E3 Electronic Washing Machine

7-SEGMENT DISPLAY   LED

SERVICE MANUAL
LAUNDRY

**Washing machine
with electronic controller**

**Functional and technical
characteristics**

Aesthetics

**E3XXXL
E3XXXD**

Index

1   Scope

The scope of this manual is to furnish technicians, who already have the basic knowledge to carryout repairs on domestic washing machines and understanding of washing machine with electronic controller.

The treated topics are:

- general characteristics
- control panel and wash programmes
- technical and functional characteristics
- accessibility to electronic controller

2   Warnings

- Maintenance of the electric device must be carried out only by a qualified person.
- Take out the power plug from the power supply before manipulating the internal parts.
- In case of replacement of heating element, substitute it with one of the same characteristics in order to ensure the safety of the equipment.
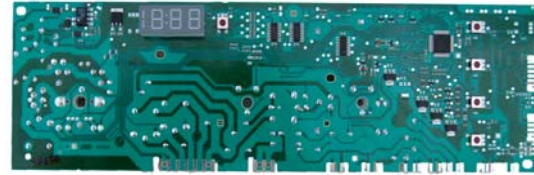
3   General characteristics

The control system for the E3XXXL and E3XXXDas one electronic card each that plays the role in power and visualization management.

LED electronic controller board
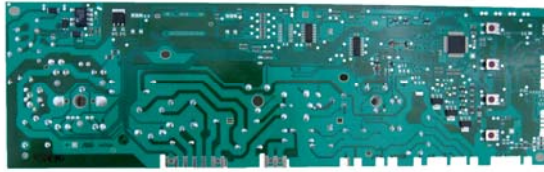
7- segment display board

Posterior side of electronic controller board

There are three versions of boards:
- Economic controller (Base) - ITWASH 39501013000 no TF, no Hot water , no 7-segment display
- Economic Advanced - ITWASH 39501013100 with TF, with 7-segment display and no Hot water
- Economic Advanced with tapped field hard ware - ITWASH 39501014200 with TF, with 7-segment d. , with Hot water

.

7 segment display version	
LED version	
Number of buttons	Maximum of 5
Number of option LED	Maximum of 8
Number of display LED	Maximum of 25
Number of knobs	2
Programme selector	16 position selector with integrated OFF
Current	220/240V 50 Hz
Type of washing	With sphere "eco ball"
Rinsing system	Traditional
Motor	Universal with tachometer
Spin speed	600 - 1400 r.p.m.
Unbalance control	FUCS

Water uptake	**Cold water model only: 1 electro-valve with 1 inlet and 2 outlets** **Model with hot water only: 1 electro-valve with 1 inlet and 1 outlet**
Detergent drawer	3 sector: pre-wash, main-wash and softener
Water level control in drum	3 level pressure switch (load, drain and overflow)
Door safety device	Traditional (with PTC)
Heating element input	1700W with integrated thermo-fuse
Temperature control	With NTC probe integrated at the base of the heating element

4   Control panel

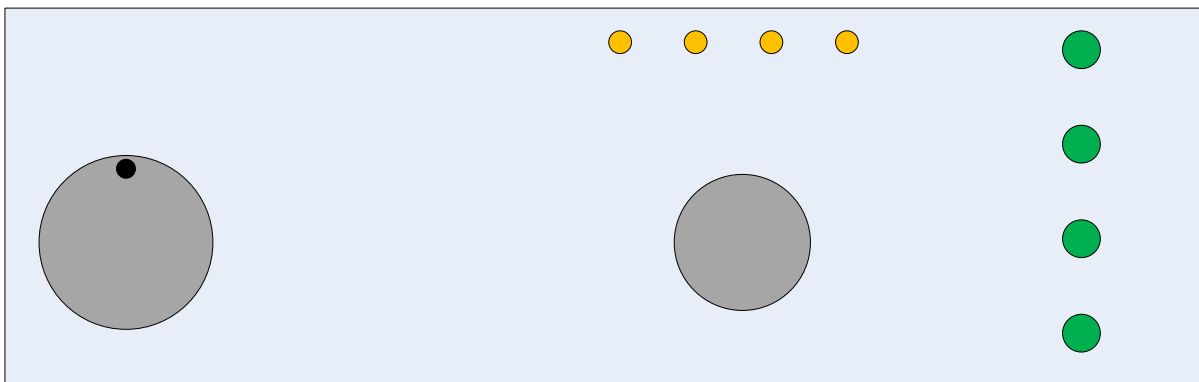### 4.1   LED aesthetic control panel
- Maximum of 4 buttons
- 16 positions programme selector with OFF integrated
- Number of leds 8
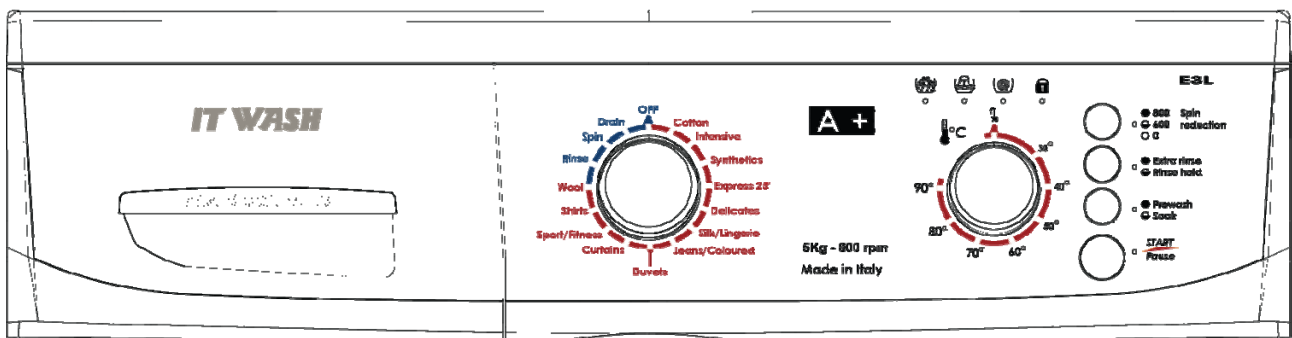
- LEDs and buttons arrangement

4.2   7-segment aesthetic control panel

- Maximum of 5 buttons
- 16 positions programme selector with OFF integrated
- LCD display
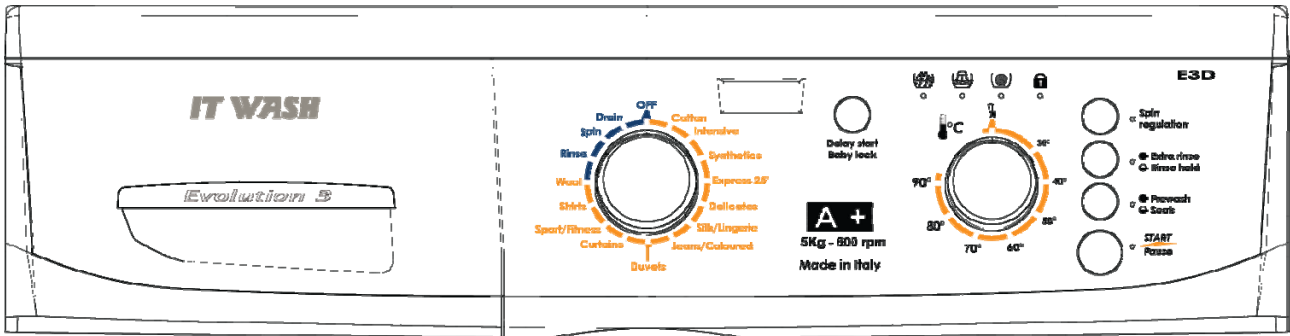
- LCD display and buttons arrangement
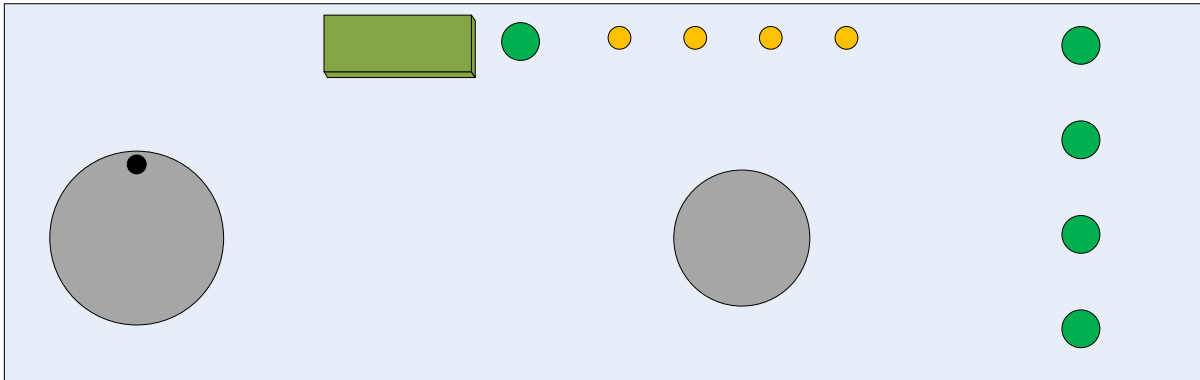
4.3 Control panel configuration

LED model

P1

S
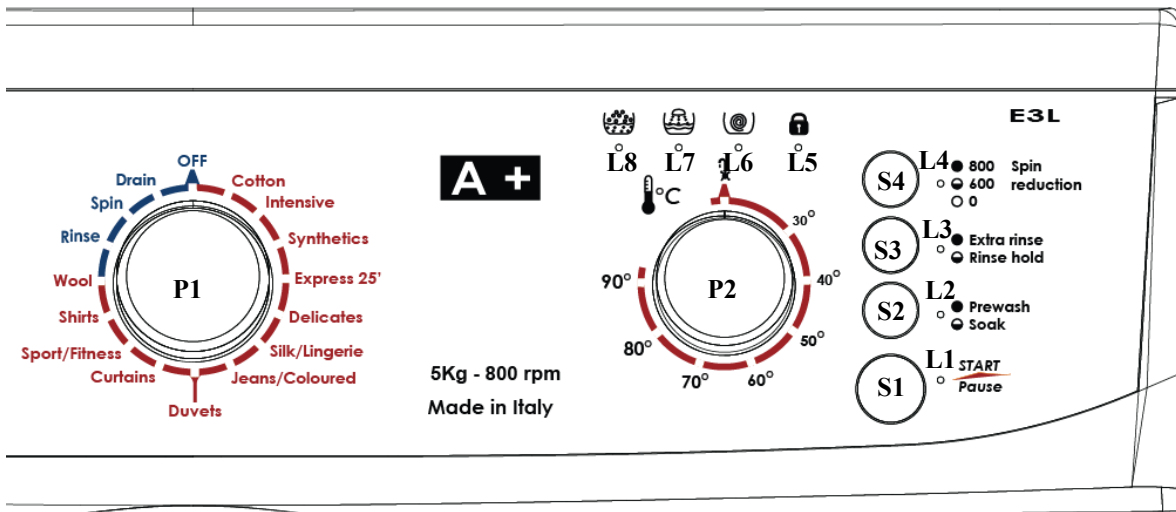
4.4 Knobs, buttons and LED

The functionality of each button is defined by the configuration of the machine.

Programme selector knob (P1)

The selector has P1 positions; from 0 to 15 with integrated ON/OFF. The various positions is configured to for different wash programmes. In the first position is the off state and the programme already in execution will be annulled if turn to the off position. Compatible options and parameters are predefined for each programme.
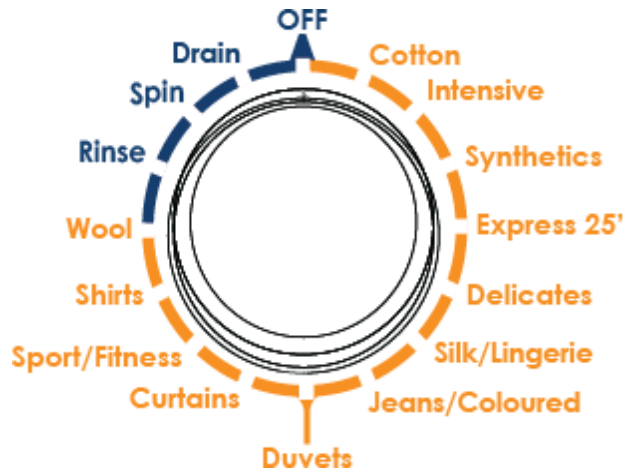
Programme selector knob (P2)

The temperature selector has 8 temperature positions on continuous resistance switch. It regulates the washing temperature from tap water temperature to 90°C. Maximum temperatures are predefined according for every wash programme. The setting of wash temperatures are defined in the phase of machine setup before washing commences. When washing commences the temperature could still be modified but cannot be modified in the heating step of the wash programmes.
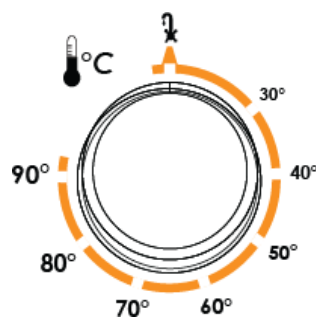
LED indicators in washing cycles

Wash	Rinse	Spin	Door lock
L8	L7	L6	L5

LEDs L5, L6 L 7 and L8 are used to as indicators for the washing cycles.

LED version

The activation and deactivation of any these options is through repeated pressing of the corresponding button. The selected option is automatically confirmed by the machine five seconds from the last operation.

- Button S1: it is bound to LED L1. Generally, it is associated to start and pause function. In the pause state the led L1 flashes while in the washing state it remains steady on. When the button S1 is pressed repeatedly the machine toggles between the pause and the washing state.

- Button S2: it is bound to LED L2. Generally, it is associated to the function of pre-wash and soak. When the button S2 is pressed repeatedly, in prewash state the led L2 is turned on and it blinks in the soak state. When no option is activated the led L2 remains in the off state.

- Button S3: it is bound to LED L3. Generally, it is associated to the extra-rinse and rinse hold function. The led L3 is turned steadily on if the extra-rinse function is activated, it blinks if the rinse hold in activate. When no option is activated the led L3 remains turned off. By pressing repeated the button S3 the led L3 toggles between the activated stated and the deactivated state.

- Button S4: it is bound to LED L4. Generally it is associated the spin reduction or spin regulation function. Pressing the S4 button the led L4 toggles between the highest spin (led L4 steadily on), intermediate spin (led L4 blinking) and spin exclusion (led L4 turned off).

Possible indications		
Led ID	**Led description**	**Function status**
L1	**Start/pause**	It is illuminated in the activated status and it flashes in the pause status
L2	**Soak**	It flashes in the activated status if soak is defined in the programme selected
	Pre-wash	It is illuminated in the activated status if pre-wash is defined in the programme selected.
L3	**Rinse hold**	It is flashed continuously in the activated status if rinse hold is defined in the programme
	Extra rinse	It is illuminated in the activated status if extra rinse is defined in the programme
L4	**Spin reduction**	It is illuminated for the highest configured spine, it flashes in intermediate configured spin and in off in spin exclusion.
L5	**Door lock**	It lights when the door safety system locks the door and it turns off when the door is unlocked.
L6	**Spin**	It is illuminated when the machine is in the spinning phase
L7	**Rinse**	It lights in the rinsing phase of a wash cycle.
L8	Main wash	It lights in the main wash phase of a wash cycle.

- Configuration of programmes

In the table below the parameters that can be used for the definition of the wash programme are indicated.

TYPE OF FABRIC	COTTON, SYNTHETICS, DELICATES, WOOL, HAND WASH, SHOES.
Special programmes	Rinse, Drain, Spin
Temperature	Variable: up to 8 steps are selectable
Spin	Variable: up to 3 steps
Options	Rinse hold, Pre-wash, Soak, Extra-rinse
Led model washing phases	Main wash, Rinse and Spin
7-segement display washing phases	Main wash, Rinse, Spin and Delay start.

4.5   7-Segment display model

4.6   LCD version

The activation and deactivation of any these options is through repeated pressing of the corresponding button. The selected option is automatically confirmed by the machine five seconds from the last operation.

- Button S1: it is bound to LED L1. Generally, it is associated to start and pause function. In the pause state the led L1 flashes while in the washing state it remains steady on. When the button S1 is pressed repeatedly the machine toggles between the pause and the washing state.

- Button S2: it is bound to LED L2. Generally, it is associated to the function of pre-wash and soak. When the button S2 is pressed repeatedly, in prewash state the led L2 is turned on and it blinks in the soak state. When no option is activated the led L2 remains in the off state.

- Button S3: it is bound to LED L3. Generally, it is associated to the extra-rinse and rinse hold function. The led L3 is turned steadily on if the extra-rinse function is activated, it blinks if the rinse hold in activate. When no option is activated the led L3 remains turned off. By pressing repeated the button S3 the led L3 toggles between the activated stated and the deactivated state.

- Button S4: it is bound to LED L4. Generally it is associated to the spin regulation function. Pressing the S4 button the led L4 turns on and the spins are displayed on the monitor. When the spin flips to zero the L4 will turn off.

- Button S5: it is bound to display V1. It is linked to the display V1 and led L5. The delay start is displayed on V1 the activation and deactivation of the baby safety locked in displayed on led L5.
  The activation of delay start can only be archived only one a washing programme has been selected. Pressing the button S5 repeatedly the delayed starting time is display on V1 and incremented by 1 hour up to 24 hours.
  Once a washing programme has commenced the baby safety lock can be activated. The activation is archived by hold pressed the S5 button for about five seconds. It is confirmed through a fast flashing of the L5 led, followed by a slow succession of flashes. The slow flashing denotes the active stated of the baby safety lock. The safe could be deactivated in a similar manner by holding pressed the S5

button for about ten seconds. The L5 led will flash in very quick succession to be confirmed with a steady lighting led.

At the end of washing programmes the machine displays END, as shown in the photograph.
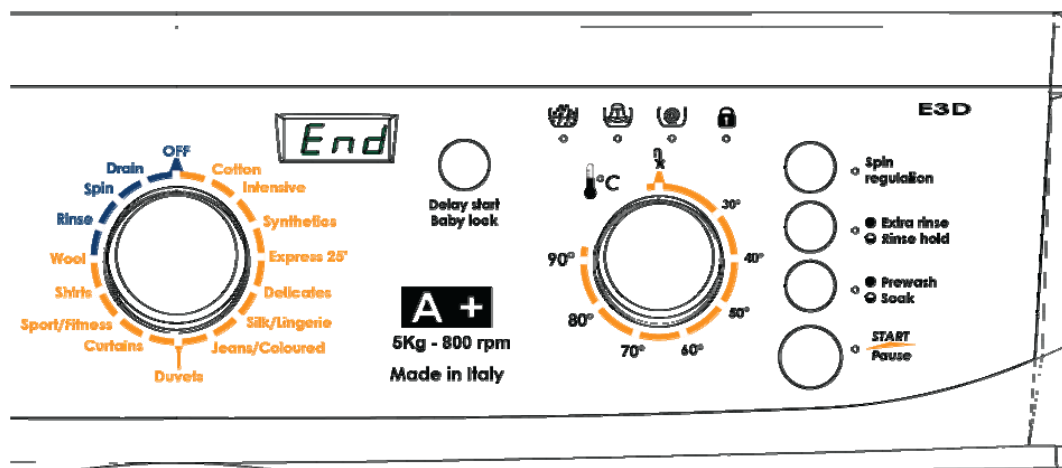
5 Washing programmes and options

5.1 Programmes

The programmes are selectable rotating the knob in both directions. The cancellation of the programmes already in execution is by taking the programme selection knob to OFF position.

Programmes	Maximum Washing temperature (°C)	Washing time (min.)			Options time (min.)		
		5/6kg	7/8kg	9/10kg	Extra Rinse	Pre-wash	Soak
Cotton	90	138	153	153	10	28	30
Intensive	90	152	167	167	10	28	30
Synthetics	60	109	124	124	10	28	30
Rapid	40	30	35	35	6	N. A.	N. A.
Delicates	40	90	98	98	10	28	30
Silk/lingerie	30	68	73	73	6	N.A.	30
Jeans/coloured	60	100	108	108	10	28	30
Duvets	60	105	110	110	10	N. A.	N. A.
Curtains	40	60	65	65	6	N. A.	N. A.
Sport/fitness	40	70	78	78	12	28	30
Shirt	60	85	93	93	10	28	30
Wool	40	56	61	61	10	N. A.	N. A.
Rinse	Cold	22	23	23	10	N. A.	N. A.
Spin	N. A.	10	11	11	N. A.	N. A.	N. A.
Drain	N. A.	3	4	4	N. A.	N. A.	N. A.

The values (washing time) could vary from those indicated according to the water pressure, hardness and temperature; ambient temperature; temperature setting, laundry type, quantity and the degree of dirtiness; type of detergent used, power fluctuation and supplementary functions selected.

5.2 Options and programmes

In the following table the possible options in each washing programme with their compatibility are shown.

The options can be activated or deactivated by pressing the buttons in the correspondence of the icons, before starting the programme or before the each option step in the wash chart.

Some of the options are forbidden for certain programs. This dependence is shown in Table 1. "A" indicates that it is available for the programme and "F" indicates it is forbidden for the programme i.e. the option cannot be or can be selected but it doesn't affect the programme.
If option can not be selected because of its incompatibility to the program its LED will stay off.

Table 1: Option-programme compatibility

No.	Program name	Options						
		Prewash	Extra rinse	Rinse hold	Speed reduction	Cold wash	Soak	Delay start
1	Cotton	A	A	A	A	A	A	A
2	Intensive	A	A	A	A	A	A	A
3	Synthetics	A	A	A	A	A	A	A
4	Rapid	F	A	F	A	A	F	A
5	Delicates	A	A	A	A	A	A	A
6	Silk/Lingerie	F	A	A	A	A	A	A
7	Jeans/Coloured	A	A	A	A	A	A	A
8	Duvets	F	A	F	A	A	F	A
9	Curtains	F	A	A	A	A	F	A
10	Sport/Fitness	A	A	A	A	A	A	A
11	Shirts	A	A	A	A	A	A	A
12	Wool	F	A	A	A	A	F	A
13	Rinse	F	F	F	A	F	F	A
14	Spin	F	F	F	A	F	F	F
15	Drain	F	F	F	F	F	F	F

5.3   Options-wash phase compatibility

Selection the options are forbidden if certain wash phases of a programme is passed or is in execution. This dependence is shown in Table 2.
"A" indicates that the such option is available until the wash phase ends; "F" means the option forbidden starting from the wash phase i.e. the option can be selected but it will not affect the wash phase.
If option can not be selected because of its incompatibility to the wash phase its LED will stay off.

Table 2: Option-wash phase compatibility

No.	Wash Phase	Extra Rinse	Rinse Hold	Speed Reduction	Cold Wash	Pre-wash	Soak
1	Selection	A	A	A	A	A	A
2	Pre Wash	A	A	A	A	F	A
3	Main Wash	A	A	A	A	F	A
4	Main Wash Heating	A	A	A	-	F	F
5	Rinse	F	A	A	-	F	F
6	Final Spin	F	F	F	-	F	F
7	End	F	F	F	-	F	F

5.4 Compatibility between options

Only one function can be activated at a time for buttons have more than one function (see table 1). One function annuls the other if the it is not in the execution phase of the washing programme.

Table 9: Table of compatibility between options

		OPTIONS				
		Soak	Pre-wash	Rinse hold	Extra-rinse	Spin regulation
OPTIONS	Soak	-	F	A	A	A
	Pre-wash	F	-	A	A	A
	Rinse hold	A	A	-	F	A
	Extra-rinse	A	A	F	-	A
	Spin regulation	A	A	A	A	-

Key:
F = **forbidden**, A = **Available**

5.5 Description of options

5.5.1 Pre-wash and soak

This button allows for the selection of the pre-wash or the soaking function. Each time the button is pressed the button's led indicator changes state. There three possible combinations are:

- ● Non blinking LED – Pre-wash
- ⊖ Blinking LED - Soak
- ○ LED off - both options excluded

5.5.2 Extra rinse and rinse hold

This button allows for the selection of the extra rinse or rinse hold option. Each press of the button the LED indicator changes state. There three possible states are:

- ● Non blinking LED - extra rinse
- ⊖ Blinking LED - resin hold
- ○ LED off - both options excluded

5.5.3 Spin reduction (only for led model)

This button allows for the adjustment of the spin speed. To change a set value press repeatedly the corresponding key until the desired value is reached. Upon each press of the button the led lighting indicator changes state, there three possible combinations are:

- ● Non blinking LED – Maximum spin
- ⊖ Blinking LED – Intermediate spin
- ○ LED off – No spin

5.5.4 Spin regulation (only for 7-segment display)

This button allows for adjustment of the spin speed. To change the set value, press the corresponding button to obtain the desired value digit display. The set value is self confirmed 5 seconds after selection.

5.5.5 Delay start (only for 7-segment display)

It retards the starting of the programme. The time is indicated on the display. Its activation is by pressing the button before the starting of a wash programmes. Each succession of pressing increases the time by 1 hour. The time can be delayed for 24 hours.

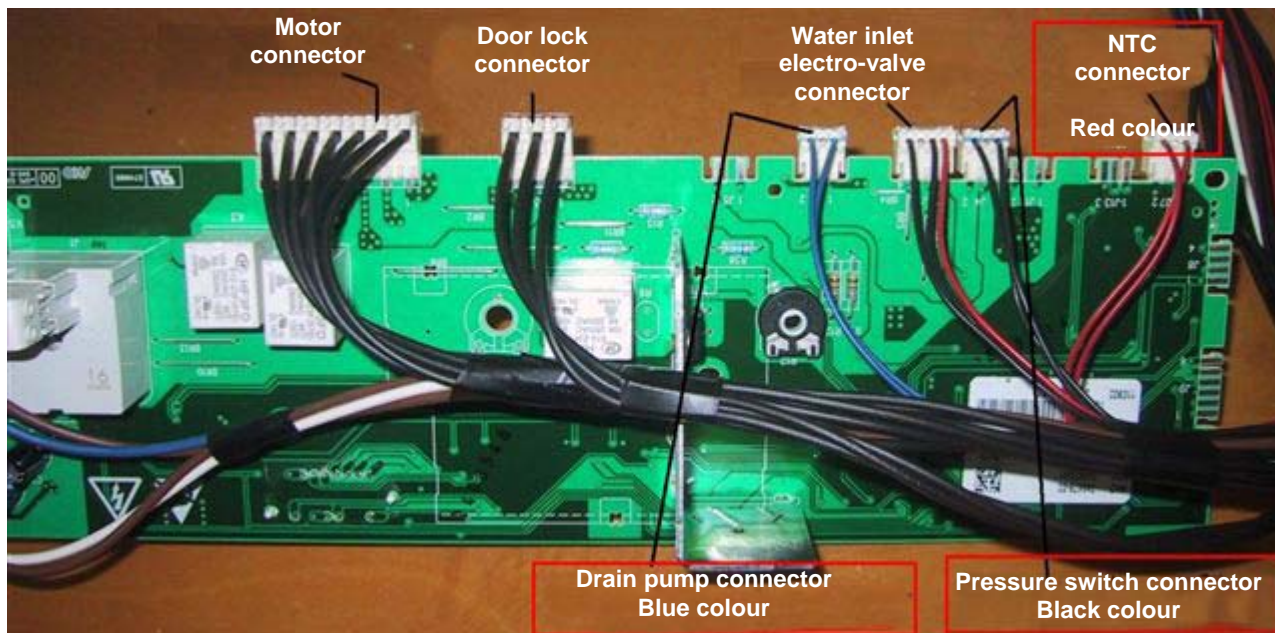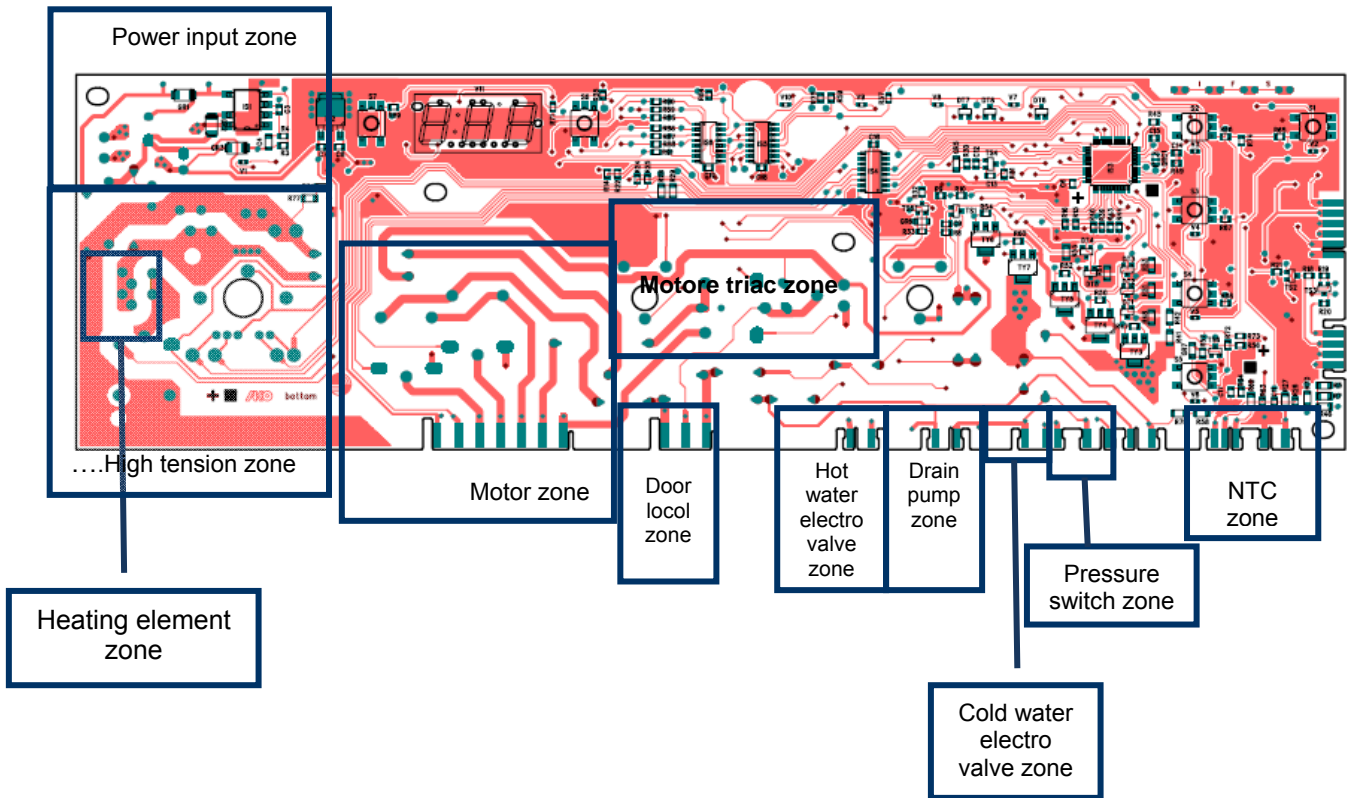**1.1   Hardware and electronic memory**

6.2.3   Hardware variant

Hardware variant word (HWV) restricts access to not mounted functional components (Display, buttons, etc.) Software does not access these functions if not available. Setting of HWV is done at production end test (Diehl Controls). HW configuration cannot be changed by the customer.

Hardware variant word

value	byte 0								byte 1							
	display	tapped field relay	hot valve	EPS	circulation pump	aqua stop	potientiometer1	potientiometer2	unused	unused	unused	unused	unused	unused	unused	unused
0	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

value	byte 2								byte 3
	unused	unused	unused	unused	unused	unused	unused	unused	HW variant CRC
0	A	A	A	A	A	A	A	A	
1	NA	NA	NA	NA	NA	NA	NA	NA	

| value | byte 0 | | byte 1 | | | | | | | | byte 2 | | | | | | | | byte 3 |
| | 7 6 5 4 | 3 2 1 0 | 7 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 6 5 4 3 2 1 0 |
	tumble size	spin speed	UI type	unused	unused	unused	unused	unused	unused	unused	unused	unused	unused	unused	unused	tapped field	hot valve	variant CRC
0	5kg	800	basic													NA	NA	
1	6kg	1000	advanced													A	A	
2	7kg	1200	future															
3	8kg	1400	future															
4	9kg	1600																
5	10kg																	
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15	undefined	undefined																

Power input zone

Motore triac zone

….High tension zone

Heating element zone

Motor zone

Door locol zone

Hot water electro valve zone

Drain pump zone

NTC zone

Pressure switch zone

Cold water electro valve zone

Motor connector

Door lock connector

Water inlet electro-valve connector

NTC connector

Red colour

Drain pump connector
Blue colour

Pressure switch connector
Black colour

2.2   Motor and Door safety device
6.2.3   Door lock

This PTC volumetric device uses 1 – 3 minutes to unlock the door at the end of the cycle.

DOOR and MOTOR CONTROL
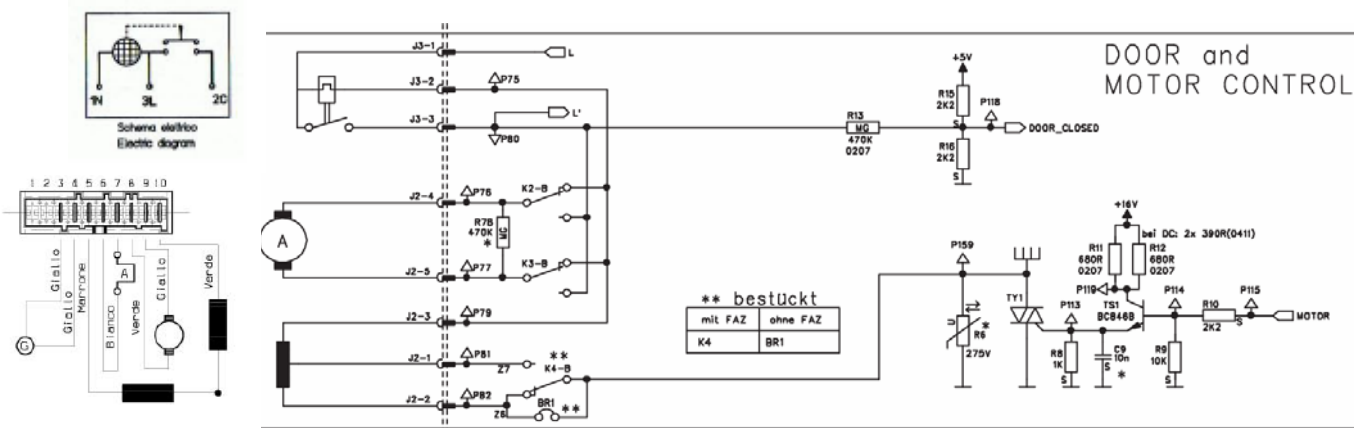
Functional principle

Once the programme has been launched by pressing the start/stop button, the bimetal PTC (contacts 1 – 3) is powered by the triac on the power board. After 2 to 4 seconds the switch (3-2) is bridged which powers the electrical components of the washing machine (only if the door is closed).

Door is prevented from open when the device is functioning. At the end of the programme, the electronic board cut-off power from the device, but the door remains still locked for 1 to 2 minutes (cooling time of the PTC).

6.2.2 Motors

600/800 r.p.m. motor resistance values

Wicklung		Widerstand (Ω) (Resistance)		Drahtdicke (mm) (Wire-diam./ -insulation)	Windungszahl (number of turns)
Polpaket	(Stator)	2,85	± 8 %	0,8	L	2x185 Wdg.
Läufer	(Rotor)	2,85	± 8 %	0,5	2L	18 Wdg./coil
Generator	(Gen.)	135	± 10 %	0,09	L	620 Wdg

1000 r.p.m. resistance values

WINDING:		RESISTANCE ±7% (OHM)	WIRE DIAMETER (mm.)	COILS
	FIELD	1,47	0,95	112 + 112
	ARMATURE	2,06	0,56	36 x 13
	TACHOGENERATOR	184	0,09	760

1200 r.p.m. motor resistance values

WINDING:		RESISTANCE ±7% (OHM)	WIRE DIAMETER (mm.)	COILS
	FIELD	1,05	1,06	95 + 95
	ARMATURE	1,60	0,60	36 x 11
	TACHOGENERATOR	184	0,09	760

6.2.3 Motor power

The electronic board powers the motor through a triac. Reversing the direction of rotation is obtained by switching the contacts of two relays (K2 - K3) which varies the connection between rotor and stator.
In some models, a third relay (K4) is used for a full powerl or half stator field depending on the spin speed.
The speed of the motor is controlled by the signal of the tachometric generator. In spin step the microprocessor controls the ai-foam and the of unbalance

6.3 Water intake and drain system

The electro-valves are powered by the electronic board through the triac and the control of water level in the drum is achieved through the mechanical pressure switch.


PUMP and VALVES
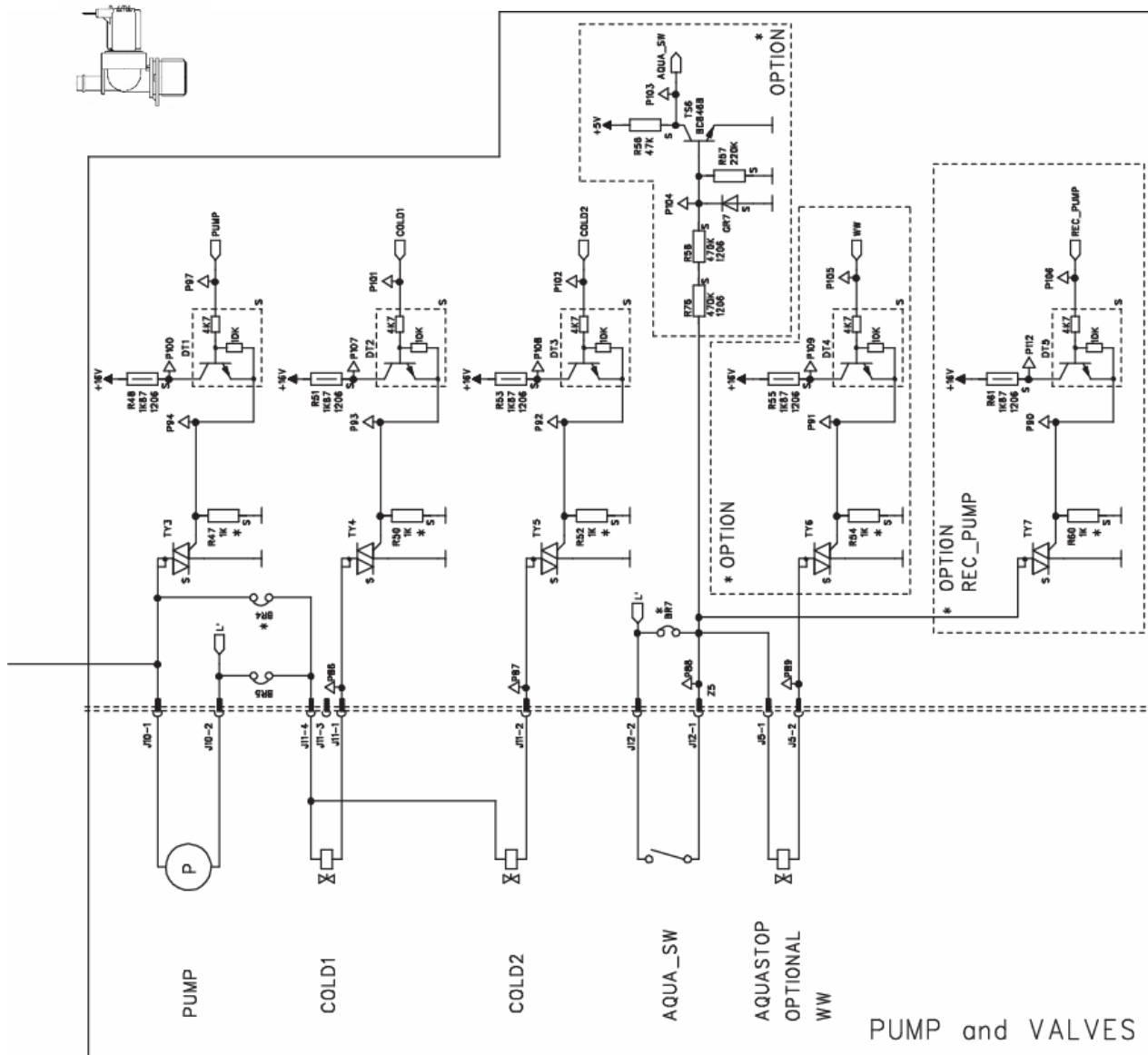
Motor pump resistivity values

Resistance (Ω)	Wire thickness (mm)	Number of turns
160 ± 7%	0.21	1800(x2)

The electronic board powers the drain pump through a triac in the following way:

- at the end to mechanical pressure switch activation in the empty status, there after a time trigger is launched or it passes to the next step.

if the pressure switch is not in the empty state , an alarm is launched after 5 minutes.

One level mechanical pressure switch for drum water level control

The pressure switch is a mechanical device which has the function of controlling the level of water in the drum.
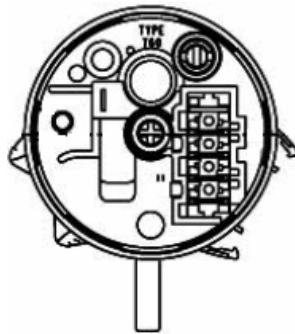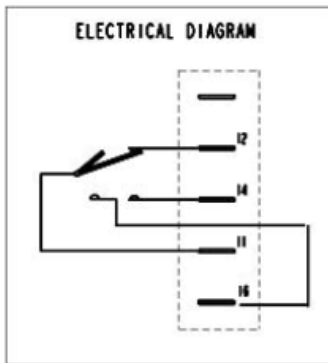

Level calibration		
Compact		
Full 87±3	Empty 62±3	Refill 320±3
5-6-7kg		
Full 95±3	Empty 70±3	Refill 320±3

The pressure switch is collected to a plastic bell jar by a hose. When water is taken into the drum, pressure is created within the hydraulic circuit which causes the drifting of the membrane in the pressure switch. This drifting modifies the position of the switch internal contact (11-12) to position (11-14). The electronic board at this point receives impulse from pin 14 and it recognises the quantity of water to take.
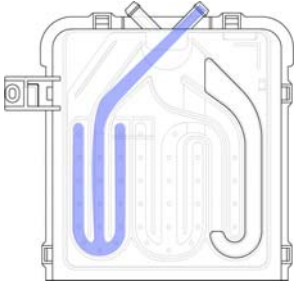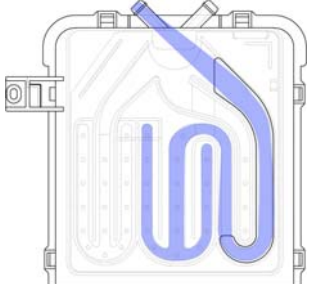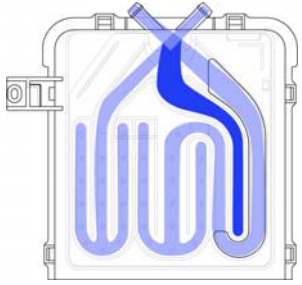
6.4 DETERGENT DISPENSER

The detergent drawer is a three compartments (pre-wash, main wash, softener). The main composition and operation are indicated below.

6.4.1 Detergent Drawer
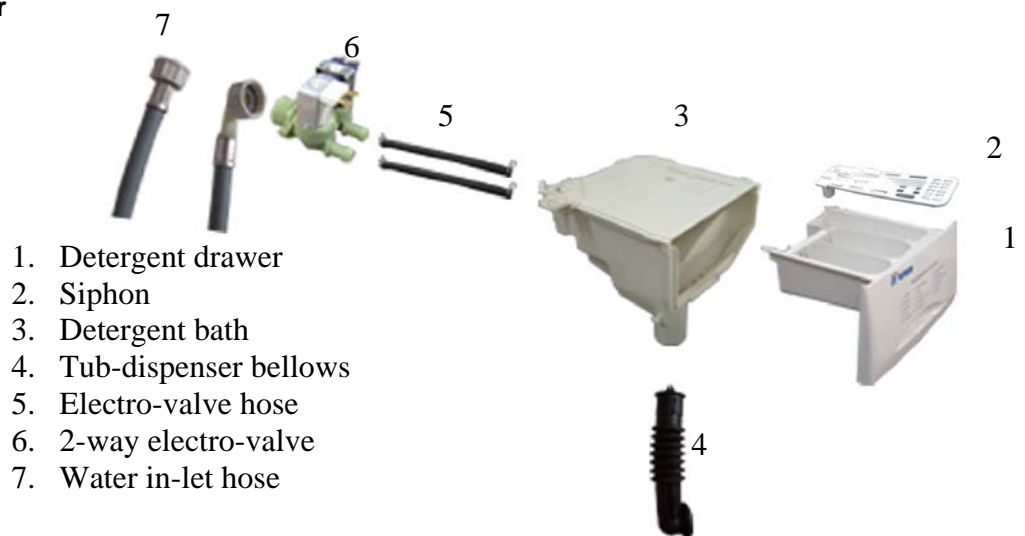
1. Detergent drawer
2. Siphon
3. Detergent bath
4. Tub-dispenser bellows
5. Electro-valve hose
6. 2-way electro-valve
7. Water in-let hose

6.4.1.1   Functional principle

Water intake into pre-water compartment (Activation of electro-valve N°1) The detergent contained in the compartment is washed away at the beginning of pre-wash.	
Water intake in the main wash compartment (Activation of electro-valve N°2) For all washing programmes, the main wash compartment is used to hold the detergent which washed away at the beginning of washing.	
Water intake in the softener compartment (Activation of electro-valve N°1 e 2) For all the washing programmes, the softener compartment is used to hold the softener which is washed away at the beginning of the last rinse.	

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6.5   Heating


HEATER and LEVEL CONTROL

NTC probe
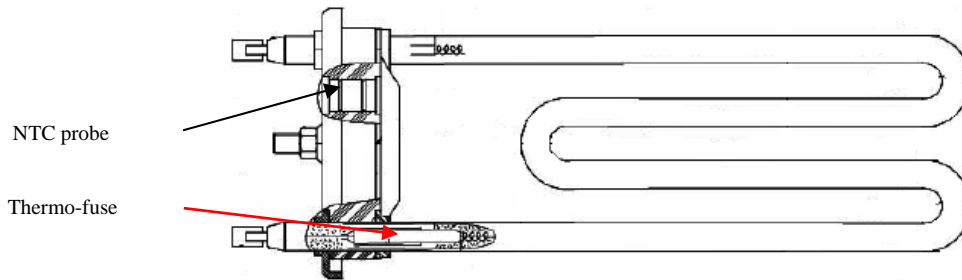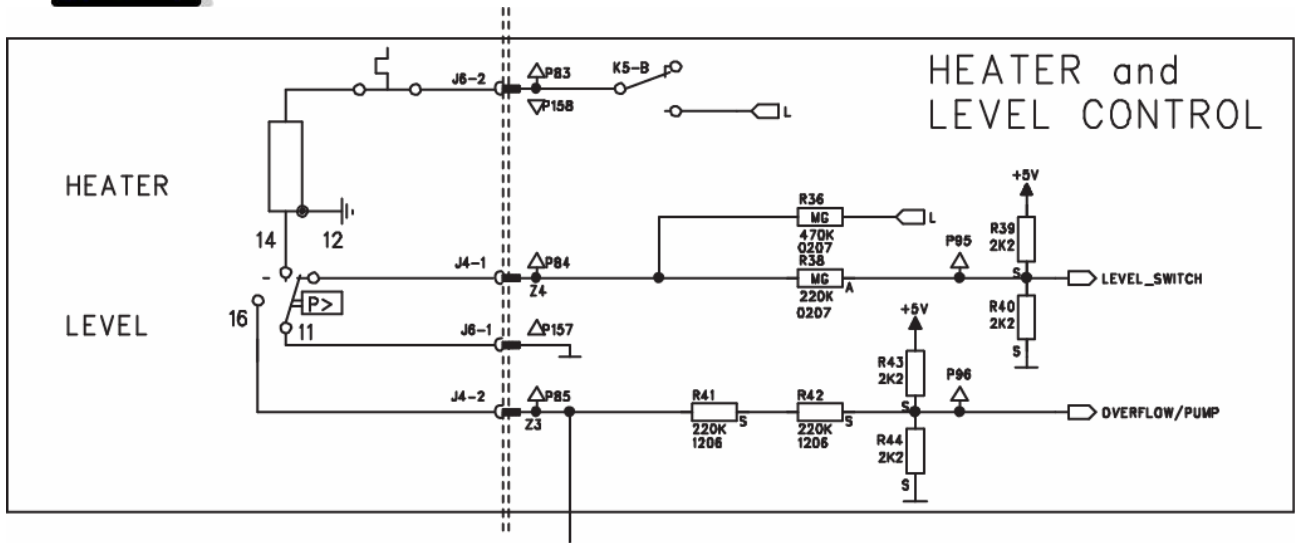
Thermo-fuse

The heating element is powered through by a relay K5 on the electronic board It is equipped with a thermo-fuse, with which it interrupts heating in case of emergency when the level of heating surpasses the calibrated values.

In case of substitution of the heating element, it must be substituted with one having the same characteristics so the safety is not compromised.

8.1   Temperature probe

The temperature is controlled by the electronic board through an NTC temperature probe integrated to base of the heating element (See Annex 1 for detail).

Body   Bulb
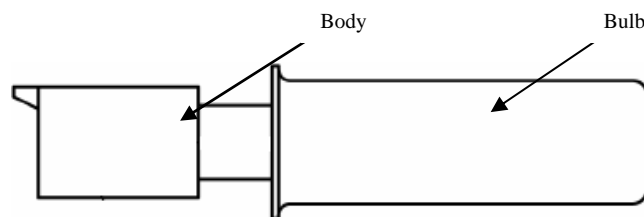
0°C	30°C	40°C	50°C	60°C	70°C	95°C
35.975	9.786	6.653	4.608	3.243	2.332	1.093
±5.8%	±3.7%	±3.1%	±2.6%	±2.0%	±2.5%	±3.7%

6.7   Unbalance control - FUCS

The unbalance control is in a dynamic manner through an electronic **F**ast **U**nbalance **C**ontrol **S**ystem – FUCS. Such a control is in the initial step of spinning a 100 r.p.m for about 15 seconds. The measure profile contains single measuring plateau at 100 rpm speed (marked with arrow and "measure UBL" symbol in fig. 1) and redistribution ramp with anti-spin direction.
If measured value of unbalance is above the limit for the specific machine, measurement profile is cancelled (red line). In such a case the controller follows the algorithm in figure 3. If value of unbalance is below the limit the controller executes spinning profile (see fig. 2).
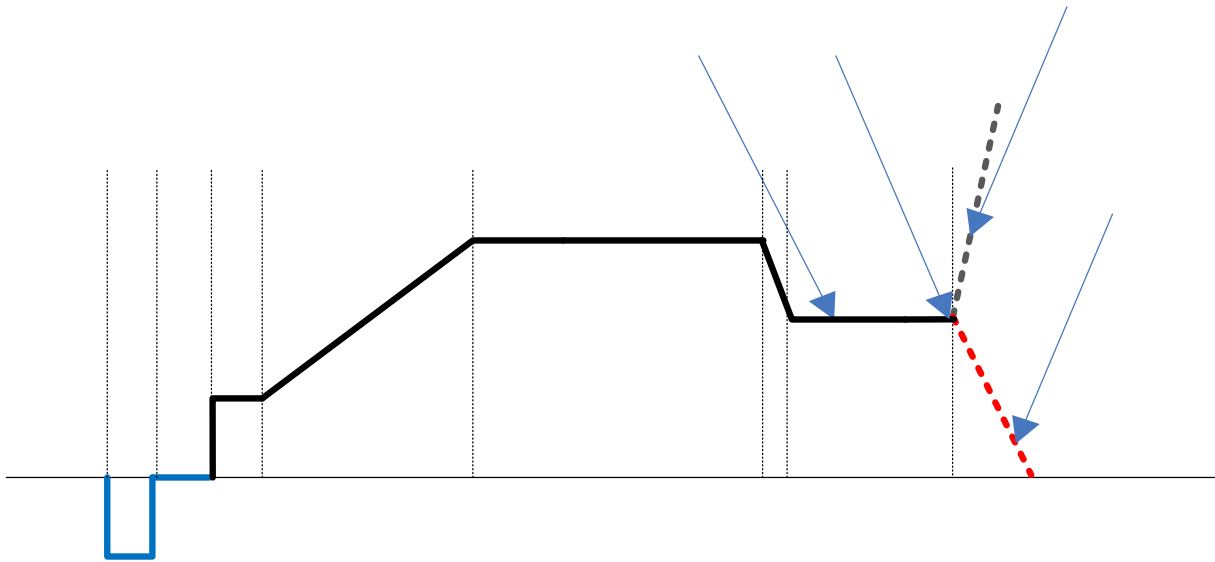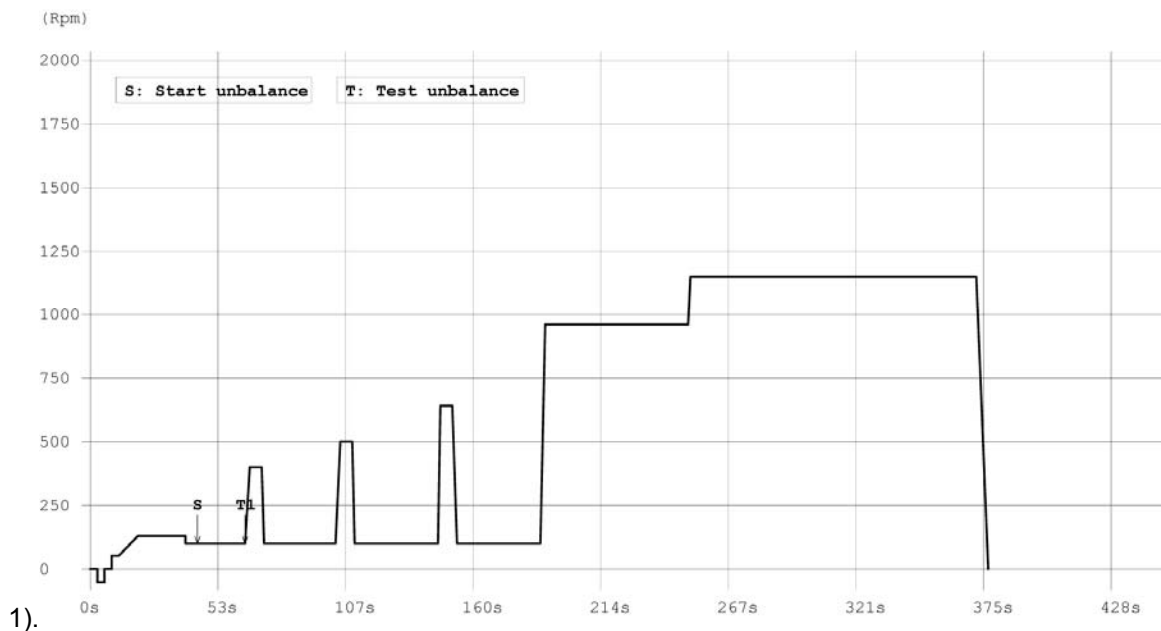
Fig. 1: FUCS curve

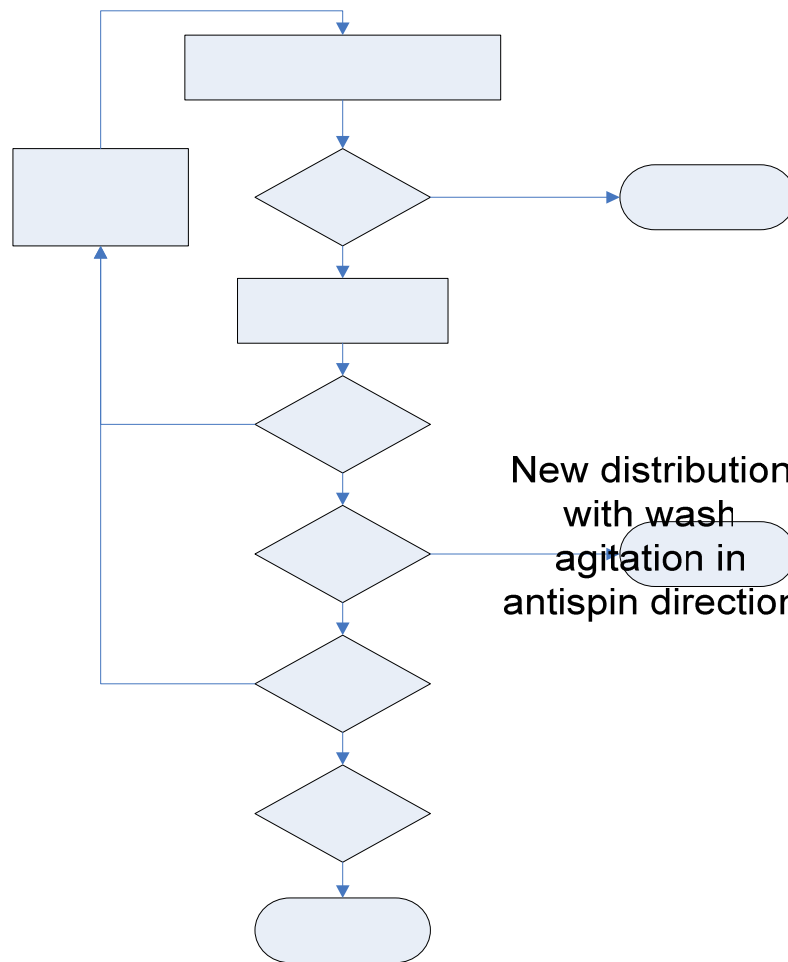**Figure 2: Normal spin curve**

1).

5"

5" 5"   45"

13

45"

-40 rpm

Fig. 3 Unbalance reaction flowchart

Perform distributi...
and measure...

Unba...
< Lim...

Increment T...

yes

Trialco...
< 6...

In case the value is greater than that the predefined, the machine makes a series of attempts during which it dynamically verifies the unbalance values. The attempt steps to eliminate unbalancing are identified as T_1 and T_2 (see figure 4).

In the T_1 step, if the unbalance value is lesser or equal to the preset data for the T_1 unbalance threshold, the machines make the normal spin profile up to the maximum. In the T_1 step there are six possible trial. In case the machine fails to make normal spin in the T_1 step, it passes automatically to the T_2 step. In this second step there are five possible trials for reduced spin. If the value of unbalance is greater than the value for the T_1 and lesser than or equal to the T_2 value the machine makes a reduced spin. No spin is registered in a situation where the value in the T_2 step is higher than the preset.
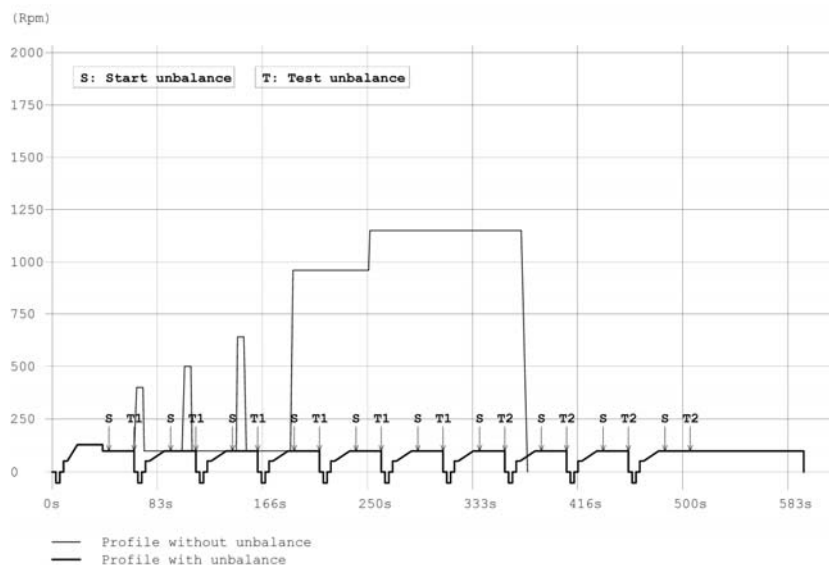
New distribution with wash agitation in antispin direction

Unba...
< Lim...

yes

Trialco...
< 1...

Unba...
< Lim...

Figure 4: Unblance retrials

22 Skip spin...

7   Testing procedure

The charter explains the procedure for activating various test programmes.

7.3   Service test

This describes the modality for activating the programme for verifying either function test in production line or in repairs.

→ Access mode:
  _ Position the programme section knob on **ON/OFF**
  _ Hold press the S**TART/STOP** button
  _ Position the programme selection knob on **1**
  _ Wait for 15 - 20 seconds
  _ Release the **START/STOP** button.

→ Interface behaviour:
  All led will be blinking
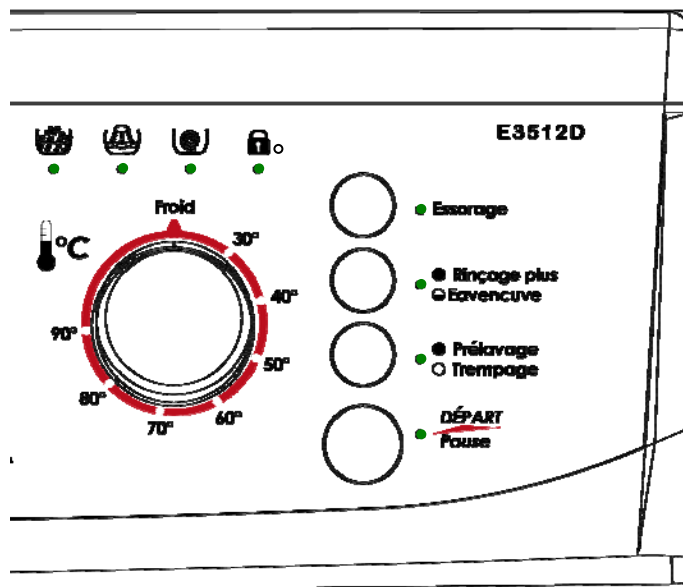
→ Washing machine activity

Step	Activities
1	Water intake to normal water level (NWL) in first compartment, no motor agitation.
2	Stop water supply to prewash compartment. Water intake for 2 seconds for 5/6kg machines and 3 seconds for 7/8/9/10kg machines in the second compartment with motor agitation at 50 rpm.
3	Water intake for 12 seconds in second compartment with agitation at 50 rpm and heating
4	Stop water in the second compartment and heating. Supply water to the last compartment for 10 seconds with motor agitation at 50 rpm.
5	Supply water to the hot water electro-valve for 5 seconds and motor agitation at 50 rpm.
6	Water intake to all electro-valves for 5 seconds with motor agitation at 50 rpm.
7	Stop water to all electro-valves. Motor agitation at 100 rpm in clock wise direction for 26 seconds and drain turned on.
9	Spin to the maximum.
10	End

→ The duration is 110 seconds.
N.B. The time indicated can vary depending the capacity and the rated of the machine.

7.2   Life test
→ Access mode:
    _ Position the programme selection knob on **ON/OFF**
    _ Hold press the **START/STOP** button
    _ Position the programme selection knob on 3
    _ Wait for 15 - 20 seconds
    _ Reposition the programme selection knob on **1**
    _ Release the **START/STOP** button.

→ Interface behaviour:
        ⌐ The lamps of washing phase indicator and options will blink continuously ⌐
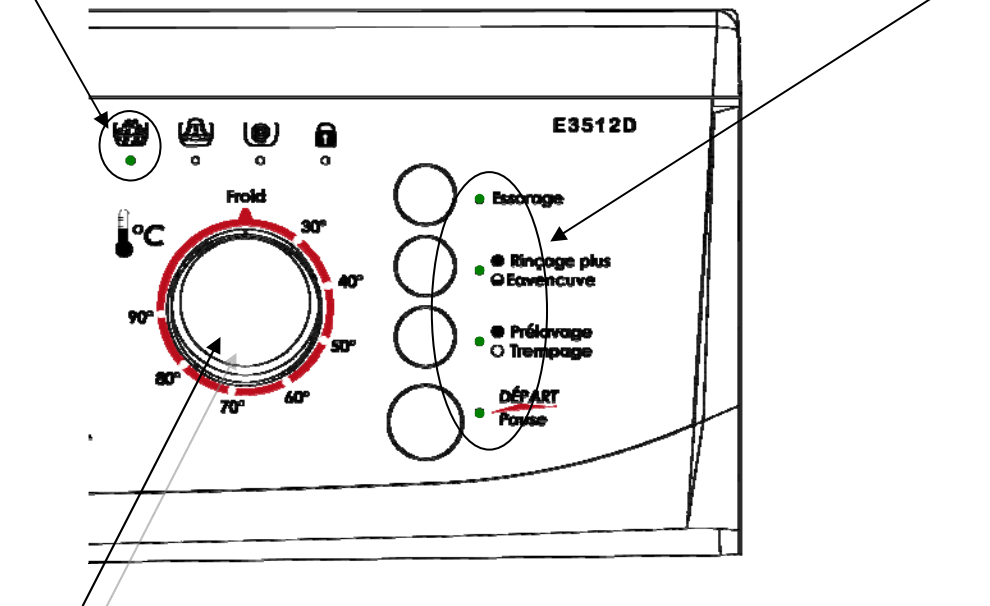
    Temperature regulation is possible
→ Washing machine activity
        - execute one cotton washing cycle
        - rinse
        - spin
At the end of the cycle it repeats the cycle for an infinite times.

→ To exit the programme, take the knob to OFF position.

Step	Activities
1	Water intake for 20 seconds first compartment with no motor agitation.
2	Water intake in the first compartment to NWL with no motor agitation.
3	Water intake in the second compartment with motor agitation at 27rpm for 720 seconds.
4	Wash with agitation rpm for 1800 seconds with agitation at 40 rpm
5	Cool down water intake for 10 seconds with motor agitation of 40 rpm for 60 seconds
6	Drain with agitation at 40 rpm
7	Spin with C1 spinning profile
8	Water intake in the second compartment and motor agitation at 48 rpm for 180 seconds + 100 seconds timed filling.
9	Wash for 120 seconds with motor agitation at 35 rpm
10	Drain and spin with C5 spinning profile
11	Water intake in the last compartment with motor agitation at 40 rpm for 180 seconds + timed filling of 30 seconds
12	Washing 120 seconds with motor agitation 40 rpm
13	Drain and spin with C5 spinning profile
14	End

7.3   STATISTICAL TEST
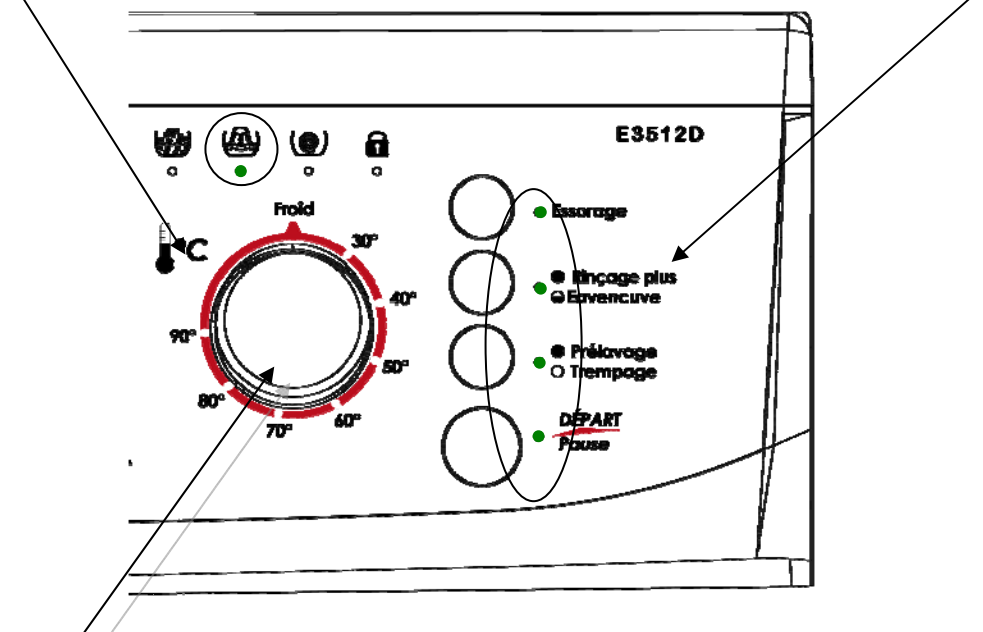
→ Access mode:

_ Position the programme selection knob on **ON/OFF**
_ Hold press the **START/STOP** button
_ Position the programme selection knob on **4**
_ Wait for 15 - 20 seconds
_ Reposition the programme selection knob on **1**
_ Release the **START/STOP** button.

→ Interface behaviour:

The lamp of the rinsing phase indicator and all the option lamps will blinking

Regulation of the temperature is possible

→ This programme executes only one cotton washing cycle with a duration of 49 minutes.

Step	Activities
1	Water intake for 20 seconds first compartment with no motor agitation.
2	Water intake in the first compartment to NWL with no motor agitation.
3	Water intake in the second compartment with motor agitation at 27rpm for 120 seconds.
4	Water intake in second compartment and heating (first step heating) with motor agitation at 40 rpm
5	Stop water and with motor agitation at 45 rpm for 300 seconds
6	Water intake in the second compartment and heating (second step heating) with motor agitation at 40 rpm
7	Water off and wash for 720 rpm with motor agitation a 50 rpm
8	Water on in the second compartment for 70 seconds with motor agitation at 50 rpm
9	Water off and wash for 300 seconds with motor agitation of 40 rpm
10	Drain with no motor agitation and no spin
11	Water in the second compartment with motor agitation at 40 rpm 70 seconds + washing for 60 seconds
12	Drain and spin with C2 spin profile
13	Water in the second compartment with motor agitation at 40 rpm 70 seconds + washing for 60 seconds
14	Drain and spin with C4 spin profile
15	End

8   Alarms

All faults or failures are indicated by an error code which is indicated on interface board (LED or 7-segment display). When an error is detected, the code is indicated by one or more blinking leds. If the machine is turned off the alarm will be cancelled because the are not memorised.
Temporary faults or failures can be cancelled by the user by pressing start button. The washing cycle will be continued after that.
Critical faults can be only cancelled by turning program selector to its 0th position and turning machine on again.

The type alarm identified depends on the nature of the fault.

Error code (on display)	Vertical error signals	Short description	Description
F1	O O ● ●	The connection with door lock is opened or door is opened	*The door should be closed before programme is started*. Once **start** button is pressed the controller will count down time until "door closed" signal is detected. When the counter reaches 30 seconds and machine could not detect the door lock signal it will be indicated as a failure.
			The "door closed" signal is checked during the whole washing cycle. If it was read as door open but it was not, the controller will a detect door lock failure and will go to the safe state (indicating the error)
F2	O ● O ●	The water level is not reached. - water tap is closed - leakage in the machine - defective water valve	The failure is displayed if in any filling or heating step the water level stays below NWL for more than 5 minutes. When the failure occurs the programme will paused. To resume the programme START button must be pressed.
F3	O ● ● O	Connection to temperature sensor open or short-circuited	Once temperature lower than 0°C or greater than 100°C is read the heating step is interrupted (heater element will be switched off) and heating sensor error will be displayed. If there are other heating steps included in programme chart the controller will skip them, but the washing cycle will be continued without heating.
		Temperature not reached the set point - defective heater	The temperature value is read every 1 minute. After 10 minutes temperature is checked. If temperature hasn't risen by at least 2°C a heater error is displayed and the relay is switched off. If there are other heating steps included in the wash programme chart the controller will skip them. Cold wash actions will be executed instead (if specified for current programme).
F4	● O O ●	The water level does not fall below normal water level (NWL) - pump is clogged - defective pump	The failure is displayed if at pumping step the water level did not fall below NWL. If the failure occurs the washing programme is interrupted cannot be to restart. The wash programme will be annulle

Error code (on display)	Vertical error signals	Short description	Description
F5	● O ● O	The connection to the tacho generator is open, short-circuited or motor thermal protector is opened	If a washing programme is in execution and the motor control unit gets no signal from the tacho generator, a pause of 20 minutes is executed. After the pause, the programme is automatically restarted. Where the fault persist the machine makes 3 trials each with 20 minutes pause. If these trials fail a fatal error is displayed and the controller will go to the safe state. The trial counter will be reset if the machine works of a minute after a successful restarting of the machine in the retrial phase.
		The triac is short-circuited	The fault is displayed if the washing programme is in execution and the motor is working without control of triac. The washing programme is interrupted immediately. After 3 minutes try and the failure is no longer present, the trial counter will be reset after one minute. If the same fault occurs again, within first minute after resumption of the last trail, the programme will be stopped completely and the controller will go to the safe state.
F6	● O ● ●	Variant failure	In case of empty variant block or wrong CRC value for the variant block a fault is displayed.
F7	● ● O O	The washin machine does not reach max. spin speed (the tapped field relay does not switch)	The fault is displayed if at the end of the spinning cycle of the testing programme the spin is 200rpm less than the set spin speed. The failure is displayed at the end of the testing program.

8.1   Common behaviours and definitions

8.1.1   Critical (fatal) error
Fatal error is a failure situation when there is no possibility to continue washing cycle after failure is detected and handled.

8.1.2   Temporary error
Temporary error is a state in which the controller detects a fault but there is a chance to repair it either by user interaction or by the controller itself.

8.1.3   Safe state
Safe state is a state in which the controller goes into if critical failure was detected.
The principle for the safe state is that all actors are disconnected by both control elements (relay or triac) and protective circuit elements (door lock's switch, water level switch).
If no alternative behaviour or exception is defined for particular failure handling, the controller will act according to flowchart in figure 5
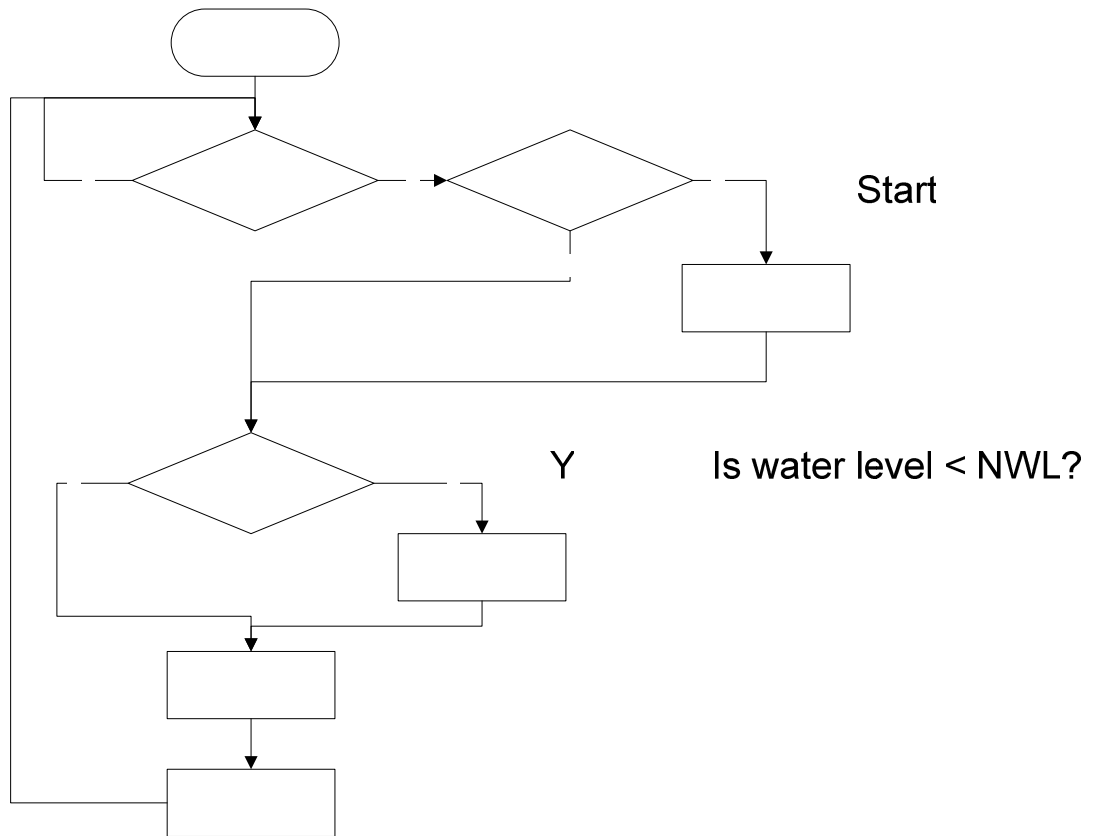
Figure 5 Flowchart for the Safe State behaviour

The flowchart contains the following labels: Start; Is water level < NWL?; Y; N; Water temperature > 50ºC; Drain until EMPTY level; Unlock the door.

8.1.4 Failure state cancellation

For temporary failures can be cancelled by the user by pressing start button. The washing cycle will be continued after that.

Critical faults can be only cancelled by turning program selector to its off position and turning machine on again.

9 Failure detection and handling algorithms

9.1 Door lock

8.1.4 Door not closed

The door should be closed before programme is started. Once start button is pressed the controller will count time until "door closed" signal is detected. When the counter reaches 30 seconds machine will indicate a failure. A program can not start until door is closed by the user.

9.1.2 Door opened during the cycle

The "door closed" signal is checked during the whole washing cycle. If it is read as door open but it was not intended to, the controller detects door lock element's failure.

The controller will not detect the "door open" failure if motor thermal protection opened before and is being handled.

Because the failure is a critical one washing cycle is aborted and controller goes to the safe state. Due to hardware construction all the actors will be disconnected if door lock would open during the cycle. Despite this the controller tries to lock the door again and pump water out as defined for the safe state.

9.2 Filling

In closed tap and/or low pressure state the controller will detect a filling error when either filling to NWL or refilling modes are active. While valves are open filling counter is incremented. As counter value reaches the maximum set time (T_{MAX}) a filling error will be detected. Such a situation can happen when tap is closed or water's flow rate is not sufficient to reach NWL within T_{MAX}.

After filling error is detected the controller closes valves and displays warning. Washing cycle is suspended. Warning is displayed until user presses START button. As START button is pressed either filling to NWL or refilling algorithms are repeated from the beginning (see figure 6 and figure 7).

If power fail is detected while the warning is indicated the alarm will reset. The controller will repeat filling (either filling to NWL or refilling) step from the beginning when power is on again. T_{MAX} is defined as 5 minutes (300 seconds) by default.
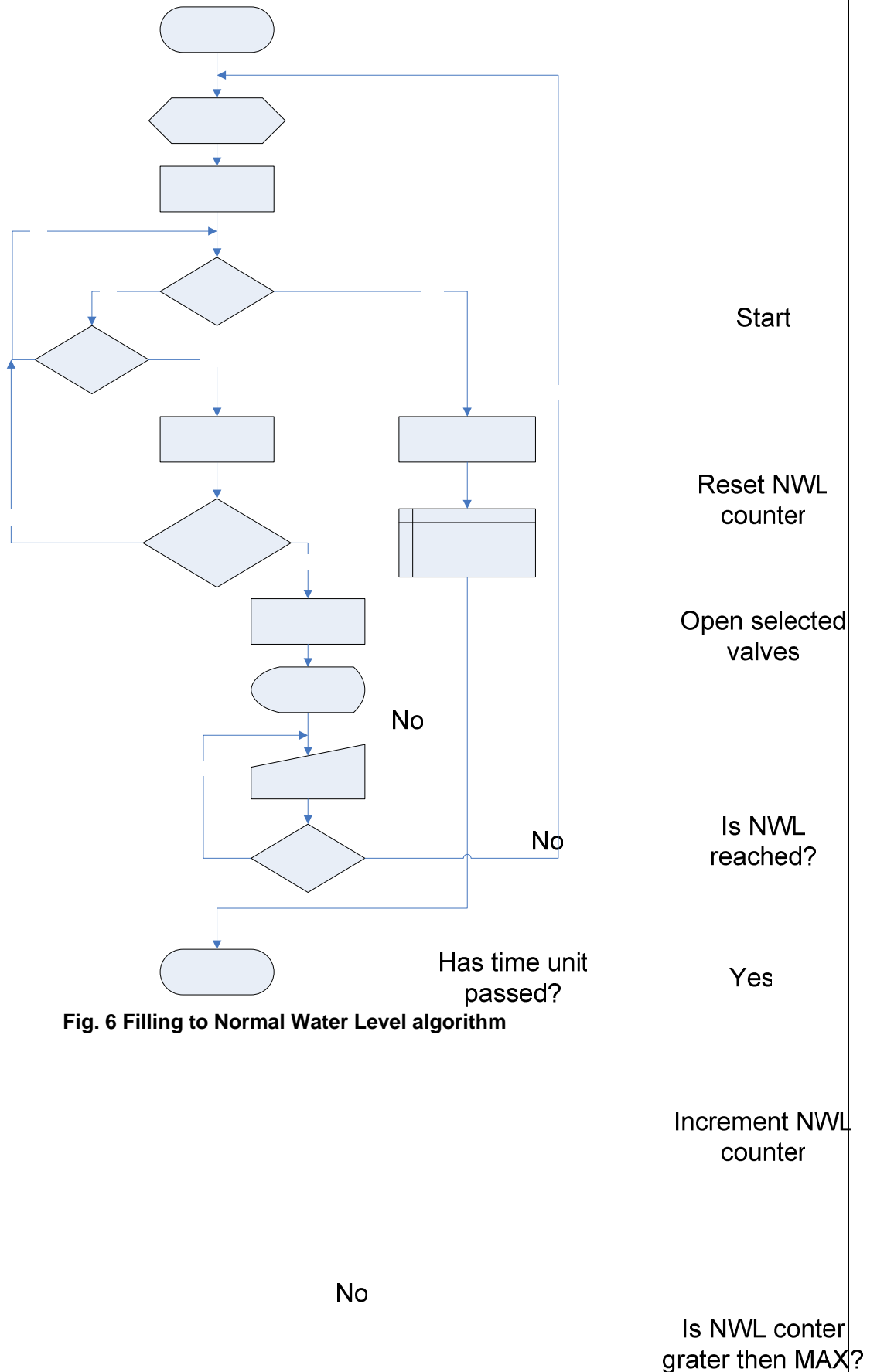

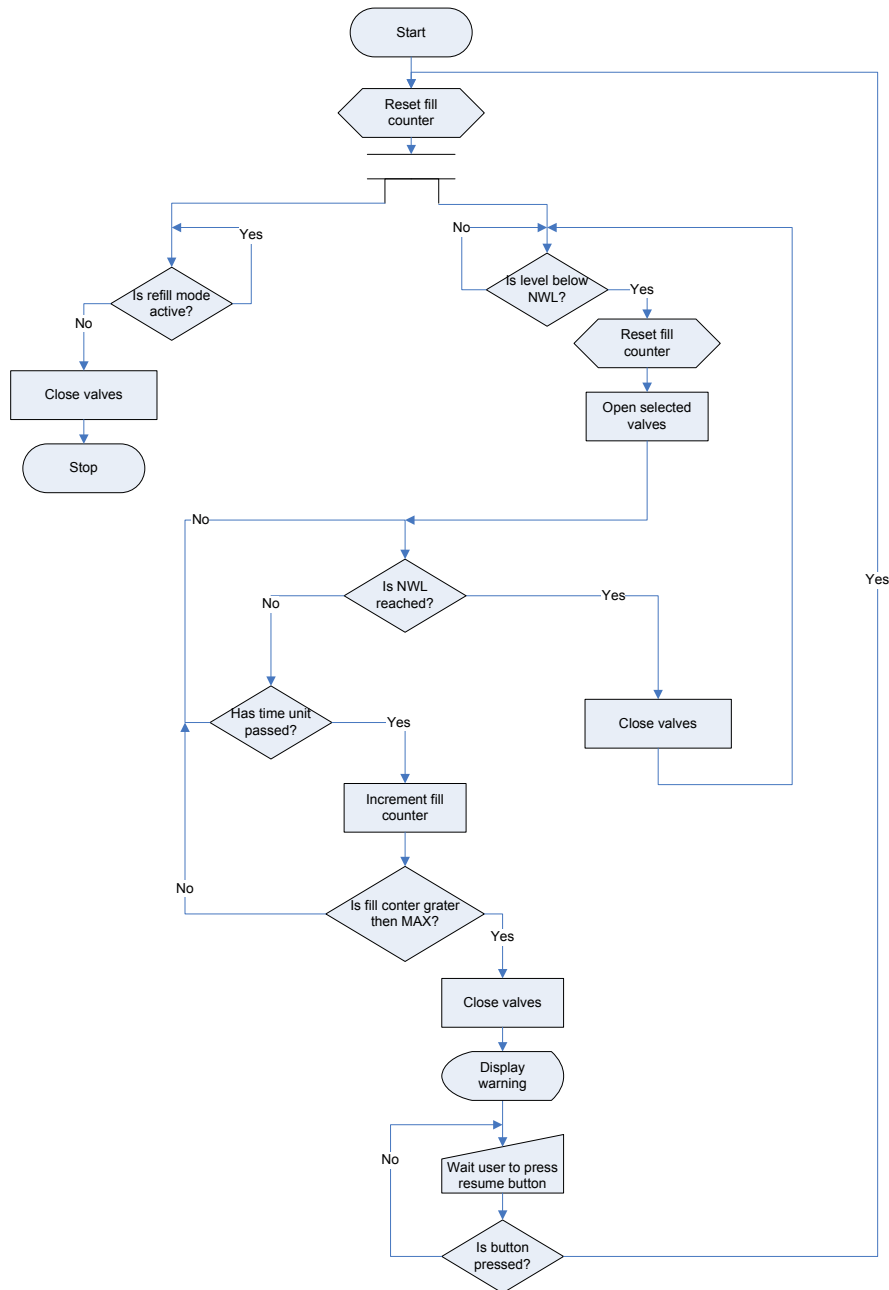**Fig. 6 Filling to Normal Water Level algorithm**

Figure 7 Refilling algorithm

9.3 NTC (temperature sensor)
A NTC resistor is used as a temperature sensor. NTC's characteristic is given in Annex 1.

The NTC is connected to analogue port of micro controller.
10 bits resolution is required for temperature measurement.
Table based temperature calculation is used.

9.4 Heating
Single heating element controlled by a relay is used to heat water during washing cycle. The heating element is powered on when relay is closed. Pressure switch disconnects heater's circuit if water level is below NWL.

9.5 Drain pump

9.5.1 Detection algorithm

The controller starts counting timeout when drain pump is turned on. The time is counted until "pressure switch" input indicates the empty level or counter reaches its maximum defined value. In the second case drain pump error will be detected and displayed. A flow chart of the algorithm is shown in figure 8. Drain timeout is defined in the process table and its default value is 5 minutes.
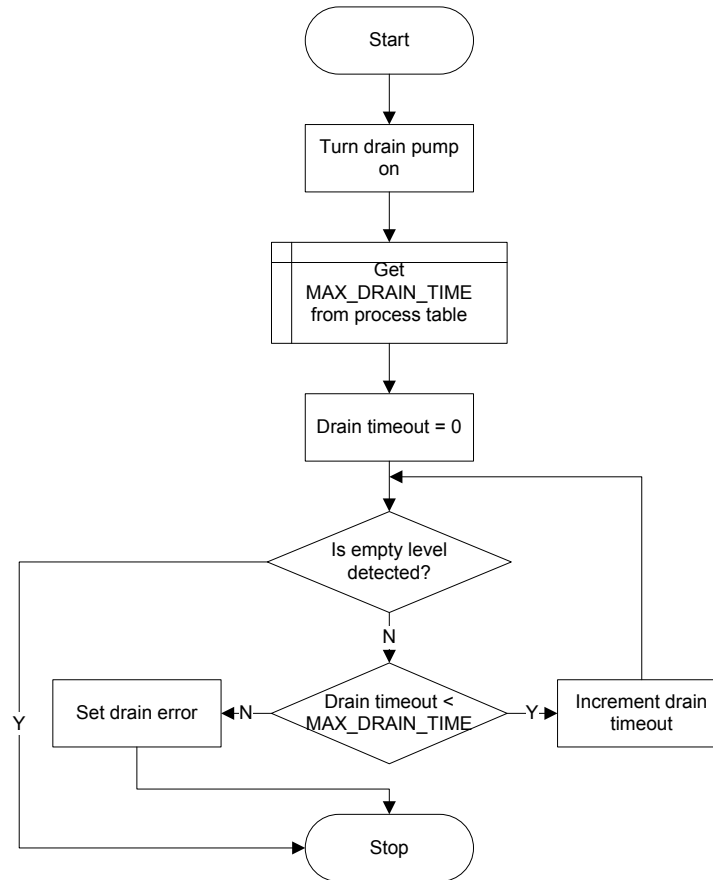

Figure 8 Drain pump error detection

9.5.2 Handling
If the error is detected first time in the drain step of a washing cycle the controller will stop the cycle and will indicate and display the error until the user presses **Start/Pause** button. After user's reaction (press of start/pause) the controller will restart the washing cycle (repeating draining step).
If the error is detected second time in the washing cycle it is then handled as a critical fault. The controller will go to the safe state. The draining and cooling parts of the safe state algorithm are skipped and the door is kept locked.

9.6 Motor triac short circuit

9.6.1 Detection algorithm

Motor triac's short circuit is detected according to desired motor speed and real speed which is read from a tacho generator (the tacho generator is an internal part of the motor).

9.6.2 Handling

The error is critical one. Once the problem is observed for the first time the controller will recognise it as temporary fault; hence the routine in figure 9 is applied. If fatal error is detected the controller will go to the safe state.

NOTE: Door could stay locked because triac is out of control – can not be set to off.
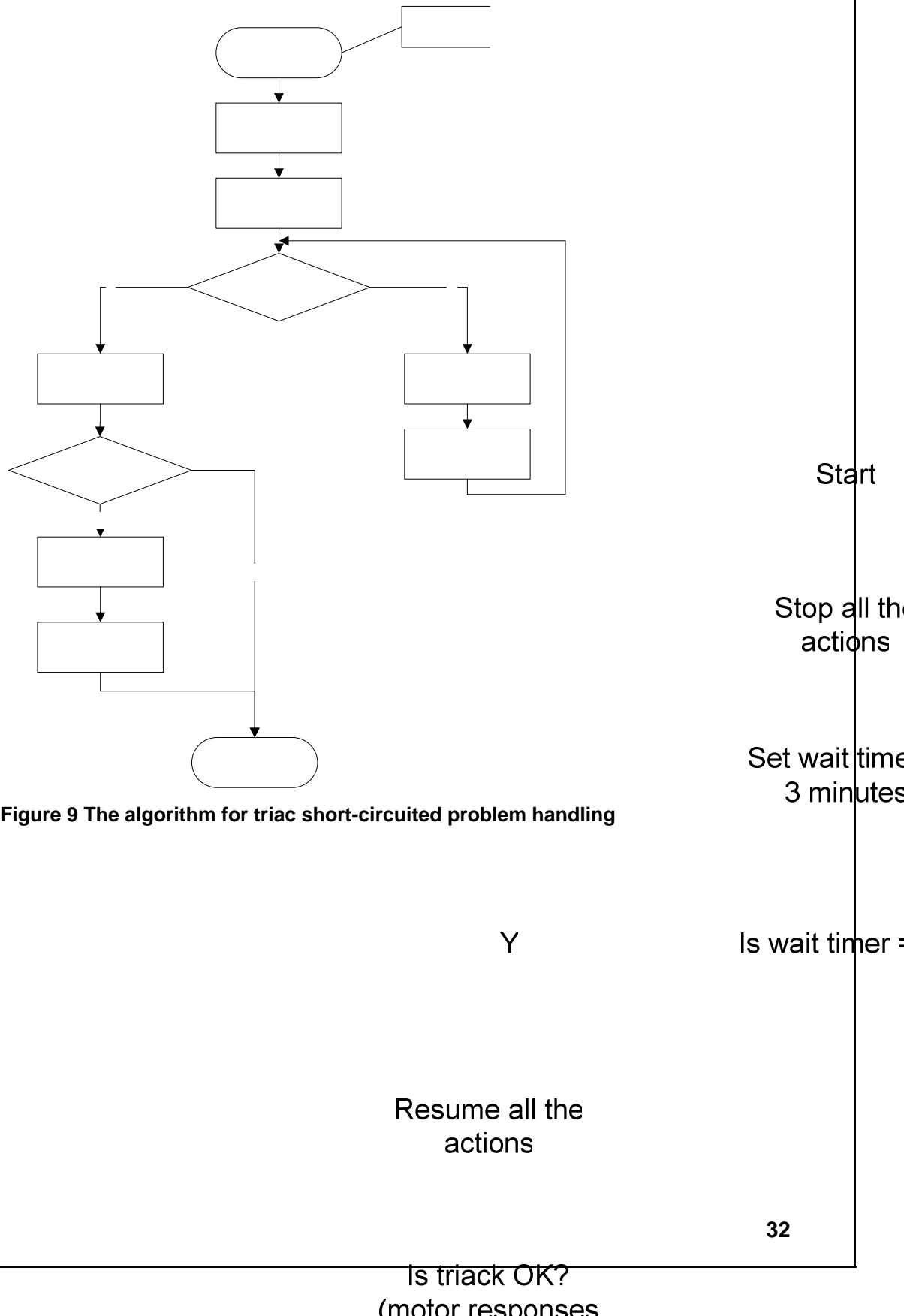

Figure 9 The algorithm for triac short-circuited problem handling

Start

Stop all the
actions

Set wait time
3 minutes

Is wait timer =

Y

Resume all the
actions

32

Is triack OK?
(motor responses

9.7 Motor's tacho circuit open / Motor's thermal protector opened

9.7.1 Detection algorithm

Motor tacho circuit is detected open if the desired motor's speed and real speed which is read from a tacho generator (the tacho generator is an internal part of the motor) differs.

Motor thermal protection opened circuit fault gives the same alarm as for the tacho circuit. Therefore there is no way to identify the real problem. Both cases have the same fault number and handling procedure.

9.7.2 Handling

Once problem is observed first time the controller recognises it as temporary situation (can be caused by thermal protection). The routine from figure 10 is then applied. If fatal motor error step is reached the controller will go the safe state.
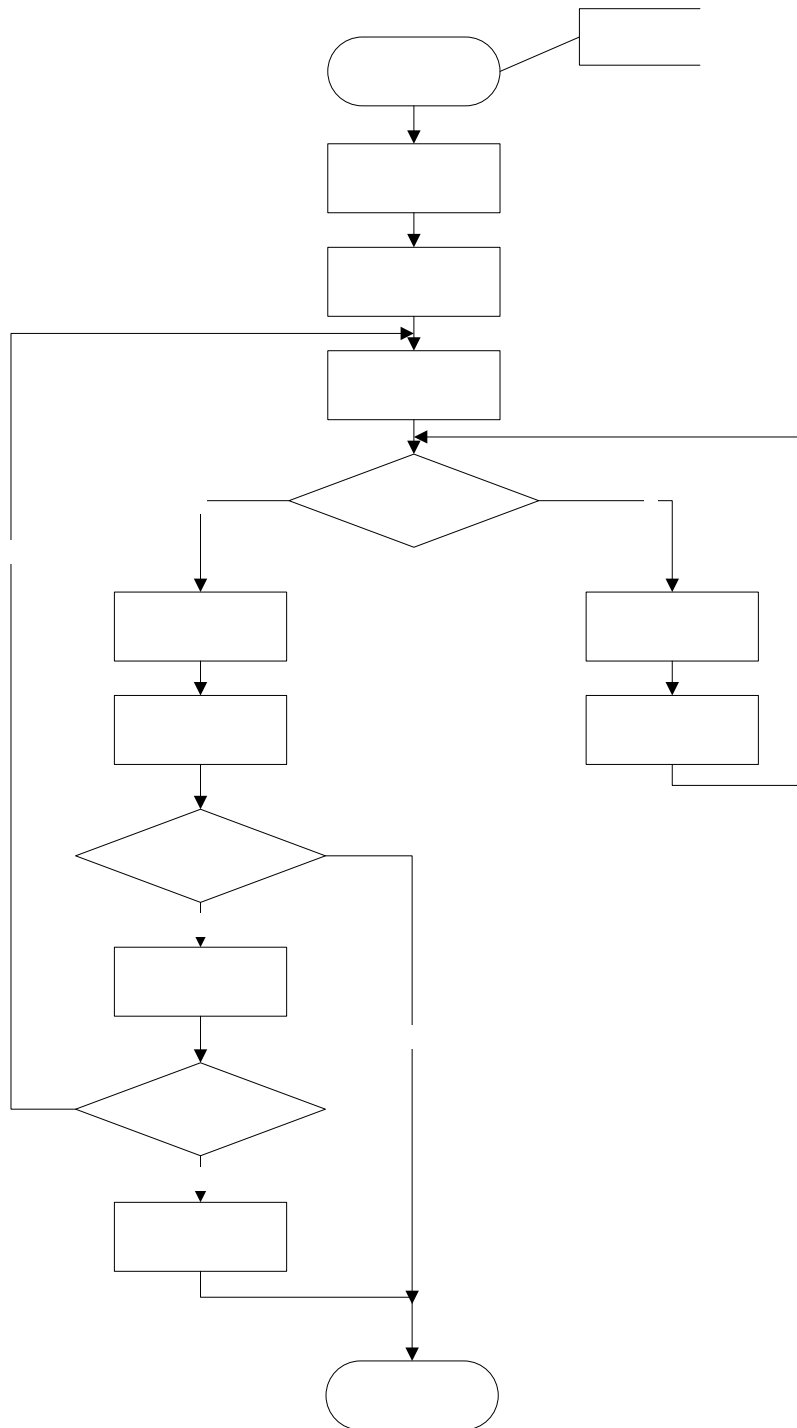

Figure 10 The algorithm for tacho generator problem handling

St

Stop
acti

S
trial cou

Set wai
20 mi

Is wait ti

Y

N

Increment
trial counter

33

9.8   Variant information mismatch

9.8.1   Detection algorithm
Every time the controller is powered it will check if variant information is valid. In case of empty variant block or wrong CRC value for the block a variant failure alarm will be detected.
Wrong CRC can be a result of flash memory degradation and can cause undefined behaviour of the washing machine.

9.8.2   Handling
The controller will go to the safe state and the fault alarm displayed.

9.9   Max spin speed not reached

9.9.1   Detection algorithm
This failure is detected if at the end of the spinning cycle of the testing program the real spin speed is more than 200rpm lesser than set point speed.

.9.2   Handling
No handling procedure. The failure is displayed after the end of the testing program.

.10   Power failure definition and related behaviours

.10.1   A power failure
A power failure is detected due to missing synchronization signal. Complete procedure of power failure detection is a part of supplier's of controller software library and is not described within this document.
In general, if power failure is detected, the controller will turned off all unnecessary current consumers and stores a set of information which will be necessary to continue the washing cycle after power is on again.

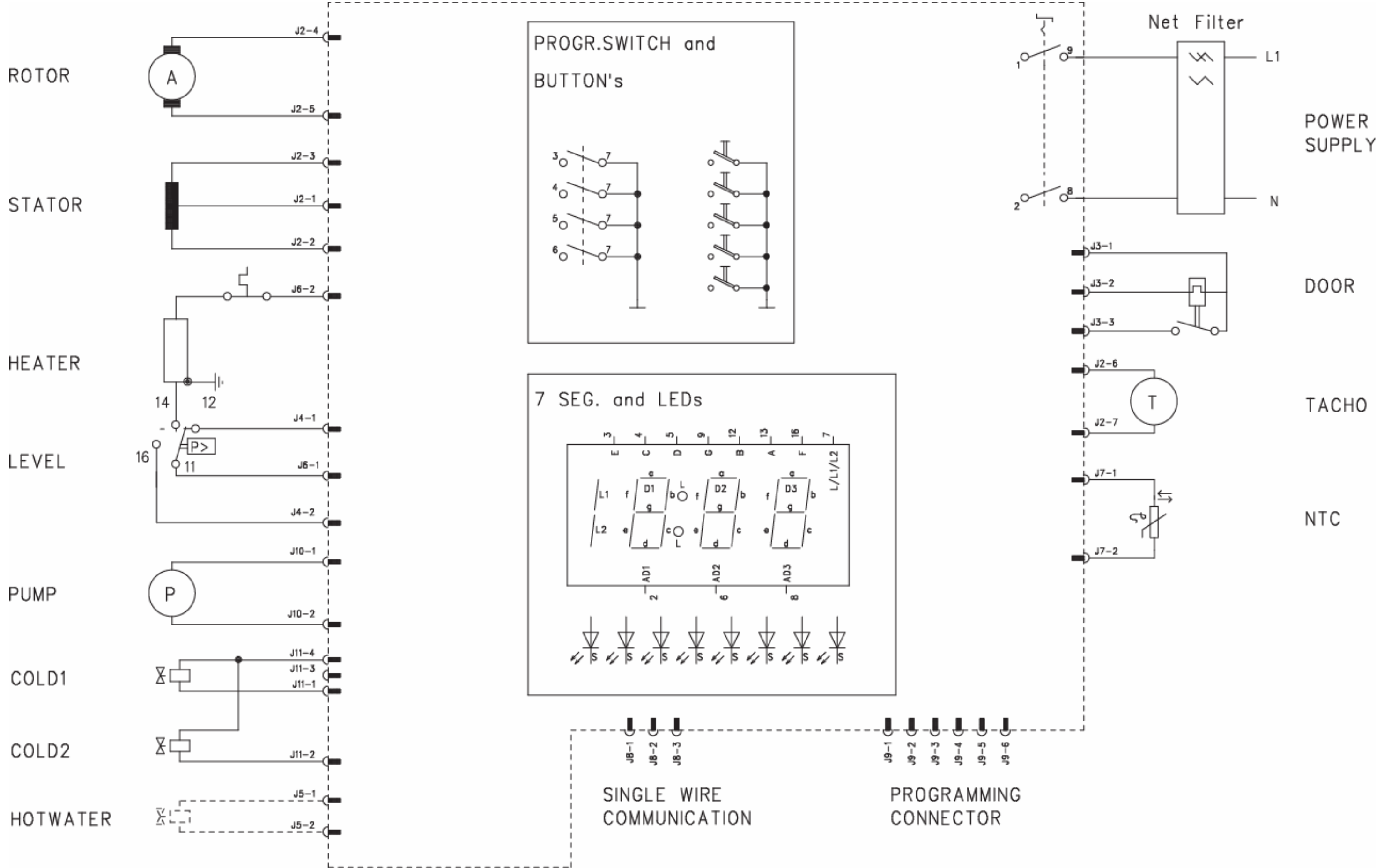#### .10.2   Failure handling in case of power fail and restore
If not defined otherwise the controller will restore the handling routine in the point it was broken due to power failure.
If critical error was already detected and the controller was in its safe state it will resume in the safe state after power on and indicates the previous failure.

.10.3   Error History
For servicing purposes the controller stores codes of last three errors. These codes could be read out via serial communication protocol.

ROTOR

STATOR

HEATER

LEVEL

PUMP

COLD1

COLD2

HOTWATER

PROGR.SWITCH and BUTTON's

7 SEG. and LEDs

SINGLE WIRE COMMUNICATION

PROGRAMMING CONNECTOR

Net Filter

POWER SUPPLY

DOOR

TACHO

NTC

11 Wash cycle management

The number of wash cycles is recorded and stored on the electronic controller. The controller uses counter which is stored in flash memory. The counter is incremented when it is half or more of the cycle length of program with exception of drain and spin programs. The information can be retrieved by technician through manipulation of keys and knob or through the comprog, to visualized information on pc monitor. The visualization of wash count on machine is displayed on the 7-segment display in advanced version or through blinking led in the in led interface of basic version – the L_5 (door lock) led.

On the basic version the number of wash cycle is revealed through the blinking of a led L_5. The total number of blinking gives the total number of wash cycles. A blink represents a number of cycles in the multiple of 10 cycles. Each blinking is distinguished from the other by a pause of the 2 seconds. Value is rounded <u>up</u> to 10 if wash counter is greater than 5.

11.1 Data retrievement on machine

This procedure describes the modality of retrieving in a PCB of electronic controller.

→ Access mode:

- Position the programme section knob on OFF.
- Hold press S_1 (start/pause) and S_4 (spin regulation) keys.
- Turn the programme selection knob to position 15 (Drain position).
- Wait for 15- 20 seconds.
- Release the S_1 and S_4 keys

→ Interface behaviour:

The number of wash cycles is displayed on the 7-segment display or the L5 (door lock) blinks for the case the basic version.
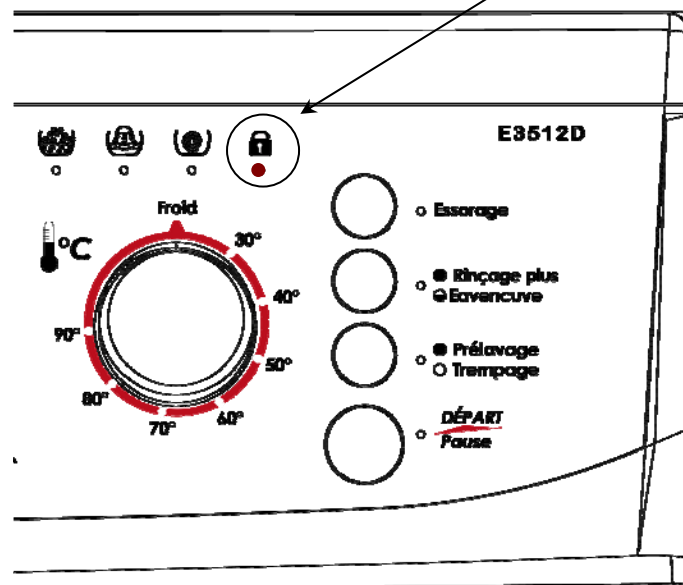
11.2 Data retrievement by comprog

Exact number of wash cycles can be accessed via serial communication protocol using COMPROG software.
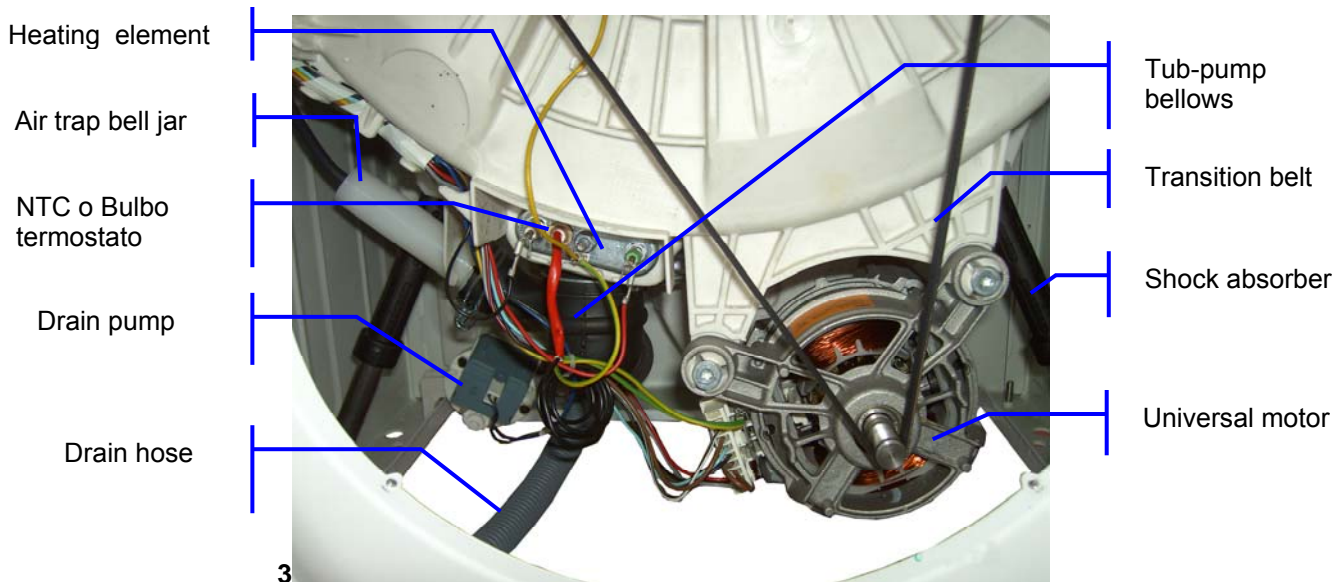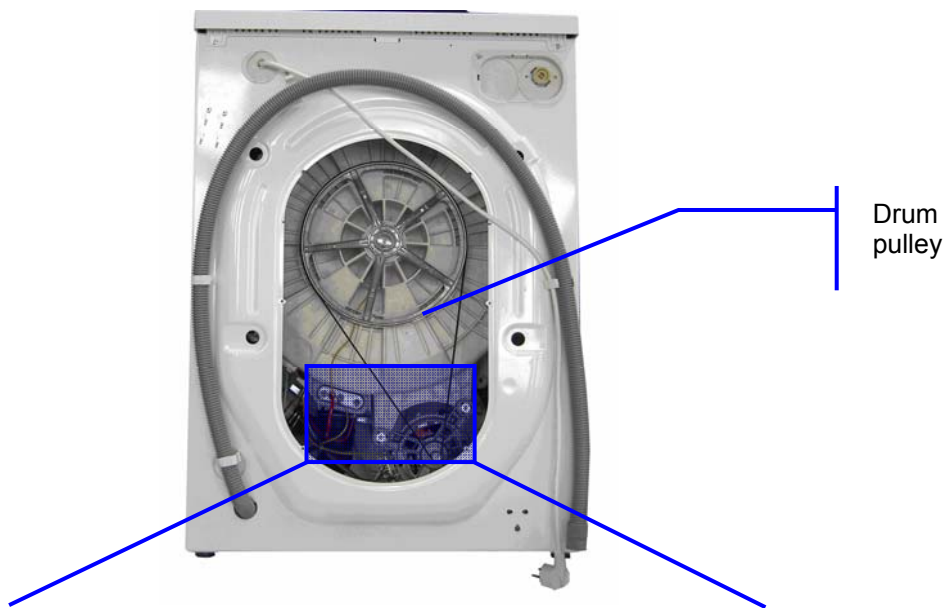
12 ACCESSIBILITY TO COMPONENTS

The components are easily accessible either from the posterior, removing protection, or from the superior by removing the top.

Positioning the washing machine as shown in the photo, it is possible to access the following components:
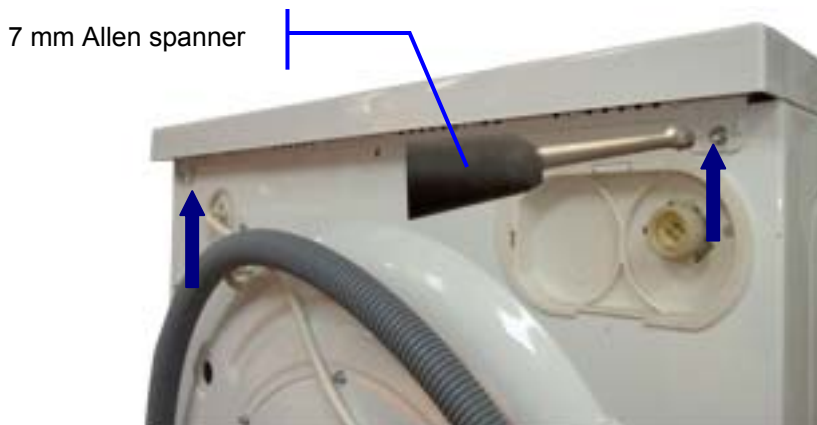
a – main motor
b – drain pump
c – heating element
d – NTC o thermometer probe
e – drain hose grafting
f – shock absorbers
g – air trap bell jar
h – tub-pump bellows
i – drum pulley

- Unscrew the fixing screws holding the back cover

Drum pulley

Heating element

Air trap bell jar

NTC o Bulbo termostato

Drain pump

Drain hose

Tub-pump bellows

Transition belt

Shock absorber

Universal motor

3

- Unscrew the due screws behind the machine
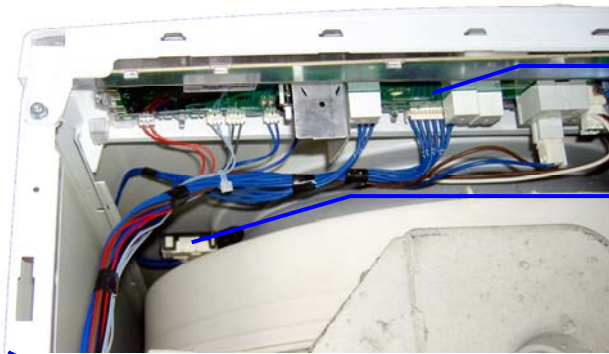
7 mm Allen spanner

- Give a rap on the side of the dispenser and lift it from behind.

After having done these two operation, is possible to access the following components:
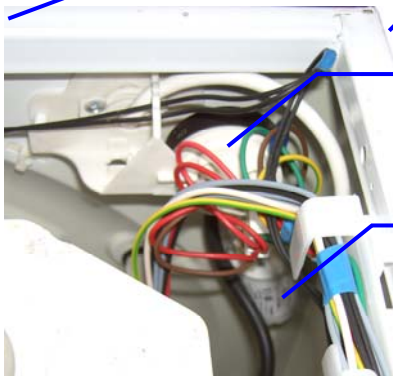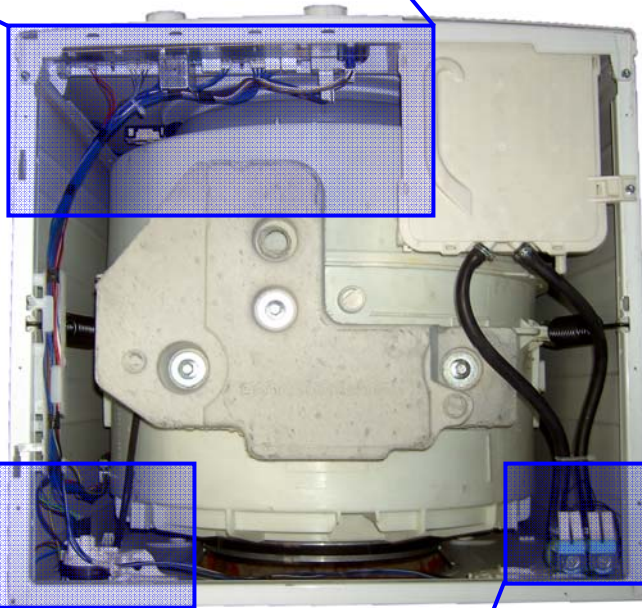
        a – controller unit
        c – pressure switch
        d – filter
        e – electro- valve
        f – door lock

Internal view

Electronic controller board

Door lock

Pressure switch

Suppression filter

2 way electro-valve

Disassembly of control panel components

Once the top has been removed, extract the controller unit board applying a leverage with a screw driver on the board housing hooks, working from one extreme to the other.

Substitution of tub-pump bellows

The tub-pump bellows used on the IT WASH machines are polarised.
The polarisation is necessary for the correct functioning of the machine. A wrong assembly can cause a general malfunctioning of the machine in the washing step.

Here are the photos of the bellows showing the polarization.
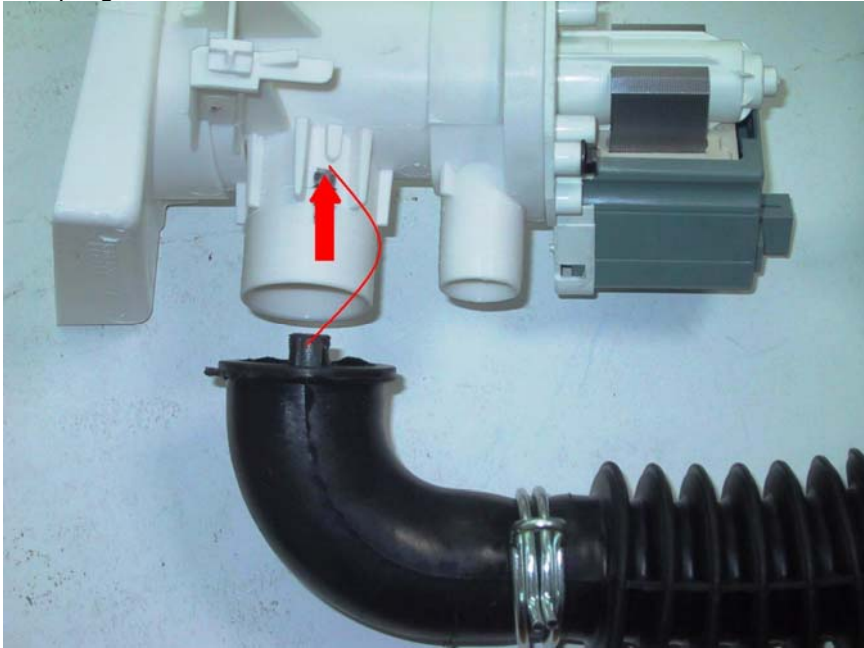
Photo of bellows showing the pump side

Photo of bellows showing the tub side

For the correct assembly of the pumping unit, position the bellows as shown in the photo.

Photo of coupling

Push in the direction of the arrow till a perfect alignment is obtained as shown.

Photo of assemblage
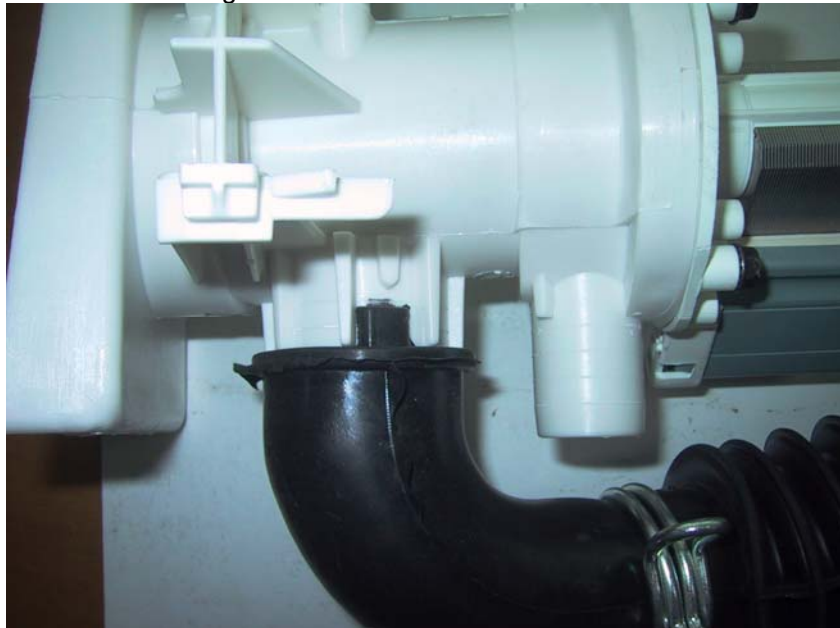
On tub side it necessary to proceed in a similar way as show in the photo

Coupling photo

Push in the direction of the arrow to attain as shown in the photo:

Photo of assembly

On a general note, it is reminded that the pump used in the washing machine do not have suction force but rotary blades that push liquid with gently into the drain hose. A wrong assembly could cause problem in drainage.

13   Tub maintenance

The electronic washing machines can be produced with a family of tubs which could be welled or locked together by clamps.
For the former there is no possibility of repair as the whole bath (washing group) must be changed. For the latter there is the possibility of intervening to replace bearings, drum and front or rear tub.
To remove either the welled washing group or that locked together with clamps, the procedure is as follows:
- The first step is to remove the top as indicated in chapter 13.
- Remove the control panel by unfastening the four screws holding to the cabinet as shown in the photo.
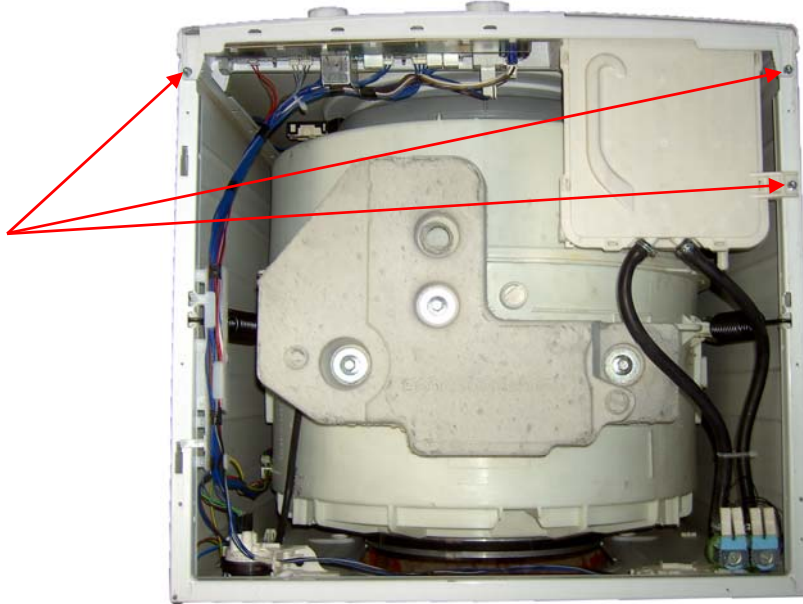
- Lift the control panel on the left hand side and unhook the bellows connecting the detergent bath to the tub at the anterior.
- Unfasten the door lock fixing screws.

- Overturn the control panel to the back of the washing machine as indicated in below.
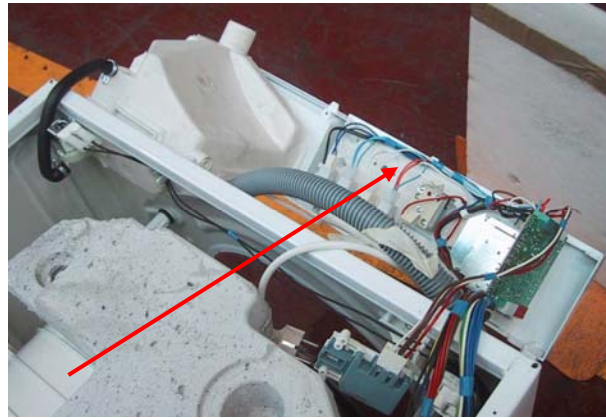
- Access the rear components as indicated in chapter 13. Disassemble the wiring by first disconnecting the motor connector, the heating element, the NTC probe in the heating element and drain pump. Proceed to remove the wiring from the hooks on the tub.
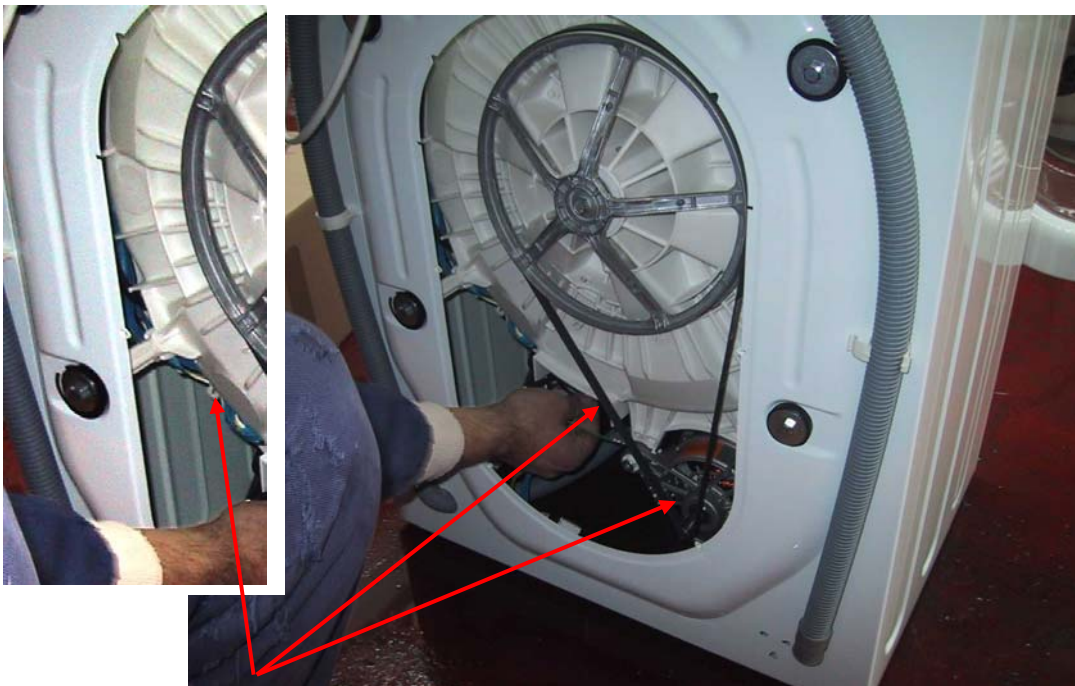
- Disconnect the wiring from the pressure switch and the filter.
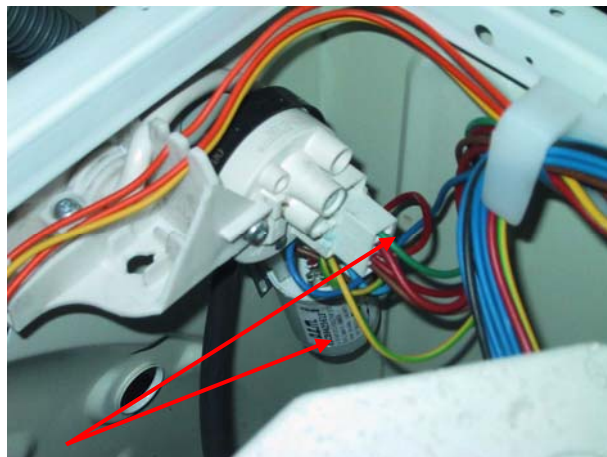
- Remove the door gasket.

- Get rid of the wiring, remove the superior counterweight blots as indicated in the figure below.

- **Lift out the counterweight. At the end the machine should present as indicated in the photo.**

Overturn the machine to lie on its back on the floor to have access to inferior components.

- Remove the splash proof protection (if installed on the machine) by pulling outward first the superior part then the inferior U-shape part.

- Unfasten the shock absorber fixing screws; remove the sleeves (bellows) connecting the tub to the to the pump from the pump side.
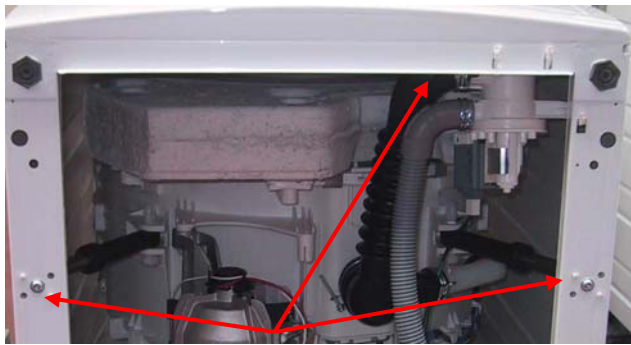
- At this point take the machine to its vertical status to takeout the washing (oscillating) group.

It is necessary to use small sized crane or two people to takeout the washing group as indicated in the photo. Where crane is used, the hook slots placed in the vicinity of the suspension spring slots are utilized for hanging.
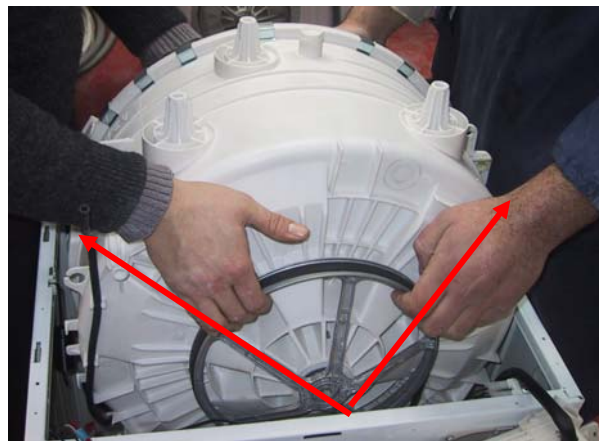
At this point, if the tubs are welled the group will be entirely substituted, while if group is the type grafted with clamps, proceed to open as follows:

- Position the group on its back on a bench.
- Remove the inferior counterweight as shown in the photo.

- Take away the clamps. This operation can be carried out with medium sized screw driver as shown in the photo.
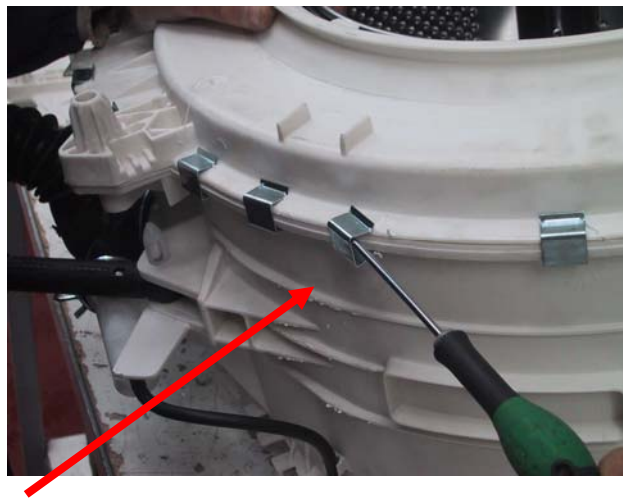
- At this point the anterior tub is lifted to gain access to the drum.

- It must be recalled that it necessary to first remove the drum pulley before taking out the drum.
  It is recommended to always change the tub seal after this operation.
  The clamps can be reused but it is advised to change the position by about 5mm from the previous.
  The use of medium sized plastic headed hammer is recommended for their insertion.

14. Substitution of drum transition belt

Among the components subject to wearing is also the transition belt. This component is realised with a rubber compound reinforced by a layer of nylon material. It transmits the motor stator rotational movement to the drum pulley. The friction generated from the wearing fragments creates the wearing for the rubber compound in contact with pulley gutter. The small wearing particles deposit in the gutter. These residues if not removed or eliminated can reduce the gutter depth. In case a new transition belt is installed, without cleaning, could cause the fallout of the belt from the pulley. It is therefore necessary to clear the gutter of any debris with metallic brush before replacing the transition belt. Below are photos for more information and comprehension.

Motor with residue

Gutter cleaning

Rubber compound residue

Motor pulley

ANNEX 1

NTC characteristic

SIEMENS MATSUSHITA COMPONENTS OHG

S+M

NTC-RESISTANCE-TEMPERATURE-CURVE

R/T-Curve = 2901 / A01

R at 25 °C = 11981 [Ω]

B(25/100) = 3760 [K] ± 1,5 [%]

R N at 60 °C = 3243 [Ω] ± 2,0 [%]

T [°C]	R_nom [Ω]	R_min [Ω]	R_max [Ω]	Δ R / R [±%]
-10	58722	54874	62570	6,6
-5	45778	42961	48596	6,2
0	35975	33900	38050	5,8
5	28516	26977	30055	5,4
10	22763	21616	23910	5,0
15	18279	17421	19137	4,7
20	14772	14128	15417	4,4
25	11981	11497	12464	4,0
30	9786	9421	10150	3,7
35	8047	7772	8322	3,4
40	6653	6444	6861	3,1
45	5523	5365	5680	2,8
50	4608	4489	4726	2,6
55	3856	3767	3945	2,3
60	3243	3178	3308	2,0
65	2744	2681	2808	2,3
70	2332	2273	2392	2,5
75	1990	1934	2045	2,8
80	1704	1653	1755	3,0
85	1464	1416	1511	3,2
90	1262	1218	1305	3,4
95	1093	1053	1133	3,7
100	949,9	913,2	986,6	3,9

ANNEX 2

Control board programming

In the next page you can consult the table for setting for the power board. The power board base is already programmed with version 7 kg 1000 rpm, bat it is possible change the setting with manual operation on the control panel. The new setting will be active at the end of setting and can be change again if the setting is wrong. The right setting must be confirm by functional test. As show in the previous page. After functional test the setting can not be change again. It is possible change bat with special tools and one pc interface.

Example to set 5 Kg 1000 rpm not tap filed.

For start the procedure of setting is necessary, the machine in power off by knob.
Push the button start and spin together and keep down.
Turn the knob programmer on position 1 and release the button (start/spin) after 10 second.
Set the knob temperature on position related to load to be set 0° for 5Kg.
Turn the knob programmer on position related to main motor pulley 7 for 1000 rpm.
Check the setting and push the button START/PAUSA for confirm.
Turn the knob of programmer on position related to spin to set 3 for 1000 rpm.
Turn the knob of temperature on position 90° for tap filed in any other position for not tap filed.
Check the setting and push the button START/PAUSA for confirm.

If the setting is good fine al led will be on blink. Turn OFF the knob of programmer, wait 5 second and
Try to start the wash. If the setting is it ok start the functional test for validate the setting.

Table variant per setting power board AKO from control panel													Vers. 04
Variant		**STEP 1**	**STEP 2**								**STEP 3**		**STEP 4**	
				Main motor									Position knob temperatur for tap filed	
Load (kg)	Spin (rpm)	Knob temperatur	ID trsmis.	Stack	Diam. Puley Motor	Diam. Puley Drum	Belt	Knob programmer		Spin set (rpm)	Psotion knob programmer		
5	600	0°C	01	30	15	265	H 1194	10		600	1	-	
5	800	0°C	01	30	15	265	H 1194	10		800	2	-	
		0°C	02	40	15	265	H 1194	9			2	-	
5	1000	0°C	03	40	19	265	J 1205	7		1000	3	-	
5	1200	0°C	04	52	19	265	J 1205	7		1200	4	90°C	
5	1400	0°C	05	52*	22,6	292	J 1256	2		1400	5	90°C	
6	800	30°C	01	30	15	265	H 1194	10		800	2	-	
		30°C	02	40	15	265	H 1194	9			2	-	
6	1000	30°C	03	40	19	265	J 1205	7		1000	3	-	
6	1200	30°C	04	52	19	265	J 1205	7		1200	4	90°C	
6	1400	30°C	05	52*	22,6	292	J 1256	2		1400	5	90°C	
7	800	40°C	03	40	19	265	J 1205	5		800	2	-	
7	1000	40°C	04	52	19	265	J 1205	5		1000	3	-	
7	1200	40°C	06	52	19	292	J 1256	7		1200	4	90°C	
7	1400	40°C	07	60**	22,6	292	J 1256	2		1400	5	90°C	
8	1000	50°C	08	52	19	292	J 1256	5		1000	3	-	
8	1000	50°C	09	52	22,6	292	J 1256	2		1000	3	-	
8	1200	50°C	05	52	22,6	292	J 1256	2		1200	4	90°C	
8	1400	50°C	07	60**	22,6	292	J 1256	2		1400	4	90°C	
9	1000	60°C	10	60**	19	292	J 1256	5		1000	3	-	
9	1000	60°C	11	60**	22,6	292	J 1256	2		1000	3	-	
9	1200	60°C	07	60**	22,6	292	J 1256	2		1200	4	90°C	
9	1400	60°C	07	60**	22,6	292	J 1256	2		1400	4	90°C	

(Column between STEP 2 and STEP 3 reads vertically: "Push START/PAUSA for accept setting". Column after STEP 4 reads vertically: "Push START/PAUSA for accept setting".)

(*) Main motor stack 52/55/60/65.
(**) Main motor stack 55/60/65.