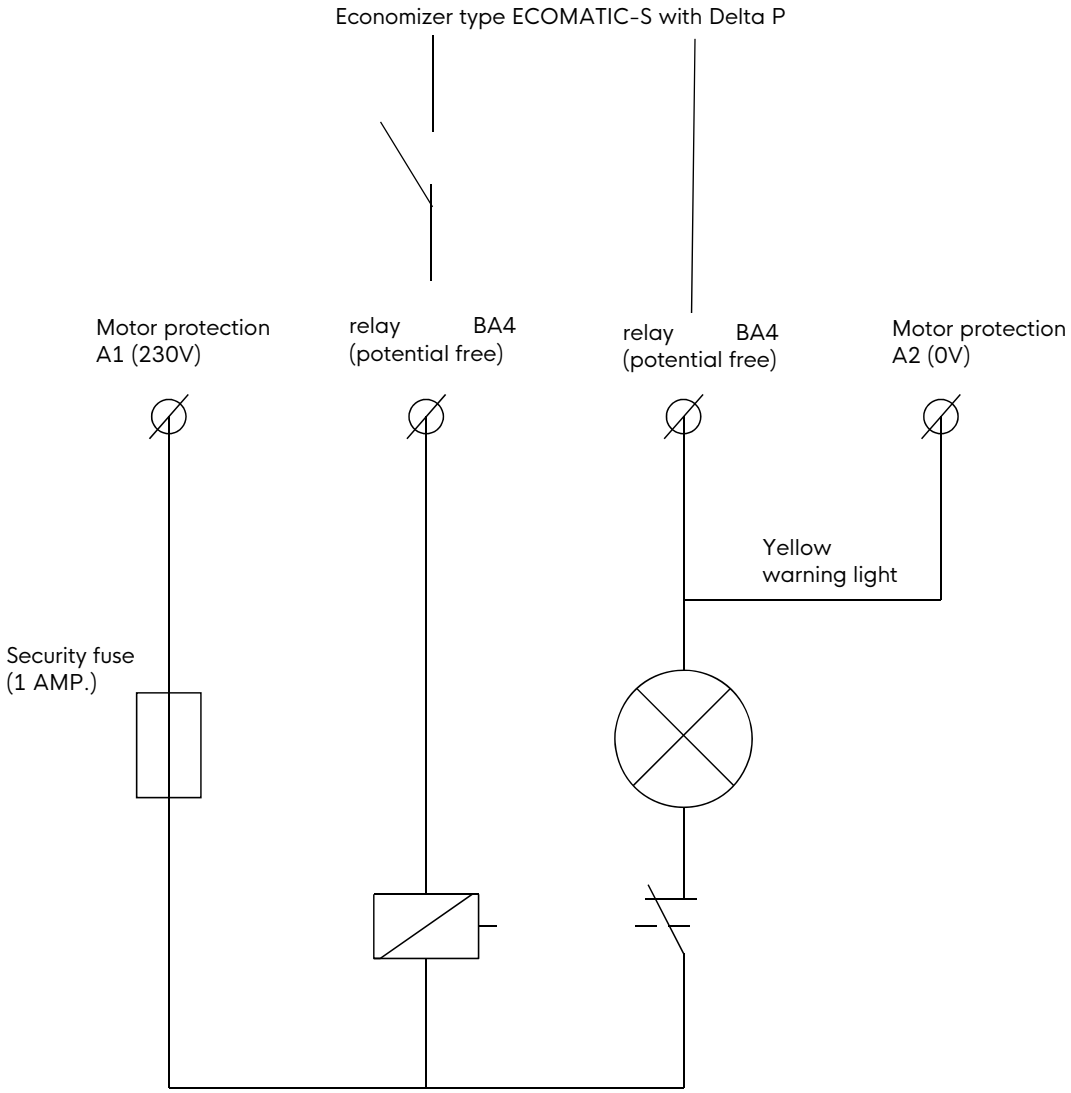
LE3-D	3 ~ 50/60 Hz AC3 θ ≤ 40°C					
	220 V	380/400 V	415 V	440 V	LRD●●	a M (A)
	kW	kW	kW	kW		
09	1,5	3	3	3	08	8
	3	5,5	5,5	5,5	12	12
	4	7,5	7,5	7,5	14	20
12	5,5	11	11	11	21	25
18	11	18,5	22	22	32	40
35	15	30	30	30	35	63

LE3-D standard



Coil voltage		Connection A	Connection B
220 V, 230 V, 240 V	LED-D09-D35	KM3 : 5	Terminal N
380 V	LED-D09-D35	KM3 : 5	KM3 : 1
Other voltages	LED-D09-D35	Terminal 1	Terminal 2

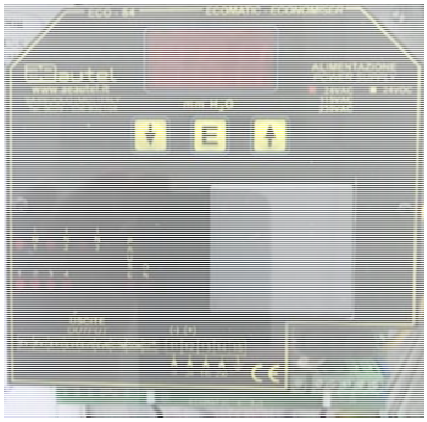
2. Diagram for yellow warning light connection



The required power for the motor protection (A1 & A2) can only be obtained when the fan is running with 230 V AC & 380 V AC.

3. Differential pressure control - type ECOMATIC-S

3.1. General description



Economisers in the ECOMATIC-S range are digital sequential timers with built-in differential pressure switches.

The versions ECOMATIC-S4, ECOMATIC-S6, ECOMATIC-S12, ECOMATIC-S20 and

ECOMATIC-S32 enable control of up to 4, 6, 12, 20, and 32 solenoid valves respectively. The version ECOMATIC-S64 is equipped with an expansion card with 32 outputs, expanding control capacity to up to 64 solenoid valves. In the same way, the model ECOMATIC-S96 is equipped with 2 expansion cards for capacity expansion up to 96 solenoid valves.

In all versions there is a display with 3 digit that can display the differential pressure unit of programmed (tens Pa, mmH2O, mbar, kPa and mmHg) or the number of the cleaning valve; the three keys also enable programming of parameters on the instrument according to personal requirements including, pause time, operation time, post-cleaning time (or number of cycles) and washing start and end pressure, postcleaning pressure, alarm pressure and operation mode (automatic/manual) .

All models are equipped with LEDs to display activation of outputs, pause phases and power on, the power supply presence, the post-cleaning status, and so on and so on.

The controllers with AC power supply are able to control both electronic valves with AC input and electronic valves with 24VDC. The output stage is made up of triac with on/off to zero-crossing to reduce noise.

Each model is supplied in polycarbonate enclosures with transparent lids and IP56 protection rating.

On demand, the ECOMATIC-S instruments can be provided of an ACTIVE analogical output proportional to the pressure read by the sensor. The pressure interval allowed is programmable through two parameters: "P14" e "P15".

3.2. General features

Voltage:	24 Vac, 115 Vac, 230 Vac +/- 15%, 50-60Hz.
Fuses ECO-S 4/6, 12:	F2 general fuse 2A 5x20 rapid F4 electro-valves power supply fuse 1.6A 5x20 delayed
Fuses ECO-S 20/32/64/96:	F1 general fuse 2A 5x20 rapid F2 electro-valves power supply fuse 1.6A 5x20 delayed
Working temperature:	-10 / +50 °C;
Connection:	Through screw terminals boards
Max Adsorbed Power:	50VA.
Input ECOMATIC-S 4/6/12/20/32/64/96:	n° 1 inputs opto-isolated
Relay Output ECOMATIC -S 4/6/12/20/32/64/96:	n° 1 relay 2A resistant load 115Vac
Relay Output ECOMATIC -S 20/32/64/96:	n° 4 relay 2A resistant load 115Vac
Electro-valves Output:	outputs triac with activation/deactivation *zero-crossing* 24, 115 o 230 Vac and 24Vdc with max. current 2A.

3.3. Technical features timer

Standard Pause Times:	Duration: 1- 999 sec	Precision: 0,1 sec
Standard Working Times:	Duration: 0.03 - 9.99 sec	Precision: 0,01 sec
Post Cleaning Times:	Duration: 1 - 999 sec	Precision: 0,1 sec

3.4. Technical features Active Analog Output (optional)

3.4.1. Current output

Visualization range : From 4.0 to +20.0 mA (standard) / From 0.0 to +20.0 mA (optional)

Precision : +/- 0.1 mA, +/- 1 digit.

Maximum load allowed : 500 Ohm

3.4.2. Voltage output

Visualization range : From 0.0 to +5.0 V (optional) / From 0.0 to +10.0 V (optional)
Precision : +/- 0.1 V, +/- 1 digit.
Minimum load allowed : 1K Ohm

3.5. Dimensions and features of ECOMATIC-S box

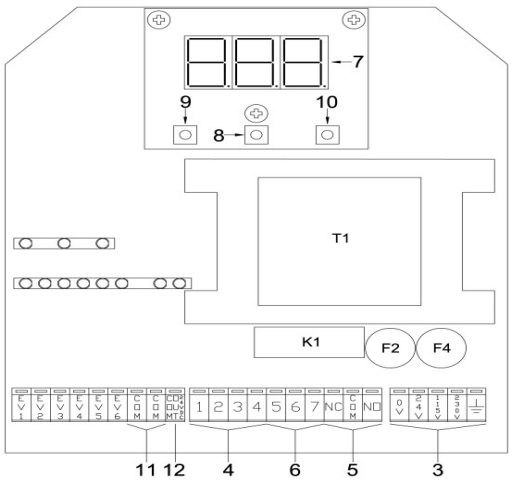
ECOMATIC-S is enclosed inside a box with IP56 protection rating.

ECOMATIC-S 4/6	Internal Dim. BxHxP (mm)	190 x 140 x 70
	Ø max allowed holes	37 mm
	Top screws (n. and type)	4 isol. Zipper pouncable
ECOMATIC12-S	Internal Dim. BxHxP (mm)	240 x 190 x 90
	Ø max allowed holes	37 mm
	Top screws (n. and type)	4 isol. Zipper pouncable
ECOMATIC-S 20/32/64/96	Internal Dim. BxHxP (mm)	380 x 300 x 120
	Ø max allowed holes	48 mm
	Top screws (n. and type)	4 isol. Zipper pouncable

3.6. Layout – Legend Board ECOMATIC-S

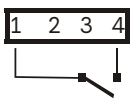
3.6.1. Layout ECOMATIC-S 4/6

1 - F2, Power supply protection fuse
2 - F4, Electro-valves protection fuse
3 - Power supply terminals



4 - Input Contacts terminals

Terminals 1, 4: Post-cleaning input;



Input open: no-activated post-cleaning;

Input close: activated post-cleaning;

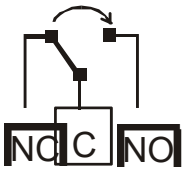
5 – Relay output terminals:

Terminals NC, COM, NO: Relay contact 1 (K1);

Terminals NC: Contact N.C.

Terminals COM: Common.

Terminals NO: Contact N.O.



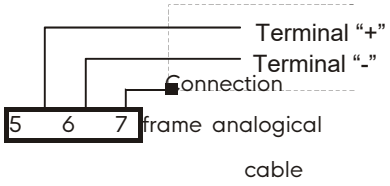
6 – Auxiliary outputs terminals (optional, used with expansion boards):

Terminals 5,6,7: in case of terminals for expansion board 4-20mA;

Terminal 5: positive terminal for analogical output board;

Terminal 6: negative terminal for analogical output board;

Terminal 7: connection frame analogical cable (optional, but advised);

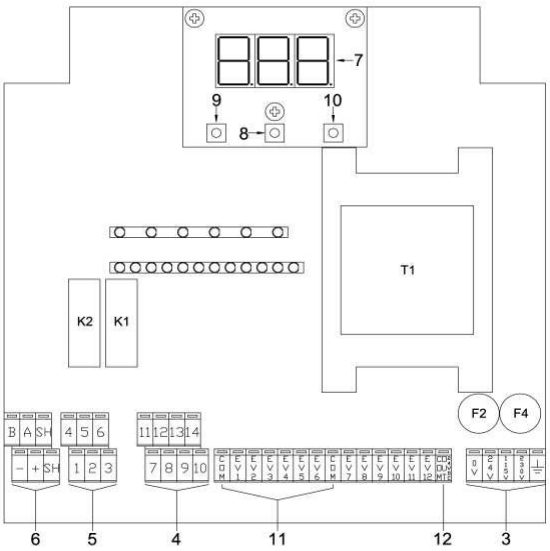


Note: the analogical output is an ACTIVE type.

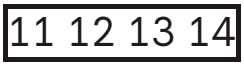
7 - Display 7 Segments 3 DIGIT;
8 - Enter Key (E)
9 - Decrease Key (↓)
10 - Increase Key (↑)
11 – Common terminal by free contact for electro-valves
12 - Common terminal with + 24Vdc for 24Vdc electro-valves

3.6.2. Layout ECOMATIC12- S

1 - F2, Power supply protection fuse
2 - F4, Electro-valves protection fuse
3 – Power supply terminals
4 – Input Contacts terminals

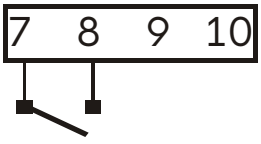


Terminals 7, 8: Post-cleaning input;



Input open: no-activated post-cleaning;

Input close: activated post-cleaning;



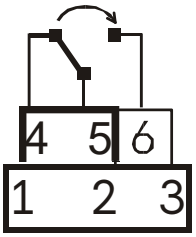
5 – Relay output terminals:

Terminals 4,5,6: Relay Contact 1;

Terminal 4: Contact N.C.

Terminal 5: Common.

Terminal 6: Contact N.O.



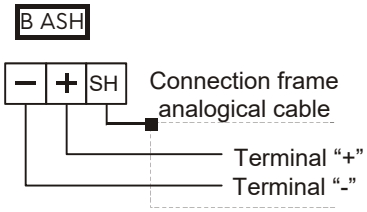
6 – Auxiliary outputs terminals (optional, used with expansion boards):

Terminals -,+, SH: Terminals for expansion board analogical output;

Terminal -: negative terminal for analogical output board ;

Terminal +: positive terminal for analogical output board;

Earth Terminal: connection frame analogical cable (optional, but advised);

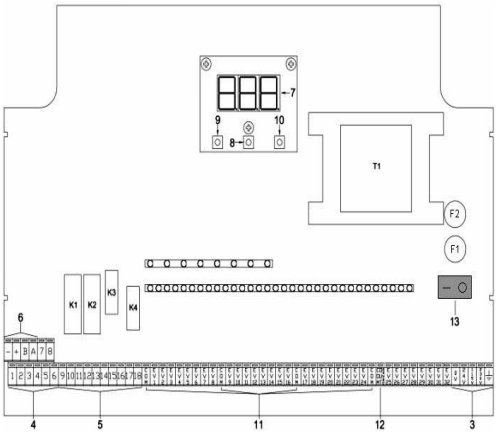


Note: the analogical output is an ACTIVE type.

7 - Display 7 Segments 3 DIGIT;
8 - Enter Key (E)
9 - Decrease Key (↓)
10 - Increase Key (↑)
11 – Common terminal by free contact for electro-valves
12 - Common terminal with + 24Vdc for 24Vdc electro-valves

3.6.3. Layout ECOMATIC-S 20/32/64/96

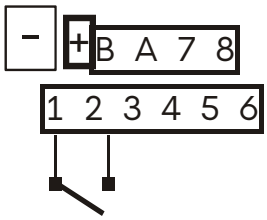
1 - F1, Power supply protection fuse.
2 - F2, Electro-valves protection fuse.
3 – Power supply terminals
4 – Input Contacts terminals:



Terminals 1, 2: Post-cleaning input

Input open: no-activated post-cleaning

Input close: activated post-cleaning



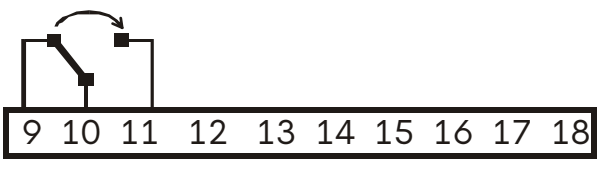
5 - Relay output terminals:

Terminals 9,10,11: Relay contact 1 (K1)

Terminals 9: Contact N.C.

Terminals 10: Common.

Terminals 11: Contact N.O.

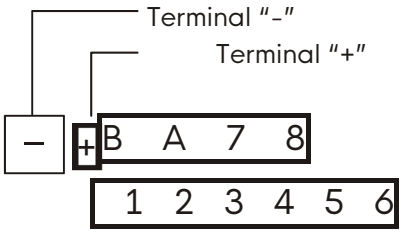


6 - Auxiliary outputs terminals (optional, used with expansion boards):

Terminals -, +, SH: Terminals for expansion board analogical output

Terminal - : negative terminal for analogical output board

Terminal + : positive terminal for analogical output board



Note: the analogical output is an ACTIVE type.

7 - Display 7 Segments 3 DIGIT
8 - Enter Key (E)
9 - Decrease Key (↓)
10 - Increase Key (↑)
11 - Common terminal by free contact for electro-valves
12 - Common terminal with + 24Vdc for 24Vdc electro-valves
13 - On/Off Power Switch

3.7. Layout – Legend Delta-P Board ECOMATIC-S

In this device, you can choose the preferred measurement' s unit through a P5 programmable parameter. Below are listed the maximum fields of reading pressure:

Measurement unit: **Measurement range**:	dPa from -99 to +999
Measurement unit: **Measurement range**:	mmH_2O from-99 to +999
Measurement unit: **Measurement range**:	mbar from-9.9 to +99.9
Measurement unit: **Measurement range**:	Kpa From-0.99 to +9.99
Measurement unit: **Measurement range**:	mmHg from-7.5 to +75.0
Precision:	+/- 1% F.S. , +/- 1 digit. Reference unit mmH_2O
Broken pressure:	0,5 bar (5000 mmH_2O).

3.7.1. Conversion Chart per Measurement units of pressure.

Equal to	mmH_2O	pascal	mbar	kpascal	mmHg
mmH_2O	1	9.8064	0.098064	0.0098064	0.07355592
pascal	0.101974	1	0.01	0.001	0.007500617
mbar	10.1974	100	1	0.1	0.7500617
kpascal	101.974	1000	10	1	7.500617
mmHg	13.5951	133.3224	1.333224	0.1333224	1

The temperature range of inlet gas to the pressure sensor is -40 ° C to +125 ° C. For values above or below it is necessary to provide cooling or heating gas.

3.8. ECOMATIC-S Power Supply

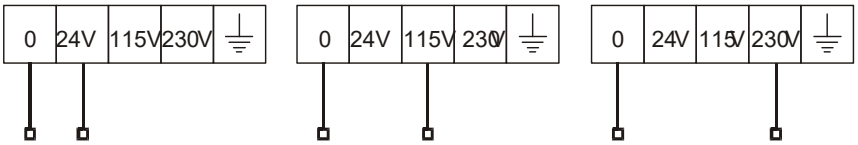
All the ECOMATIC-S models can have as power supply 3 different tensions 24 Vac, 115 Vac e 230 Vac.

CAUTION
Ensure that the power supply is disconnected before making or modifying cable connections.

The power supply has to be connected in this way (according to the chosen power supply).

3.8.1. ECOMATIC-S 4/6/12/20/32/64/96

Power supply terminals board



Power supply

0 24Vac 0 115Vac 0 230Vac

Note

- The power supply has to be sectioned *upstream* of the equipment.
- Both for the *economizers* and the *electro-valves* has to be done the earth connection.
- You have to use shielded cable, far from noise sources, like Inverter power cables and engines in general.

3.9. Electro-valves Connection Scheme

The solenoid valves are connected between output terminals 1 -2 ... - N and terminal C (common) which is connected to a suitable power supply via an external connection.

The controllers are equipped with more than one common terminal: obviously they are all interconnected and therefore do not require additional external connections.

According to the power supply given to the unit it is possible to use some types of electro valves. Here following the options:

- **Power supply 24 Vac**: it can be used **24 Vac** or **24 Vdc** electronic valves
- **Power supply 115 Vac**: it can be used **24 Vac**, **115 Vac** or **24Vdc** electronic valves
- **Power supply 230 Vac**: it can be used **24 Vac**, **115 Vac**, **230 Vac** or **24 Vdc** electronic valves

In case of controller's power supply with DC it is necessary to indicate it at the purchase order phase in order to adapt the circuit at this kind of output.

For the load's connection has to be done an external bridge connected according to the voltage of used electronic valves (to do the connection between the terminal C (common), and the power supply terminal, corresponding to the operating power of the electro valves). If you forget to do this connection, the electro valves will not be driven: the instrument will quickly scan all the outputs (the LEDs on the outputs will be switched on for a short time, and the pause LEDs will quickly blink) without activating any electro-valve.

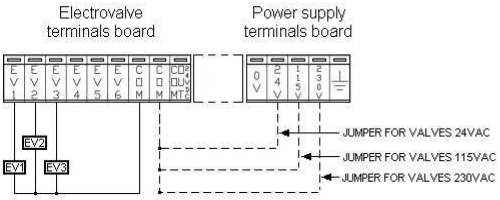
N.B. : In the case of electro valves with 24DC, the connection bridge for the power supply of the load has to be done with ComOut 24VDC (output common with 24Vdc) and the terminal C (Common). This voltage is automatically created by the card and therefore it must not be supplied from outside.

The following pictures show the different kinds of connection that have to be made according to the working voltage of the electro-valves.

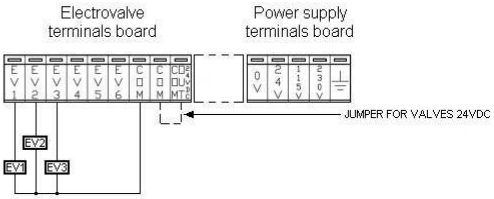
VOLTAGE SUPPLY
VALVES
VAC

VOLTAGE SUPPLY
VALVES
VDC

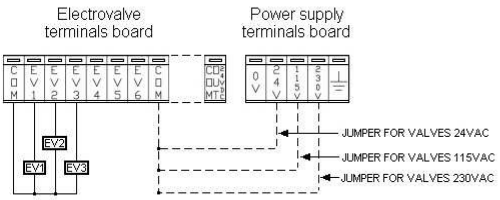
ECOMATIC-NET 4/6



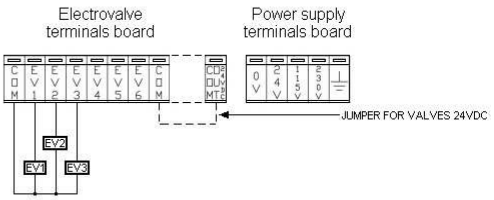
ECOMATIC-NET 4/6



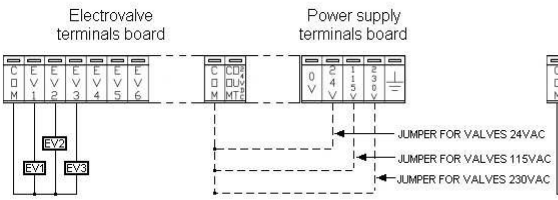
ECOMATIC-NET 12



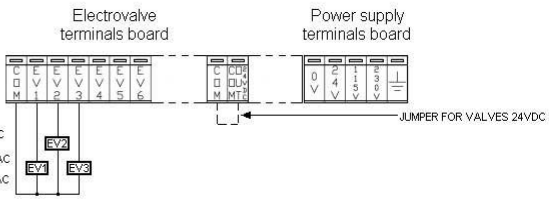
ECOMATIC-NET 12



ECOMATIC-NET 20/32/64/96



ECOMATIC-NET 20/32/64/96



ECOMATIC-S cards are able to control up to 2 Electro-valves for a single output, or to activate up to 4 outputs at the same time for 110V/220V power supply and 2 outputs at the same time for 24VAC/DC power supply.

ATTENTION: to activate more than one electro-valve in parallel or on various outputs, you need to have *the same* tension for valves power supply and instrument power supply. In this way, the requested power is supplied by the supply net (e.i. instrument power supply 230VAC and coils 230VAC).

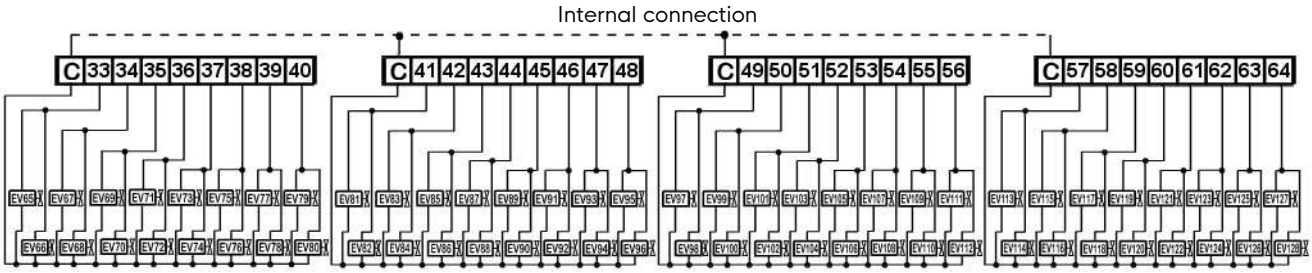
CAUTION

!In all the models of ECOMATIC-S, in the case you have to drive two electro-valves at the same time, the value of two fuses on the board has to be changed:

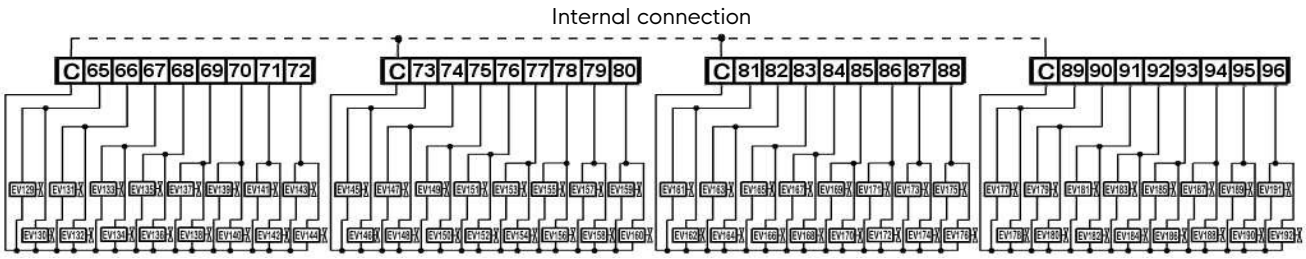
- the one for general protection of 2A quick has to be changed into 4A quick and the one for load protection of 1.6A delayed has to be changed into 3.15A delayed.

In particular, in the versions ECOMATIC-S 64/96, the connection of the double electro-valves to the outputs on the expansions has to be done according to the following scheme:

1st expansion (both ECOMATIC-S64 and ECOMATIC-S96)



2nd expansion (just in the ECOMATIC-S96)



Note: For connecting the load of the double electro-valves on the *expansions* (ECOMATIC-S 64/96) it is necessary to do one *connection* between the terminal C (common) of the expansion board and the terminal C of the ECOMATIC-S32 board.

We suggest you to put the cables of electro-valves far from noise sources, like inverter power cables and engines in general;

3.10. Display visualization

Through the display you can see different information of the system, regarding pressure, output number or cleaning command, cycle status and value of analogical output. There are 2 or 3 visualization menu (3 if the analogical output is enabled) selected through the button **Inc** (↑) while the button **Dec** (↓) indicates which menu is visualizing. The three menus are divided as follows:

The 1° menu identifies the pressure value read by the instrument;

- visualization : **"Pr."**
- followed by a number to identify the pressure measure unit.: **"0"** tens Pascal
  "1" mmH_2O
  "2" mbar
  "3" KPa
  "4" mmHg

The 2° menu identifies the system status, the output number or cleaning command, and the command for cell opening or closing;

- if the system is in **STOP** or almost in stop, you will see: **"S.xx"**
- is the system is in **CLEANING,** you will see: **"U.xx"**
- if the system is in **POSTCLEANING,** you will see: **"P.xx"**

In all these statuses of the system, on the part xx you can view the following wordings:

- **number n°** (if it is an output for cleaning valve)
- **SC** (during the cycle start-up)

The 3° menu (if enabled) identifies the value of the analogical output

- visualization: **"Cor."** (if the output is in current)
- visualization: **"Vol."** (if the output is in tension)

3.11. Error visualization

3.11.1. Pressure error

When the instrument visualizes the pressure value, two indications of out of range are foreseen: if the input differential pressure is higher than the positive full scale set, the display will visualize the indication ' EEE '.
In the case the pressure would be lower than the negative full-scale set, the display will visualize the indication '-EE'.

3.11.2. E2PROM Error

In the case we will have problems with the configuration of the E2prom, the instrument will visualize on the display the indication "---" to show the loss of programming and setting data.

Pressing the key Dec (↓) the normal function of the instrument will be reloaded as well as the default data, although it will be necessary to do once more the setting and programming phase by qualified people in the company.

3.12. Preliminary Procedures

At the ignition, the unit will be ready for the visualization of the differential pressure value read by the internal sensor.
With the button Inc (↑) or Dec (↓) you can look through the visualizations of the pressure, the number of valve in cleaning and of the value in analogical output (if enabled).
To enter in the programming menu is enough to press the key E: it will appear the first parameter L1.

N.B. Please pay attention to this menu because it is where the proper function of the board comes from.

Pressing continuously the key Inc or Dec, it will be possible to look at one by one all the parameters.
The exit from the programming menu is automatic after 10 seconds when you do not press any key during the parameters scrolling.

3.13. Programming Parameters

The following table shows all the available parameters, explaining the function and the admissible range of values.

Param.	Function	Possible values	Default values	Notes
L1	Hourcounter.	0 - 65534 hours		Hourcounter functioning
L2	Cyclecounter	0 - 65534 cycles		Cyclecounter functioning
P1	Pause time	1 – 999 seconds	20 (5-30)	Automatic and Manual functioning
P2	Working time	0.03 – 9.99 seconds	0.25	
P3	Value of time or cycles.	1 – 999 seconds 1 – 999 cycles	5	Postcleaning functioning
P4	Postcleaning function.	0=Disabled 1=Internal 2=External	1	
P5	Unit pressure measure	0 = tens Pa 1 = mmH_2O 2 = mbar 3 =Kpa 4 = mmHg	3	Unit pressure measure
P6	Postcleaning time or cycles selection.	0= Time 1= Cycles	1	Postcleaning functioning
P7	Man./Auto	0=Manual 1=Automatic	1	
P8	Start cleaning pressure	From 0 to F.S. positive	0.90	Automatic functioning
P9	End cleaning pressure.	From 0 to F.S. positive	0.40	Postcleaning functioning
P10	Internal postcleaning pressure threshold	Da 0 al F.S. positive	0.1	
P11	Relay 1 pressure threshold	From 0 to F.S. positive	G115AV = 2.30 G116A = 3.00	Relay Output functioning
P12	Enable precoating.	0=Disabled 1=Enabled	0	Precoating Functioning
P13	Precoating threshold	From 0 to F.S. positive	1.20	
P14	Value of pressure responding to the minimum value of the analog output	From 0 to F.S. positive		Analog output functioning
P15	Value of pressure responding to the maximum value of the analog output	From 0 to F.S. positive		

P16	Relay 1 functioning selection.	0 – 1	0	Relay Output functioning
P17	Function of relay 1.	0=Normal 1=Temporized 2=Hysteresis pressure	0	
P18	Value of relay 1 function.	From 1 to F.S. positive or from 1 – 999 seconds	1	
P19	Pause time in post-cleaning mode	1 – 999 seconds	3	Post-cleaning functioning
H0	Pressure zero	To be done by specialized staff *only if* the pressure with open air vents is appreciably different from zero		

3.14. ECOMATIC-S Function

ECOMATIC-S instruments have two possibility to clean the filters, to be set in parameter P7.

The filter cleaning mode are Manual or Automatic.

With the Automatic functioning you can have a real save in air consumption and on the life of bags and filters, because you operate only when necessary.

Let's see in details these single functioning modalities:

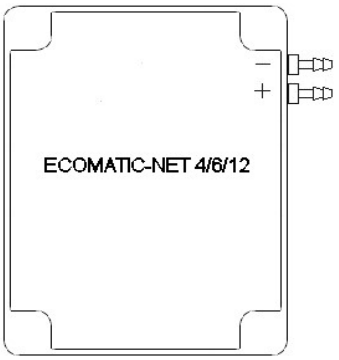
Manual: the ECOMATIC-S drives one by one the output correspondent to the connected valves, regardless any kind of programming. The driving of the outputs starts from the first electro-valve, going ahead with the second, the third and so on and so on, after which starts again from the first. The working time and pause time will alternate each other between the activation of one output and the other.

Automatic: the electro-valves will be activated if the visualized pressure is higher to the one set in the parameter **P 8** (starting cleaning pressure); the activation itself will be interrupted as soon as the pressure will go down the value set in the parameter **P 9** (end cleaning pressure).

When the pressure goes down the end cleaning pressure, the normal cycle of function will be stopped just if the ECOMATIC-S is on pause phase and after the last valve of the cycle.

3.15. Delta-P Tubes Connection Scheme

Disposal of pressure tube connection on the ECOMATIC-s device are as follows:

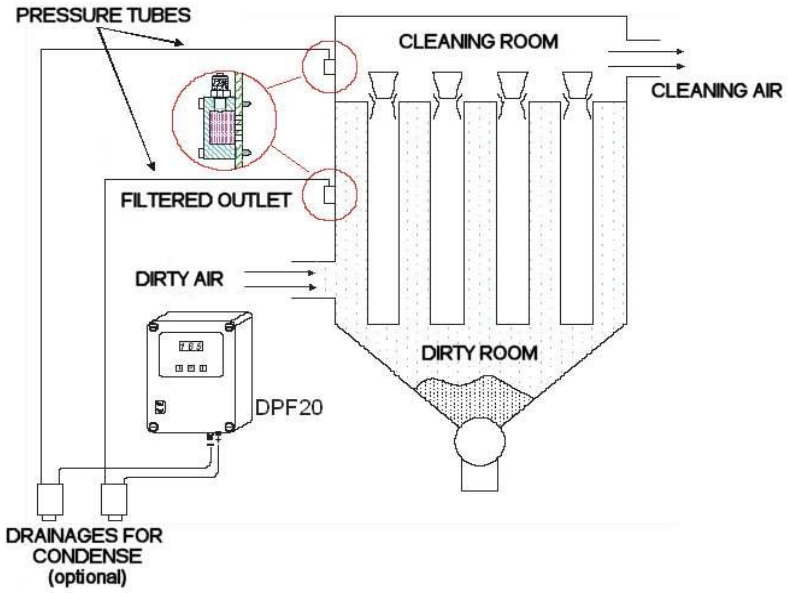


With the installation of pressure gauges is recommended the installation of filtered outlets to limit possible failure internal pressure sensor.

These filters prevent dust or other substances to be traced back to the pressure sensor and small bodies to obstruct the flow inside the tubes.

It can also be possible not to use these filters, but at the expense of the safety of the instrument.

These filters are mounted directly on the filter where they are usually positioned in the outlet pipes. It is recommended to install a filtered outlet for each pressure tube applied, both with the extent of Delta-P inside the filter:

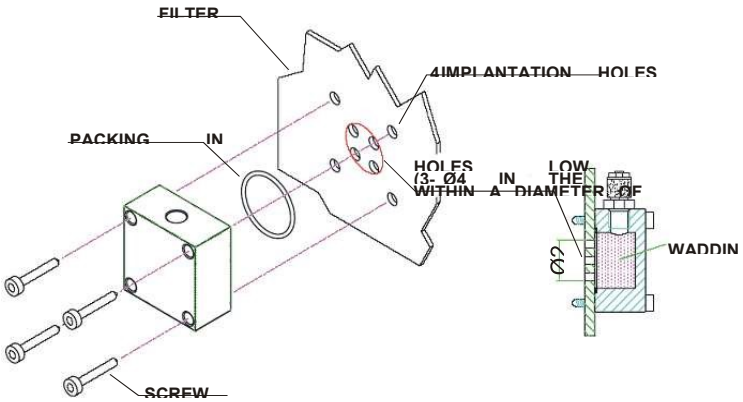


The pressure hose recommended is the Rilsan type 6x4.

The positive nozzle of the instrument must be connected to the dirty room while the negative nozzle must be connected to the clean room of the filter.

At temperatures above 125 ° C it is necessary to reduce the level of inlet sensor temperature in order to fall within the permissible temperature range (-40 °C / 125 °C). To do this we suggest using a length of copper tubing needed to dissipate excess heat.

Let's have a look now at the installation of these filters in details.



3.16. Pressure Zero Setting

During the operation it may happen that the pressure on the display slightly different for equal pressure applied to the sensor, due to the changing conditions of temperature, humidity, etc.. .

To restore the correct pressure, you must perform an operation to eliminate the pressure reading of the instrument.

Entering programming using the key E in the menu and make sure that the jets of grafting of the tubes are free, i e not connected to the pipes from the air filter.

Pressing Inc select the parameter H 0 and follow the steps listed below:

- Press **E** (flashes the message **0**); - Wait 4 or 5 sec.;
- Confirm the reset by pressing the **E** key (the display will show once more the indication **H 0**)
- Wait 10 seconds so that the display returns to the pressure value and verify that the reading is 0.

CAUTION

Pressure can be reset (parameter **H 0**) only if the pressure reading on display with outlets open is notably different from zero. This operation must be carried out exclusively by skilled personnel and only after the instrument has been switched on for at least 15 minutes.

3.16.1. Output test activation function

It is possible to use a particular configuration of the card to prove each exit in case it becomes necessary during the testing, maintenance or any mal operations.

To join this setup go with the key Dec (↓) on the number visualization of the active output. In this condition simultaneously press the keys Inc (↑) e Dec (↓) and so it enters the menu of test outputs. Once you will enter you will see the number of outputs by activating flashing.

To activate the visualized output press the key E, while to change the number of output use the keys Inc (↑) and Dec (↓). The minimum time that must pass for a shot through the following key E is 1 second. To return to the normal cycle of operation simultaneously press all three keys.

3.17. Active Analogical Output Functioning (optional)

ECOMATIC-S can provide a current or tension output, which changes in a linear way. When you place the order, you need to indicate the solution you need. Current or Tension output must be specified in order phase, as standard this option will be supplied with current output.

3.17.1. Current output

It is possible to generate a current which change in a linear way between 4-20 mA or between 0-20 mA in output, through the programming of P 14 e P 15 parameters.

P 14 parameter corresponds to the pressure which has to be supplied to obtain a current output equal to 4 mA or 0 mA. P 15 parameter corresponds to the pressure which has to be supplied to obtain a current output equal to 20 mA. According to the displayed pressure, it is possible to generate a current output linear function of the pressure.

N.B. : Max applicable load 500 ohm.

3.17.2. Tension output

It is possible to generate a tension which change in a linear way between 0-10V or 0-5V in output, through the programming of P 14 and P 15 parameters.

P 14 parameter corresponds to the pressure which has to be supplied to obtain a current equal to 0V. P 15 parameter corresponds to the pressure which has to be supplied to obtain a current equal to 5V or to 10V. On the basis of the displayed pressure, you can generate current output linear function of pressure.

NOTE: Minimum load applicable 1 Kohm.

3.17.3. Analogical output connection

Connection between ECOMATIC-S and expansion card 4-20 mA and a potential external has to be performed using the following terminals on the basis of the instrument model:

- for ECOMATIC-S 4/6, terminals n°5 (+) , n°6 (-) and n°7 (earth) ;
- for ECOMATIC-S 12/20/32/64/96, terminals +, – and earth as indicated in the printed.

3.17.4. Hour-counter function

The value hour-counter is possible to be visualized in the parameter L 1 from the programming menu. The hours counter starts to count when the pressure visualized on the display is higher or equal to the one set in the parameter P 10 (post-cleaning pressure).

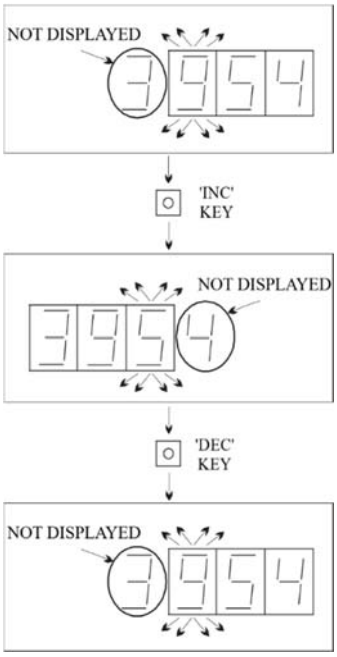
The maximum value that can be set for the number of hours is "65534", after which the counter is reset automatically.

Although the instrument is fitted with a 3-digit display, numbers comprising up to 5 digits can be displayed: for values from 0 to 999, the number of hours is displayed as normal; for values greater than 999, the display cannot show the entire number but when one of the 2 outer numbers (left or right) flashes, this indicates that the number

on display is not complete. If the left number flashes, the remaining numbers for display are to the left and vice versa. If both numbers flash this means that there is a number remaining both to the left and right.

Example

If the number displayed is "954" and the number 9 is flashing, this means that there is a hidden number to the left of the number 9. Press "inc" to display the number to the left (the other numbers are shifted to the right). At this point, the number displayed is "395" but the whole number is "3954"; in this case the number 5 flashes to indicate a number remaining to the right. Press "Dec" to display the number to the right (the other numbers are shifted to the left, concealing the first figure to the left); the figure "954".



3.17.5. Cycle-counter function

Parameter L2 enables access and display of the counter monitoring operation cycles performed during output scanning.

The counting is done every time one complete cycle of activation of outputs even if these are not connected.

The total number of possible cycles is "65534", after which all stored values in the counter memory are reset.

The method to display the number of cycles is as described above for the hour counter.

3.18. Relay Output Functioning

The relays present on the ECOMATIC-S have different ways of functioning, selectable in the programming menu. Each relay is independent from the others, with its own parameters and with the possibility to activate every relay in a different way. The possible ways of functioning are:

1) **= 0 as minimum relay:**

a) standard (see paragraph **STANDARD MINIMUM RELAY**);
b) temporized relay (see paragraph **TEMPORIZED OUTPUT**);
c) hysteresis (see paragraph **HYSTERESIS OUTPUT**);

2) **= 1 as maximum relay:**

a) standard (see paragraph **STANDARD MAXIMUM RELAY**);
b) temporized relay (see paragraph **TEMPORIZED OUTPUT**);
c) hysteresis (see paragraph **HYSTERESIS OUTPUT**);

3.18.1. Relay of standard minimum and maximum

Let's suppose to work with relay 1 as minimum standard relay.
First of all, we need to set the value 0 in parameter P 16 and P 17, in P 11 the pressure value of relay work. When the pressure is equal or less then pressure in P 11, our relay will be activated.

Let's suppose to work with relay 1 as maximum standard relay.

First of all, we need to set the value 1 in the parameter P 16 and value 0 in the parameter P 17, in P 11 the pressure value of relay work. When the pressure is major then pressure in P 11, our relay will be activated.

3.18.2. Temporized output

The temporized output allows us to activate the relay with a settable pressure gap.

1) E.i.: relay 1 **as minimum temporized relay.**
First of all, we need to set the value 0 in P 16 parameter, in P 11 parameter the pressure value for relay, in P 17 the value 1 and in P 18 our time value.

Let's suppose P 11 equal to 20 mmH_2O and P 18 equal to 3 sec.

The functioning of our relay will be the following:

- the relay will be activated after 3 seconds when the pressure will be equal or less than 20 mmH2O;
- the relay will be deactivated when the pressure will be more than 20 mmH2O.

2) E.i.: relay 1 **as maximum temporized relay.**
First of all, we need to set the value 1 in P 16 parameter, in P 11 parameter the pressure value for relay, in P 17 the value 1 and in P 18 our time value.

Let's suppose P 11 equal to 20 mmH_2O and P 18 equal to 5 sec.

The functioning of our relay will be the following:

- the relay will be activated after 5 seconds when the pressure will be more than 20 mmH2O;
- the relay will be deactivated when the pressure will be equal or less than 20 mmH2O.

3.18.3. Output with hysteresis

Output with hysteresis allows us to activate and deactivate the relay with a settable pressure gap.

1) E.i.: relay 1 **as minimum relay and pressure hysteresis**
First of all, we need to set the value 0 in parameter P 16, in P 11 parameter the pressure value for relay, in P 17 the value 2 and in P 18 our hysteresis pressure.

Let's set P 11 equal to 20 mmH_2O and P 18 equal to 4 mmH_2O.

The functioning of our relay will be the following:

- the relay will be activated when the pressure will be equal or less than 20-4=16 mmH2O;
- the relay will be deactivated when the pressure will be more than 20+4=24 mmH2O.

2) E.i.: relay 1 **as maximum relay and with pressure hysteresis**
First of all, we need to set the value 1 in P 16 parameter, in P 11 parameter the pressure value for relay, in P 17 the value 2 and in P 18 our hysteresis pressure.

Let's set P 11 equal to 20 mmH_2O and P 18 equal to 4 mmH_2O.

The functioning of our relay will be the same:

- the relay will be activated when the pressure will be more than 20+4=24 mmH2O;
- the relay will be deactivated when the pressure will be equal or less than 20-4=16 mmH2O

3.19. Post-Cleaning Functioning

Post-cleaning is activated through the closing of an external contact (if **P 4**=2), or when the pressure is *lower* than the value set in **P 10** parameter (se **P 4** =1); the economizer scans in sequence all the outputs, alternating work time (**P 2**) to pause time (**P 19**). The process ends after a *time* (if **P 6**=0) or the *number of cycle* (if **P 6**= 1) set in **P 3** parameter.

The internal post-cleaning (**P 4** =1) has effect in Automatic and not in the manual functioning.

The external post-cleaning (**P 4** =2) has effects in all the functioning modalities.

The post-cleaning cycles begin to be counted starting from the first crossing of the electro-valve N°1 to consider complete scan cycles. If the post cleaning starts from valve N° 10 having 12 valves in total, the first cycle will be composed by 12 + 3 (10-11-12) valves.

Note: if **P 4** = 1, the activation of the post-cleaning cycle can take place only if the device, after the ignition, has passed the threshold set in **P 10** at least one time.

3.20. Precoating Functioning

When the ECOMATIC-S is set to Automatic, the parameter **P 12 = 1** and the parameter **P 13** is set to a value higher than the start pressure cleaning or minimum pressure, the tool remains stationary (in stop) till the pressure on the display shall not exceed the pressure of pre-coating.

After passing this threshold, the cyclical starts and now it behaves normally, that is the function of pre-coating is automatically disables permanently (even power cycle the instrument, the disabled remain stored).

NOTE: To re-enable the function of pre-coating is necessary again to force the parameter **P 12 = 1.**

4. Dismantling and recycling

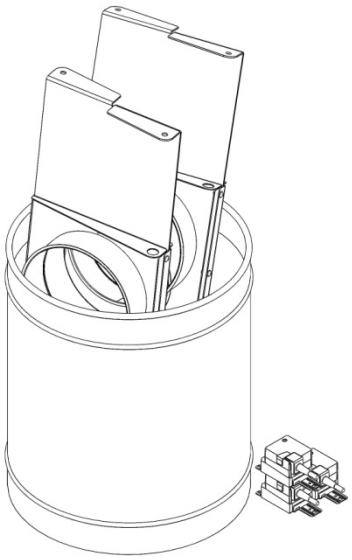
When dismantling a unit, be sure to keep in mind the following important information:

- As the unit is dismantled, set aside all still functioning parts to re-use them on another unit.
- You should always separate the different materials depending on their type: iron, rubber, oils, greases, etc...
- Recyclable parts must be disposed of in the appropriate containers or brought to a local recycling company.

The rubbish must be collected in special containers with appropriate labels and disposed of in compliance with the national laws and/or local legislations in force.

CAUTION !

It is strictly forbidden to dispose of toxic wastes in municipal sewerage and drain systems. This concerns all oils, greases, and other toxic materials in liquid or solid form.



5. Maintenance log

date	description

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